LEARNING EXPERIENCES IN DEVELOPING ELECTRONIC PORTFOLIOS IN A
MASTER’S EDUCATIONAL TECHNOLOGY PROGRAM: A CASE STUDY

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This dissertation entitled

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The purpose of this qualitative case study is to investigate and understand the learning experiences and learning processes that occur in Master of Education students’ development of their electronic portfolios. The meaning students give to their experiences is also investigated in order to understand how students learn in a technology-enriched learning environment. The participants of this study are seven M.Ed. students majoring in Computer Education and Technology at a large Midwestern university. They chose to create electronic portfolios as their culminating project rather than write a research paper.

The theoretical framework that guided this case study was constructivist learning theory, which helped the researcher to understand the learning experiences of her participants. The researcher also used the phenomenological approach to guide her interpretation of the meaning that students gave to their experiences. Multiple sources of information were used to gather data: in-depth interviews, observations, and document analysis. Qualitative data analysis techniques were used to analyze data.

Findings from this study show that creating electronic portfolios helps students develop technology-related knowledge and skills as well as critical thinking and problem-solving skills. Findings from this study indicate that creating electronic portfolios is a meaningful task because it provides an opportunity for students to synthesize what they have learned in the Master’s program, show their growth over time, and demonstrate that
they have mastered the program’s standards. The whole process of developing electronic portfolios involves metacognition and self-evaluation because students have to reflect on their strengths and weaknesses and set their future learning goals. Findings from this study imply that the portfolio is not just a substitute for a research paper, instead, it provides opportunities for students to connect professional training with classroom experiences and to reflect on interpretations and judgments. Findings from this study demonstrate that students become active, independent, and motivated learners in developing electronic portfolios. Students reported that they learn by doing, learn from viewing samples and collaborating with peers, and learn from reflecting on and synthesizing their final products.

Approved: Sandra Turner

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Chapter One: Introduction

“One of the most exciting developments in the reform of teacher education programs is the use of alternative forms of assessment to evaluate student learning, and one of the most popular forms of authentic assessment is the use of portfolios” (Barrett, 2001). Teacher education programs often use portfolios to replace traditional comprehensive exams because portfolio assessment allows teacher candidates to collect, select and reflect on artifacts that allow them to demonstrate teaching competencies and standards (Clark, Topp, & Goeman, 2002; Shaver & Avalos, 2002). The use of technology in the portfolio development process greatly enhances this process (Clark, Topp, & Goeman, 2002). Therefore, the use of electronic portfolios as a means of authentic assessment and evaluation has become increasingly popular in undergraduate as well as graduate programs (Tellez, 1996), especially in teacher education. Recent research indicates that electronic portfolios in teacher education have distinct advantages over other forms of assessment, such as the traditional portfolio or comprehensive exam (Clark, Topp, & Goeman, 2002; Jackson, 2000; Swain & Ring, 2000). When students add digital video, audio, and other multimedia artifacts, as well as reflection narrations to the portfolio, it presents a much richer picture of the student’s abilities than a traditional assessment would (Clark, Topp, & Goeman, 2002). Benefits of electronic portfolio assessment are demonstrated both in terms of authentic student evaluation and in students’ ongoing use of technology in their practical and professional endeavors.

Beginning in the spring of 2002, Master of Education students majoring in Computer Education and Technology in the college of education at a midwestern university were given the option of 1) assembling an electronic portfolio as their
graduation assessment, or 2) writing a seminar research paper/thesis. According to the syllabus for the portfolio (Appendix A), electronic portfolios provide an opportunity for students to synthesize what they have learned in the Masters program, show their growth over time, and document that they have mastered the National Educational Technology Standards for Teachers (NETS-T) developed by the International Society for Technology in Education (ISTE) (Appendix B).

An effective assessment system allows students and teachers to have a shared understanding of what constitutes good work (Porter & Cleland, 1995). Several teacher education programs have changed their assessment from paper-based portfolios to electronic portfolios (Barrett, 1999, 2001; Read & Cafolla, 1999). According to Barrett (2001), electronic portfolios offer several advantages compared to their paper-based analogs, including: reduced storage demands, ease of back-up, portability, ability to create links, and development of students’ own technology skills.

In addition, creating electronic portfolios gives students the responsibility of reflecting on their learning and structuring their knowledge and skills. The power of reflection is that it helps students and teachers move beyond seeing the portfolio as a mere alternative to traditional assessment to appreciating its value as a learning strategy (Porter & Cleland, 1995).

Statement of Problem

In this technology age, teachers are expected to integrate technologies into their teaching. According to McKinney (1998), teachers who demonstrate their competence in technology through the development of an electronic portfolio are more likely to incorporate technology into their own classrooms. Similarly, Goldsby and Fazal (2000)
indicated student teachers must learn to effectively use technology in their preparation program because teachers with little or no experience with technology are less likely to incorporate its use in their classrooms. If teacher candidates understand the advantages of developing electronic portfolios, the problems encountered in the process, and their implications and possible solutions, then they will be more confident in using electronic portfolios in their future classrooms. So electronic portfolio development in teacher education is important for preservice and inservice teachers.

According to constructivist learning theories, the teacher’s role is changing from “sage on the stage” (fount/transmitter of knowledge) to “guide on the side” (facilitator, coach); higher order skills such as problem-solving, reasoning, and reflection are taught in the classroom; learners are enabled to learn how to learn; more open-ended evaluation of learning outcomes is used, and cooperative and collaborative learning skills are engaged in class activities (Fosnot, 1996). When creating electronic portfolios, do students experience these aspects? There is a need to investigate the experiences and the roles of instructors and students in the entire context and conceptualization of developing electronic portfolios.

**Purpose of the Study**

Farr and Tone (1998) tell a story of *The King and The Carpenters* in the prologue of their book to indicate the relationship among curriculum, teaching methodology, and assessments. The story talks about a wonderful kingdom, where people were interested in becoming a banker or a doctor but nobody wanted to be a carpenter. As a result, there was a shortage of houses, and the carpenters and plumbers were getting too old to build houses. Therefore, the king asked these old men to teach students how to build houses.
before it was too late. Every morning, students and teachers would discuss their plan for building for that day before starting work. They also discussed the solutions to the problems they came across. The students seemed to learn the most from actually building houses. The kingdom had plenty of new houses, and the king even got a strong and beautiful palace.

One day, the king went to an educational conference and presented how his students learned from building houses. To his surprise, nobody liked his presentation because he did not have students’ test scores. For them, the pictures of the houses did not tell what students were learning, and only test scores were a reliable and valid way to show that students were learning. When the king came back, he asked for test scores from teachers so that he would have splendid graphs and charts with lots of numbers showing how much his students learned. The teachers created a test according to the king’s requirement. The test was made up of multiple choice questions, such as choosing the right answer from various names of a hammer. But the test results were terrible because students knew how to use a hammer but never noticed its different names. In order to improve students’ test scores, teachers tried different ways to help students remember those names. For example, they drew the pictures of hammers in one column and wrote the names of the hammers in another column in a different order so that students could match them. They designed more and more complex distinctions and took all class time to teach memory and testing skills and students did not have time to build real houses any more. Many years later when the king was proud of showing his beautiful charts at the educational conference, the houses built by the high-scoring students fell apart.
The moral of this story became obvious to the king and others: There is a big difference between naming a hammer and being able to use one. A good score does not necessarily mean students really understand and will be able to use what they have learned. This story also indicated how assessments influence the way of teaching and learning. The same is true of using electronic portfolios as assessment tools, which not only change the way of assessment, but also change the ideology of teaching and learning because curriculum and teaching methodology are influenced by how students’ progress and achievement are evaluated.

The purpose of this study was to investigate and describe the learning processes that occurred as Master of Education students assembled their electronic portfolios. The study aimed to understand the experiences of students related to the development of their electronic portfolios, and how these experiences affected their learning. Issues that emerged in the process of developing electronic portfolios were also studied. Using in-depth interviews and observations of students at different stages of assembling their electronic portfolios, the researcher sought an understanding of how students constructed their individual knowledge through developing electronic portfolios. Students’ learning experiences and the meaning students gave to their experiences were investigated in order to understand how students learned in a technology-enriched learning environment.

Another purpose was to acquire an in-depth understanding of the electronic portfolio as an assessment tool and its implications in teacher education. This study described how engaging in the electronic portfolio process helped students to develop technology-related knowledge and skills; how students used course assignments along with outside experiences as potential artifacts to demonstrate competency in national
standards, and how students expected to use the experience of creating electronic portfolios in their own teaching.

With in-depth interviews, this study considered whether the creation of multimedia portfolios encouraged collaborative learning, goal setting, critical thinking skills, teamwork, and opportunities to revise and rethink (Ivers & Barron, 1998). In the technology-enriched environment of developing electronic portfolios, how did students, as active participants, construct knowledge that was meaningful, applicable, and memorable?

According to Porter and Cleland (1995), as the most important component of electronic portfolios, reflection, the narration accompanying artifacts, is very powerful in that it helps students move beyond seeing the portfolio as a mere alternative to traditional assessment to appreciating its value as a learning strategy. In this capacity, Porter and Cleland contend that portfolios become vehicles for reflection in which learners examine where they have been, where they are now, how they got there, and where they need to go. An additional purpose of the research was to help course instructors to understand the function of reflection in graduate student learning through in-depth study and detailed description of students’ experiences.

Research Questions

The following research questions were addressed:

1. What are the learning experiences of Master’s students in developing their electronic portfolios?

2. What meaning do they give to these experiences?
3. What are the learning processes encountered by Master’s students when developing electronic portfolios?

*Significance of This Study*

This research is significant for several reasons. First, there is a lack of current research about the learning processes that occur in developing electronic portfolios. For example, there were more than 40 sessions listed under the category of Electronic Portfolios in the program of the Society for Information Technology and Teacher Education 2002 Conference. According to Barrett (2002), most of these papers were case studies of implementation decisions and strategies in a school, college or department of education. Only three of these papers reported on data collected and analyzed on electronic portfolio development, beyond the exploration of implementation issues. The same is true of other research reviewed. Most of the relevant research is concerned with the procedures of developing electronic portfolios, such as what artifacts would be included in electronic portfolios, how to convert them into digital format, how to assess them, and what problems students encountered. This study provides detailed descriptions of the learning strategies students used in creating electronic portfolios. The a priori learning strategies, as generated from the pilot study, include learning through reflection, learning by doing, learning from peers, and learning from synthesis.

This case study makes an important research contribution regarding the processes of developing electronic portfolios, which has been lacking in the previous literature on electronic portfolios. There are many papers that focus on implementation of electronic portfolios, how they achieved the goals, and the benefits of doing so; but few papers provide detailed data on how the benefits of creating electronic portfolios extended to the
classroom and enhanced student learning. Through in-depth interviews, direct observations, and document analysis, this study investigates and describes the learning experiences of a specific group of Master’s students in developing their electronic portfolios and contributes to filling this gap in electronic portfolio research.

Secondly, this research provides data for future empirical research. As educational multimedia, hypermedia, and telecommunications become more and more accessible, and as the use of electronic portfolios as a means of authentic assessment becomes increasingly popular in undergraduate as well as graduate programs in teacher education, some might question in the future the meaning and value of electronic portfolios versus other forms of assessment in constructing knowledge. With the in-depth interviews, observations, and document analysis, this research provides first-hand detailed data to address those questions.

Finally, this research is beneficial for instructors who are using electronic portfolios as an assessment tool to improve their instruction. It helps them to understand the potential problems in creating electronic portfolios and provides them with possible solutions. The information provided in this research allows potential users of electronic portfolios to understand the learning processes and experiences in the development of electronic portfolios.

Scope of the Study

The scope of this study includes seven M.Ed. students in Computer Education and Technology. A qualitative case study forms the methodological framework of this study. The case study aims to understand the case in depth and in its natural setting, recognize its complexity and its context. The purpose of this study was to understand and interpret
the meaning of the learning experiences of a group of unique students, M.Ed. students in Computer Education and Technology, in assembling their electronic portfolios. Therefore, an in-depth case study could provide an understanding of the important aspects of the students’ learning experiences. Research activities were carried out according to an established timeline.

The researcher conducted face-to-face interviews with M.Ed. students at different stages of their development of electronic portfolios. The researcher first observed the program orientation meeting where M.Ed. students met for the first time and got to know the requirements of this program and criteria for the electronic portfolios. This meeting was a preparation for students to think about their future project because they had to collect and organize their artifacts throughout their program. During and after the spring quarter, the researcher conducted two rounds of in-depth individual interviews and direct observations.

During the data collection and analysis, the researcher focused on such components of developing electronic portfolios as the learning processes they went through, the software they used, the problems they encountered, the strategies they used to solve the problems, the support they got from both their professors and their classmates. The content of students’ electronic portfolios was analyzed according to their reflection on how their artifacts met the standards and their future learning goals. Evaluation techniques and procedures in electronic portfolios, such as what to look at in an electronic portfolio itself and how to judge it, will be discussed at the end of this study. Gender and cultural differences and the social context out of which and from which
learning and motivation emerge may furnish future researchers with other topics as a separate research study.

**Limitations of the Study**

This study is limited to the learning experiences of seven M.Ed. students in Computer Education and Technology as they developed their culminating electronic portfolios in the college of education at a large midwestern university. As most of them assembled their portfolios in their final quarter, the time this researcher spent in the field was limited and the access to students was also limited.

Another limitation is that although all of the participants were interviewed once or twice and observed during their presentations, only two out of the seven participants were observed while assembling their electronic portfolios because they were the only students who assembled their electronic portfolios in the lab while the other five students did their projects at home.

**Definition of Terms**

Artifact is the evidence/work that students collect and select to show their achievement in learning, such as a paper, a lesson plan, or a project. It is used to document that they meet certain standards.

Alternative assessment, authentic assessment, and performance-based assessment are often used synonymously to mean variants of performance assessments that require students to generate rather than choose a response. The characteristics of this type of assessment are: the student is involved in meaningful performance tasks; there are clear standards and criteria for excellence; there is an emphasis on metacognition and self-evaluation; the student produced quality products and performances; there is a positive
interaction between assessor and assessee (cited from online *Educational Technology Encyclopedia*, 2001).

**Constructivist learning theory** used in this study was derived from the ideas of Dewey, Piaget, Vygotsky, and Bruner: learning is an active process in which students use hands-on and mental activities to construct knowledge through their own experience with a meaningful content; communication, interaction, and collaboration are very important parts in learning; learners assimilate new knowledge based on previous knowledge; and they learn how to learn by learning.

**Evaluation** is “the application of a standard and a decision-making system to assessment data to produce judgments about the amount and adequacy of the learning that has taken place” (Fenton, 1996, p. 16).

**Portfolio** is a purposeful collection of student work that shows a student’s efforts, progress, or achievement over a period of time. Portfolios should include a reflection of each artifact and tell what the artifact is and why it was selected.

**Electronic portfolio** is a carefully selected collection of exemplary artifacts with reflection that demonstrates one’s best work and achievements by using electronic technologies in such media types as: audio, video, graphics, and text.

**A standards-based portfolio** is a portfolio guided by specific standards. In this study, students used the National Educational Technology Standards for Teachers (NETS-T). Hypertext links clearly show the relationship between the standards or goals, the artifacts and the reflections.

**Multimedia** refers to the integration of video, audio, graphics, and text within a computer-based document.
Reflection refers to the narration accompanying artifacts. In the reflection, the student would first summarize the artifact that documents the experience. Second, the student would reflect on what he or she learned and how this leads to meeting the standard. And third, the student would address implications for future learning and set forth refinements or adaptations.

Technology refers to the electronic devices used in the classroom to enhance instruction; examples of technology include computers, printers, scanners, digital cameras, CD burners, VCR sets, and televisions.

Organization of the Study

This dissertation is organized into five chapters. Chapter One includes an introduction, the statement of the problem, the research questions, the significance of the study, the scope of the study, the limitations of the study, the definition of terms and organization of the study. Chapter Two contains a review and critique of the literature that includes a discussion of constructivist learning, learning with technology, assessment, the concept and characteristics of electronic portfolios, and the strength of electronic portfolios. Then the problems that may be encountered in the process of developing electronic portfolios are addressed. Chapter Three reviews in detail the methodology of this study, including research setting, participants, role of the researcher, research methodology, data collection, data analysis, and summary. The report of a pilot study is included in this chapter. Chapter Four presents the findings of this study. Chapter Five summarizes, discusses, and interprets the findings and proposes recommendations and suggestions for further research and practice.
Chapter Two: Literature Review

Introduction

This literature review covers materials that provide a theoretical framework and background information about electronic portfolios, including their potential and their implications for education. It also covers issues pertaining to electronic portfolio design and how it facilitates learning based on constructivist learning theory. First of all, constructivist learning theory will be discussed because electronic portfolios derived from constructivist perspectives. Secondly, studies on assessment, both traditional assessment and alternative assessments, will be explored. Thirdly, the concepts and characteristics of electronic portfolios, different types of electronic portfolios and the stages of developing an electronic portfolio will be covered. Then, literature on the strengths of electronic portfolios and how they can be used to support learning will be reviewed in the context of constructivist learning theory. Finally, criteria for evaluating electronic portfolios and the problems in designing electronic portfolios will be addressed.

Constructivist Learning

Constructivist learning has emerged as a prominent approach to teaching during this past decade. Constructivism represents a paradigm shift from education based on behaviorism to education based on cognitive theory. Fosnot (1996) has provided a recent summary of these theories and describes the constructivist teaching practice. While behaviorist epistemology focuses on intelligence, domains of objectives, levels of knowledge, and reinforcement, constructivist epistemology assumes that learners construct their own knowledge on the basis of interaction with their environment.
There are two major strands of the constructivist perspective: cognitive constructivism and social constructivism. Cognitive constructivism is based on the work of Piaget. His theory emphasizes the need for students to have a rich environment for exploration, thus giving students opportunities to assimilate and accommodate new knowledge. Social constructivism is based on the work of Vygotsky. His theory of learning emphasizes the importance of the social and cultural context for learning. He claims that it is the collaboration between people that causes learning to occur, not just a rich, interesting environment. Although these two strands are different in emphasis, they share many common perspectives about teaching and learning. In many cases the strengths of one theorist complement the weakness of the other.

Developing an electronic portfolio is an individual activity. It is the students themselves who decide the goals and contents of their portfolios, artifacts they will use to document their learning, and the formats they will use to develop and present their portfolios. However, both peers and teachers play a very important role in this process because teachers should be ready to support and provide advice to their students, and students will learn most from their peers especially from those who had the same experience. It can be hard for students to finish their projects without the collaboration with their classmates. Therefore, this study will combine the ideas of Piaget with those of Vygotsky and use the general term, constructivism, as the theoretical framework.

According to constructivism, learning is an active process and should be whole, authentic, and real. Piaget’s theory of cognitive development suggests that learners cannot be “given” information which they immediately understand and use. Instead, they must “construct” their own knowledge. They learn by fitting new information together
with what they already know. Learners learn best when they actively construct their own understanding. Learning is also affected by the context, the beliefs and attitudes of the learner. Vygotsky's (1978) zone of proximal development is the idea that human learning presupposes a specific social nature and is part of a process by which children grow into the intellectual life of those around them. Learners are encouraged to invent their own solutions and to try out ideas and hypotheses. They build their knowledge through experience. As Dewey (1963) indicated,

> We live from birth to death in a world of persons and things which is in large measure what it is because of what has been done and transmitted from previous human activities. When this fact is ignored, experience is treated as if it were something which goes on exclusively inside an individual's body and mind. It ought not to be necessary to say that experience does not occur in a vacuum. There are sources outside an individual which give rise to experience.

(p. 39)

According to Dewey, although education should be based on experience, not all experiences are equally educative. An experience that distorts growth or lacks growth of further experience is either mis-educative or non-educative. Experience must be qualified if it is to become a part of the growth and educative process. First, it must be experience of a certain type, and second, it must be reconstructed through a reflective process that involves the individual as an active participant in the growth process.

The world in which we live is not a settled and finished one but a world which is changing all the time. In order to be able to deal with this moving world, one must learn continuously for growth. According to Dewey, growth is a continuous process of
reconstructing or reorganizing experience through action upon the environment. Dewey explained this in his *Experience and Education* as:

In a certain sense every experience should do something to prepare a person for later experiences of a deeper and more expensive quality. That is the very meaning of growth, continuity, reconstruction of experience (Dewey, 1963, p. 1).

For Dewey, one of the aims of education is to help children learn to live a social life with efficiency - social efficiency. He said, “Education should not cease when one leaves school” (Dewey, 1916, p. 100). Creating electronic portfolios helps students to continue their learning.

Learning, for Dewey, has different angles. In one sense, learning is a kind of activity which includes experiencing, trying, doing, acting, observing, playing, communicating, working, making, and studying. Dewey said, “Learning means something which the individual does when he studies. It is an active, personally conducted affair” (Dewey, 1916, p. 390).

In another sense, learning is a mental process involving thinking, using intelligence, making judgments, and looking for meanings, connections and possibilities. In other words, in the process of learning, one needs to use the mind to organize activities, and intelligence to direct them. In addition, a learning activity is not an activity that occurs just in the mind, although it involves the mind; it occurs in a social medium through social interaction, especially in “the very process of living together” (Dewey, 1963, p. 7).
Dewey emphasized that learning is a social activity and should take place in a social medium. For Dewey, social participation is a way of exchanging and expanding experiences. Through this activity one increases one’s social interest, skills, understanding, and virtue which, in turn, helps further learning.

Dewey believed that learning requires some outside guidance from teachers, parents, or social institutions. For Dewey, since not all experiences are educative, in order to help children to have educative experiences, guidance from the teacher is still necessary. Dewey also advocated that learning should meet students’ needs. He suggested child-centered learning and using the child’s impulses, needs and experiences as the starting point of learning.

Piaget developed Dewey’s idea in creating a meaningful learning environment for students. According to Piaget, in a constructivist classroom, students must be given opportunities to construct knowledge through their own experiences. Less emphasis is put on directly teaching specific skills and more is put on learning in a meaningful context. Exploring interesting things within a classroom encourages students to become active constructors of their own knowledge through experiences that encourage assimilation and accommodation. Assimilation occurs when students try to compare old information to new information they come across to see if new information fits with older information already learned. Accommodation occurs when students take the new information and then either save it in their mind since it is similar to older information or try to discard the information if it doesn’t fit with the existing information or develop new categories to accommodate the new information. Creating electronic portfolios offers a vast array of
such opportunities. In this technology enhanced learning environment, students’ conceptual and experiential background can be expanded.

When Hein (1991) discussed the meaning of constructivism in his paper, he stated that students have to recognize that there is no such thing as knowledge “out there” independent of the knower, but knowledge they construct for themselves as they learn. Learning is not understanding the “true” nature of things, nor is it (as Plato suggested) remembering dimly perceived perfect ideas, but rather a personal and social construction of meaning out of the bewildering array of sensations which have no order or structure besides the explanations which we fabricate for them (Hein, 1991).

Hein suggested that learning consists of an individual’s constructed meanings. According to Hein, learning is an active process in which the learner uses sensory input and constructs meaning out of it; and people learn to learn as they learn: learning consists both of constructing meaning and constructing systems of meaning. The crucial action of constructing meaning is mental: it happens in the mind. Physical actions and hands-on experience may be necessary for learning, especially for children, but it is not sufficient; activities which engage the mind as well as the hands need to be provided. Hein suggested that one needs knowledge to learn: it is not possible to assimilate new knowledge without having some structure developed from previous knowledge to build on. The more one knows, the more one can learn. Therefore, “Any effort to teach must be connected to the state of the learner and must provide a path into the subject for the learner based on that learner’s previous knowledge” (p. 18). However, it takes time to learn: “learning is not instantaneous” (p. 18). For significant learning people need to revisit ideas, ponder them, try them out, play with them and use them. He also mentioned
that motivation is a key component in learning. Not only is it the case that motivation helps learning, it is essential for learning.

Hein explained that learning is a social activity. According to him, our learning is intimately associated with our connection with other human beings, our teachers, our peers, our family as well as casual acquaintances. We are more likely to be successful in our efforts to educate if we recognize this principle rather than try to avoid it. Much of traditional education, as Dewey pointed out, is directed towards isolating the learner from all social interaction, and towards seeing education as a one-on-one relationship between the learner and the objective material to be learned. In contrast, constructivism recognizes the social aspect of learning and uses conversation, interaction with others, and the application of knowledge as an integral aspect of learning.

Bruner (1960) regarded learning as an active process in which learners construct new ideas or concepts based upon their current/past knowledge. The learner selects and transforms information, constructs hypotheses, and makes decisions, relying on a cognitive structure to do so. In The Culture of Education, Bruner (1996) described four dominant models of learners’ minds. According to him, “these models are not only conceptions of mind that determine how we teach and educate, but are also conceptions about the relations between minds and cultures” (p. 53). The first model sees students as imitative learners and focuses on passing on skills and know-how through example and demonstrative action. This approach emphasizes talent, skills, and expertise, rather than knowledge and action. The second regards students as learning from didactic exposure. It is based on the idea that learners should be presented with facts, principles, and rules of action which are to be learned, remembered, and then applied. The third views students
as thinkers and focuses on the development of intersubjective interchange. This model revolves around how students make sense of their world. It stresses the value of discussion and collaboration. The fourth model views students as knowledgeable and stresses the management of objective knowledge. This model indicates that teaching should help children grasp the distinction between personal knowledge, on the one hand, and what is taken to be known by the culture, on the other.

In order to help understand the four dominant models of learners’ mind, Bruner (1996) set out nine tenets that guide a psycho-cultural approach to education. They are: the perspectival tenet, the constraints tenet, the constructivism tenet, the interactional tenet, the externalization tenet, the instrumentalism tenet, the institutional tenet, the tenet of identity and self-esteem, and the narrative tenet.

Only five tenets that are relevant to this study are discussed here in order to help us understand how students learn in the process of developing electronic portfolios. According to Bruner, educational theory lies at the intersection between the nature of mind and the nature of culture. The perspectival tenet is about meaning making. “The meaning of any fact, proposition, or encounter is relative to the perspective or frame of reference in terms of which it is constructed” (p. 13). According to Bruner, understanding something in one way does not preclude understanding it in other ways. He stated, “Interpretations of meaning reflect not only the idiosyncratic histories of individuals, but also the culture’s canonical ways of constructing reality” (p. 14). He further stated, “It is the interaction between them that both gives a communal cast to individual thought and imposes a certain unpredictable richness on any culture’s way of life, thought, or feeling” (p. 14).
The constraints tenet refers to two crucial forms of meaning making that are accessible to human beings in any culture. The first exists in the nature of human mental functioning itself because human evolution has specialized them into certain characteristic ways of knowing, thinking, feeling, and perceiving. The second imposed by the different languages and notational systems accessible to different cultures because one function of education is to equip human beings with the needed symbolic systems for doing so. He said, “Thinking about thinking has to be a principal ingredient of any empowering practice of education” (p. 19).

In the constructivism tenet, Bruner emphasized that reality is made, not found. According to him,

Education must be conceived as aiding young humans in learning to use the tools of meaning making and reality construction, to better adapt to the world in which they find themselves and to help in the process of changing it as required. In this sense, it can even be conceived as akin to helping people become better architects and better builders. (p. 20)

Bruner discussed the interactional tenet in passing on knowledge and skill, which, like any human exchange, involves a subcommunity in interaction. He said, “the minimum, it involves a teacher and a learner — or if not a teacher in flesh and blood, then a vicarious one like a book, or film, or display, or a responsive computer” (p. 20).

As for the narrative tenet, Bruner described it as, “the mode of thinking and feeling that helps children create a version of the world in which they can envisage a place for themselves — a personal world” (p. 39). According to Bruner, human beings organize and manage their knowledge of the world, even structure their immediate
experience by treating physical things or people and their plights. He said, these are conventionally known as “logical-scientific thinking and narrative thinking” (p. 39).

*Learning with Technology*

In their book *Learning With Technology*, Jonassen, Peck, and Wilson (1999) discussed how educators can use technologies to support constructivist learning. In the past, students learned from technology as a medium for delivering and communicating messages. Computer programs were developed with the belief that they could convey information (and hopefully understanding) more effectively than teachers. But constructivists believe that neither teacher nor computer programs can convey understanding, which can only be constructed by learners. Therefore, Jonassen et al. argued that technologies were more effectively used as tools with which to construct knowledge. Their perspective is that technology is a tool with which to think and learn.

According to Jonassen et al., students cannot learn from teachers or technologies. Rather, students learn from thinking — thinking about what they are doing or what they did, thinking about what they believe, thinking about what others have done and believe, thinking about the thinking processes they use — just thinking. “Thinking mediates learning. Learning results from thinking” (p. 2). They emphasized that thinking was engaged by activity and different activities engaged different kinds of thinking. That is to say, different kinds of thinking are required to memorize a list, read a book, understand a lecture, solve a problem, design a new product, or argue for a belief. These activities can be presented and supported by teachers and technologies. But teachers and technologies do not necessarily cause thinking, so they do not necessarily cause learning. They may, if
the learner has a need or desire to learn, but they may not, if the learner is thinking about something else. Therefore, Jonassen et al. concluded,

The role of teachers and technologies in learning is indirect. They can stimulate and support activities that engage learners in thinking, which may result in learning, but learners do not learn directly from the technology; they learn from thinking about what they are doing. Technology can foster and support learning if they are used as tools and intellectual partners that help learners to think. (p. 2)

Jonassen et al. further discussed that students learn from experiencing phenomena (objects, events, activities, and processes), interpreting those experiences based on what they already know, reasoning about them, and reflecting on the experiences and the reasoning. Bruner (1996) called this process meaning making. Meaning making is at the heart of constructivism.

Assessment

In order for assessment to play a more useful role in helping students learn, it should be moved into the middle of the teaching and learning process instead of being postponed as only the end-point of instruction (Shepard, 2000). From a constructivist perspective, student knowledge must be evaluated based on its viability (Jonassen et al., 1999). Does it make sense, is it well founded and justified by the learners, is it well represented by the learners, can it be applied meaningfully, and is it consistent with the standards that are accepted by the field? According to Jonassen et al. (1999), this form of assessment is more difficult and time consuming than traditional forms of assessment, which seek to commoditize knowledge as something that can be acquired.
As for assessment of learning with technology, constructivism suggests that the meaning that learners have co-constructed from their interactions with the world should be assessed, which is different from traditional learning. In a traditional classroom, students are evaluated by the amount of knowledge that they have acquired from the teacher and the textbook. “Assessment, from a constructivist perspective, is process-oriented. Assess learning as it is occurring, rather than separating assessment from learning, focusing not only on what students have learned (their knowledge), but also on the ways that students learn” (Jonassen et al., 1999, p. 15).

Assessment from a constructivist perspective seeks to know what the learner knows. Because meaning making is a complex and multifaceted phenomenon, assessment of learners’ knowledge must also be multifaceted and multi-modal. According to Jonassen et al., no single measure can begin to assess the complexity of human understanding, especially a multiple-choice measurement. So, we need to develop more diverse and complex ways of assessing learning. We should assess student-constructed knowledge bases, including those produced with technologies.

*Traditional Assessments versus Alternative Assessments*

Traditional assessments focus on grades and rankings, knowledge, curriculum, and skills. They are implemented through classroom assessments (tests, quizzes, homework assignments) and standardized tests (either norm-referenced or criterion-referenced) (Burke, 1999; Fogarty, 1998).

*Educational Technology Encyclopedia* (2001) refers to nontraditional assessments as alternative assessment, authentic assessment, or performance-based assessment, which is often used synonymously to mean variants of performance assessments that require
students to generate rather than choose a response. The characteristics of this type of assessment are:

The student is involved in meaningful performance tasks; there are clear standards and criteria for excellence; there is an emphasis on metacognition and self-evaluation; the student produced quality products and performances; there is a positive interaction between assessor and assessee. (Burke, 1999 as cited in *Educational Technology Encyclopedia*)

Porter and Cleland (1995) compared the differences between traditional assessments and non-traditional assessments (Table 1) and discussed the advantages of using alternative assessments over traditional assessments.

Table 1

*Traditional Assessments versus Nontraditional Assessments*

<table>
<thead>
<tr>
<th>Traditional Assessments</th>
<th>Nontraditional Assessments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Focus on skill performance</td>
<td>Focus on process</td>
</tr>
<tr>
<td>Students acquire objective knowledge</td>
<td>Students thoughtfully judge their own work</td>
</tr>
<tr>
<td>Achievement matters</td>
<td>Development matters</td>
</tr>
<tr>
<td>Teacher’s responsibility</td>
<td>Shared responsibility</td>
</tr>
<tr>
<td>First and only draft work valued</td>
<td>Multiple drafts valued</td>
</tr>
<tr>
<td>Used to determine a grade</td>
<td>Used by student and teacher to guide learning</td>
</tr>
</tbody>
</table>

From Porter & Cleland, 1995, p. 23
Referring to the above table, Porter and Cleland indicated: 1. Compared with the traditional assessment, which is to determine if the student has learned what has been taught, alternative assessment allows learners to focus on their process. 2. Therefore, students in the traditional classroom only care about the information that will be on the test while students in the nontraditional classroom have a chance to go back to previous assignments and analyze the changes, determine what caused change, and then set goals for future learning based upon that analysis. 3. Students in the traditional classroom are judged by mastery of facts or skills while the individual growth in knowledge and development of abilities are valued in the nontraditional classroom. 4. In the traditional classroom, the teacher decides what to teach, how to teach, and how to evaluate a students’ progress; but in the nontraditional classroom, the student decides the process of sorting through and examining the artifacts of learning, then trying to make their own sense out of it through self-evaluation. 5. In a standard test, the student does not have a chance to revise ideas or create a final draft. However, in alternative assessment, the learners’ process, from the inception of an idea to the final product, is examined so that they are beginning to understand their own style, to analyze their audience, and to work for additional detail. 6. The assessment instrument in the traditional classroom is used to find out how much material the student has learned, which is seldom used to determine future learning experiences. In contrast, the alternative viewpoint is that learning is never complete. Therefore, assessment is used to guide learning.

In addition, Porter and Cleland recommended, “Assessment needed to match the beliefs we had about learning, which in turn was reflected in our classroom instruction and informed by the assessment instruments being used” (p. 29).
Based on the above discussion, from a constructivist perspective alternative assessment is preferable over traditional assessment. Electronic portfolios, as one type of alternative assessment, allow students to review, reflect, and determine what caused them to change. Then they can use this new information to determine future learning experiences. According to Testerman and Hall (2000/2001), as the field of technology is expanding rapidly every day, opportunities for electronic portfolios as an assessment tool will continue to advance. When undergraduate students go on to be graduate students, “the mystery and challenge of technology will be lessened due to increasing requirements for technology competency at the K-12 and post secondary level. Electronic portfolios may become as ordinary as research papers in the near future” (Testerman & Hall, 2000/2001, p. 206).

*The Concept and Characteristics of Electronic Portfolios*

*Definition of Portfolio*

The concept of portfolio has long existed in many fields outside the classroom. For example, artists, architects, and photographers use portfolios to illustrate their work to potential clients; financial advisers speak of a client’s investment portfolios. In education, however, portfolios are a relatively new phenomenon and their full potential needs to be explored (Danielson & Abrutyn, 1997).

In reviewing the literature, different definitions of portfolios are provided. The National Education Association (1993) defined a portfolio as “a record of learning that focuses on the student’s work and her/his reflection on that work. Material is collected through a collaborative effort between the student and staff members and is indicative of
progress toward the essential outcomes” (p. 41). Johns (1992), Kingmore (1993), Lustig (1996), Vavrus (1990), and Wiggins (2000) recommended that a portfolio should be a systematic collection of student work to show their academic progress and achievement over a period of time. Arter (1990) and Barrett (1999) defined a portfolio as a purposeful collection of student work that tells the story of a student’s efforts, progress, or achievement. They suggested that a portfolio must include student participation in the selection of portfolio content, criteria for selection, criteria for judging merit, and evidence of student self-reflection.

According to Barrett (1999), a learning portfolio normally contains work that a learner has collected and selected to show growth and change over time. A critical component of a learning portfolio is the learner’s reflection on the individual piece of work (often called an artifact) as well as an overall reflection on the story that the portfolio should tell. The traditional storage format for portfolios in education has been paper-based, usually in folders, three-ring notebooks or larger containers.

**Electronic Portfolio**

Portfolios can be presented in different formats, and electronic portfolios are one of them. Therefore, electronic portfolios keep all the features of portfolios, that is, a carefully selected collection of exemplary artifacts that allows demonstration of one’s work and accomplishments. But an electronic portfolio developer uses electronic technologies to collect and organize portfolio artifacts in many media types, such as: audio, video, graphics, and text. Different from the traditional formats of portfolios, electronic portfolios are easily accessible and are easy to update. In addition, the
hyperlinks among standards, artifacts, and reflections provide a much richer picture of a student’s abilities and growth than traditional assessments.

Barrett (2000) pointed out that “a portfolio without standards is just a multimedia presentation or a fancy electronic résumé or a digital scrapbook” (p. 3). Therefore, electronic portfolios normally use some kind of standards as the organizing basis. The standards used in this program were the National Educational Technology Standards for Teachers (NETS·T) developed by the International Society for Technology in Education (ISTE). A standards-based portfolio uses hypertext links to clearly show the relationship between the standards or goals, artifacts and reflections. The learner’s reflections provide the rationale that specific artifacts are evidence of achieving the stated standards or goals.

Electronic portfolios in a teacher education program provide an efficient method for displaying pre-service teachers’ work that meets high standards and documents growth throughout the program (Costantino & De Lorenzo, 2002). Electronic portfolios may exhibit benchmark performance measures for pre-service teachers by allowing for the evaluation of the effectiveness of teaching strategies. Pre-service teachers may use artifacts that are similar in nature to show their progress towards meeting the standards of their programs (Andrews, Ducharme, & Cox, 2002).

**Purposes of Electronic Portfolios**

The literature review (Barrett, 2001; Hartnell-Young & Morriss, 1999; Wolf, 1999) indicates that there are three general purposes for developing portfolios: learning/formative portfolios, assessment/summative portfolios, and employment/marketing portfolios.
Learning/formative portfolios usually occur on an ongoing basis supporting professional development so that students may show their growth over time by comparing the early products with the later ones. The main purpose of the learning/formative portfolio is “to provide teachers with an opportunity to explore, extend, showcase, and reflect on their own learning” (Wolf, 1999, p. 12). Assessment/summative portfolios usually occur within the context of a formal evaluation process. The primary purpose of this type of portfolio is to “evaluate teacher performance for certification licensure, or professional advancement” (Wolf, 1999, p. 13). Students often choose their best products as evidence of their achievement. They can link these artifacts to the standards with the reflection on why they think they meet the standards, how to prove it, and what their future goals are. Employment/marketing portfolios are used for seeking employment. Wolf (1999) defined it as “customized and attractive collections of information given by teachers to prospective employers and are intended to establish a teacher’s suitability for a specific professional position” (p. 14). Usually students can easily convert their summative portfolios into employment portfolios.

Denzine (2001) distinguished between two types of learning/formative portfolios commonly used in educational settings: the learning portfolio and the professional portfolio. According to Denzine, the differences are:

First, whereas the learning portfolio is typically created as part of a course or program of study, the professional portfolio usually addresses goals outside of a specific course or academic program. Second, the professional portfolio is typically more comprehensive than the learning portfolio. In contrast to the learning portfolio, which involves selecting artifacts that
demonstrate what the student is learning, the professional portfolio contains artifacts that demonstrate what the individual is learning and doing as a professional. (p. 498)

Developing Electronic Portfolios

Based on the literature on portfolio development and multimedia development, Barrett (2000) identified five stages of developing electronic portfolios: 1, defining the portfolio context and goals (purpose and audience); 2, the working portfolio (collection); 3, the reflective portfolio (selection, reflection, and direction); 4, the connected portfolio (connection); and 5, the presentation portfolio (celebration, publishing).

According to Barrett, students firstly identify their assessment context, including the purpose of the portfolio and the goals to be addressed in the portfolio, which will help them to collect and select artifacts. In this study, students have a fixed purpose, to fulfill the requirements for the degree of Master of Education. Their goals are to show their growth over time and document that they have mastered the National Educational Technology Standards for Teachers (NETS-T) developed by the International Society for Technology in Education (ISTE).

According to ISTE, NETS-T, which focuses on preservice teacher education, define the fundamental concepts, knowledge, skills, and attitudes for applying technology in educational settings. There are six standards areas with performance indicators listed under each standard. These indicators provide specific outcomes to be measured when developing a set of assessment tools. The six areas are general guidelines for preservice teachers and teachers currently in the classroom. “Being prepared to use technology and
knowing how that technology can support student learning must become integral skills in every teacher’s professional repertoire” (ISTE). Being professionally trained in Computer Education and Technology, the M.Ed. students not only have to master the above skills but also have to be ready to help other teachers in integrating technology into their classroom. Therefore, they have to be very familiar with the software typically found in K-12 settings.

Knowing the standards they are trying to demonstrate helps them determine the types of portfolio artifacts to be collected and then selected. Students will gather the multimedia materials that represent their achievement. They may use a scanner to digitize images, including documents in paper form. They may use a microphone and sound digitizing program to digitize audio artifacts, and use a video camera, digitizing hardware and software to digitize video artifacts.

After selecting their artifacts, students need to reflect on their works. Dewey (1963) stressed that students did not learn from experience but learned from reflecting on experience. To clarify this reflective process (Campbell, Melenyzer, Nettles, & Wyman, 2000, based on Van Wagenen & Hibbard, 1998), the following three questions need to be answered: 1) What; 2) So what; and 3) Now what.

First of all, the student would summarize the artifact that documents the experience. That is the answer to the question “What?” Then, the student would reflect on what he/she learned and how this leads to meeting the standard, which answers the question “So what?” Finally, the student would address implications for future learning needed and set forth refinements or adaptations, in order to answer “Now what?” Barrett
stressed that this final step of setting future learning goals turns electronic portfolio development into a powerful tool for professional development.

Then students should connect their portfolios. This step is unique to the electronic portfolio to some extent because students can create hypertext links between documents, artifacts, and their reflections, either locally or on the Internet. Hartnell-Young (2000) points out the unique benefits of creating a portfolio with hypertext links:

Hypertext allows for deeper understanding and explanation through links that go from summary statements to complete documents, related items, and reflections. In addition to displaying artifacts effectively, links can allow the collection of material in a Personal Archive to become broader and more thoughtful. (pp. 23-24)

The process of creating a portfolio with hypertext links contributes to the summative assessment process. This process effectively brings together instruction and assessment, portfolio development and professional development.

At the final stage, the student records the portfolio to an appropriate presentation and storage medium. According to Barrett, the best medium for a working portfolio is video tape, computer hard disk, Zip disk, or network server because it is easy for creators to edit their products. The best medium for a formal or presentation portfolio is CD, Web server, or videotape because they are easy to access. All students in this study are required to store their electronic portfolio on a CD.

After three years of assisting students in developing both traditional and electronic portfolios at Saint Mary’s University of Minnesota, Jackson (1999) compared and analyzed three students’ portfolios: a web-based portfolio, a paper-based portfolio,
and a CD-based portfolio. He concluded that electronic portfolios were clearly superior to paper portfolios, and CD-based portfolios were superior to web-based portfolios.

According to Jackson, web-based portfolios allowed easy access and maintenance, but they required the creator to be a self-directed learner and to be able to troubleshoot during the development. Besides, with video, audio and graphic files, the portfolio might need very large storage space, which was not practical for a student; and it would take a long time to download video and audio files. In addition, the artifacts with children’s pictures might not be allowed to be published.

In contrast, a CD-based portfolio not only kept the advantages of a web-based portfolio but also avoided its disadvantages. Jackson mentioned that the CD-based portfolio included an extremely interactive medium for the instructor to review the portfolio, and a CD allowed virtually unlimited access to storage capabilities. The most important was the ability to utilize many different types of software with the development of portfolios, which allowed the student to generate a very professional portfolio that not only reflected their professional growth but also became a showcase for their capabilities as a teacher.

*Strengths of Electronic Portfolios*

The literature review (Barrett, 1999; Daniels, 2002; Ring, 2002; Gatlin & Jacob, 2002) indicates electronic portfolios in a teacher education program provide many benefits to preservice teachers.
Benefit one: Electronic portfolios increase students’ hands-on technology skills and enable them to demonstrate effective and appropriate use of technology

Lyons (1999) suggested that the process of developing electronic portfolios helps beginning teachers articulate their teaching philosophy and develop their teaching techniques. Testerman and Hall (2000/2001) found in their study that electronic portfolios help educational leaders enrolled in a doctoral program extend their understanding of technology and learn applications worthwhile for personal and professional involvement. Testerman and Hall indicated that creating portfolios helped students to understand the methodology for archiving, indexing, and organizing new materials through an electronic media. “The portfolio can become the foundation repository for future uses such as employment applications or demonstrations of comprehensive technology skills, knowledge, and synthesis” (p. 202). They stated, “The skills acquired through preparing and presenting an electronic portfolio provide graduate students the ability to develop other useful applications for personal and professional improvement” (p. 205).

Similarly, Purves (1996) found that portfolios are not simply an alternative to a test, but represent a different way of viewing the nature of curriculum and instruction. Portfolios transfer the focus of the course from the teacher to the student. “They call for maturity and independence on the students’ part, and they make any course become a matter of student learning rather than of teacher instruction” (p. 146).
Benefit two: Electronic portfolios document students’ progress and encourage improvement

Roberts (2002) thought that the portfolio grading system could provide a method of tracking how well students are improving. Portfolios contain both student projects and student reviews of their projects that document how they feel about their performance. He provided students with a review form so that they can review what materials, tools, and fasteners they used to construct the project.

Ellsworth (2002) reported her findings from a three-year case study of an elementary school in which student portfolios were implemented as part of a comprehensive school reform effort. Her participants were seventeen classroom and specialist teachers who were involved in the implementation of portfolios over three years. The result indicated that portfolios were an important mechanism through which teachers came to a deeper understanding of their professional practices and that teachers started to recognize changes in classroom practice and schoolwide responsibilities and to identify organizational structures and professional development opportunities needed for the inquiry and reform process. In her study, “teachers reported significant professional growth as a result of implementing student portfolios in an environment where they could inquire and reflect on what the portfolios were telling them” (p. 353).

Andrews, Ducharme, and Cox (2002) reported on the development process and use of electronic portfolios in the teacher education program at Valdosta State University. According to them, an electronic portfolio serves as an instrument for gaining a better understanding of pre-service teachers’ abilities by examining artifacts (tangible evidence of knowledge gained and skills mastered) they have chosen to use to document what they
know and are able to do. They found that different dimensions of a pre-service teacher’s preparation program might be elaborated to provide indicators of progress that could be measured through electronic portfolio documentation. National, state or district standards may be used as a guide for deciding on the areas of assessment. As students near the completion of their teacher preparation programs, the electronic portfolio becomes a tool for them to market themselves to potential employers. After graduation, the electronic portfolio helps novice and veteran teachers continue in their professional growth as educators (Campbell et al., 1997).

**Benefit three: Electronic portfolios motivate involvement in learning**

Ring (2002) reported the results of the first year of implementation of the electronic portfolio project among undergraduates in teacher education. She stated that the development of the portfolio enabled students to step back from their assignments and reflect on what they were learning and its relevance to their teaching. Student comments in this study such as: “After I began to work on my portfolio and put all the elements together, I began to see that I really had learned a lot!” reiterated that reflection is a necessary element of the portfolio development process. In addition, through their reflective (rationale) statements students provided tangible evidence that they had a clear understanding of the Florida Accomplished Practices.

Ring stated that the portfolio project had the potential to impact the curriculum, level of technology integration, and evaluation. However, changes were rarely easy and not embraced quickly and evenly. Although many professors had little involvement with the portfolio project in the first year, by the second year, many were beginning to discuss
portfolios with their students and seek ways to integrate the electronic portfolio project in their courses. In addition, many professors who had not previously used technology in their teaching were taking advantage of the faculty development opportunities available to them in the college.

In an earlier paper describing the same project, Swain and Ring (2000) discussed the benefits of electronic portfolios in educational technology. They stated,

Creating portfolios gives students the opportunity to create a learning environment which demonstrates what they learned, as well as providing students an opportunity to work on an open-ended project. An additional benefit of electronic portfolios is that students will leave their educational program with a product demonstrating their knowledge and abilities. (p. 340)

Swain and Ring found that the creation of portfolios forced students to think about their work and the process of learning. As early as 1993, Courts and McInerney found that creating an electronic portfolio helped students see that learning should not be disconnected across disciplines nor isolated within a given course, but encouraged them to make connections among and across their own learning experiences.

**Benefit four: Electronic portfolios motivate self-assessment**

“Portfolio assessment allows for the specific talents and abilities of individuals to be highlighted as preservice teachers evaluate their own work and products” (Gatlin & Jacob, 2002, p. 35). Clark, Topp, and Goeman (2002) demonstrated electronic portfolios permit preservice teachers to reflect on their growth over a long period of time and across 
courses while giving them a much clearer picture of how their coursework and field placement activities are inter-related.

Delett, Barnhardt, and Kevorkian (2001) indicated that portfolio assessment was an ongoing, interactive assessment that actively involved both the teacher and the students in the process of learning. In the environment of electronic portfolio, both teachers and students found themselves in new roles with new responsibilities. According to them, portfolios were one means of developing a learner-centered classroom. “Well-designed portfolios offer students the opportunity to become actively involved in the learning process by contributing to instructional planning and assessment” (p. 560). They found that portfolios were most useful as tools for assessing progress in language development by establishing a partnership between teachers and students in the language classroom.

**Benefit five: Electronic portfolios motivate reflective learning**

Van Wagenen and Hibbard (1998) found that in-service teachers developed many effective strategies for studying students’ work and discovered important connections between teaching and learning, through the electronic portfolio construction process. Similarly, Danielson (1996) showed teachers could use electronic portfolios as a method for self-reflection and analysis, as a process to support mentoring and coaching relationships, and to strengthen a résumé.

The most important benefit from creating an electronic portfolio is the reflection. Reflection is a highly valued attribute of effective teachers (Henderson, 1996; Lyons, 1999). Without the disposition to reflect on their performance, teachers are less likely to
improve their practice or to be able to see the links between theory and practice (Levin & Camp, 2002).

Porter and Cleland (1995) stated that the power of reflection helped students and teachers move beyond seeing the portfolio as a mere alternative to traditional assessment to appreciating its value as a leaning strategy. In this capacity, Porter and Cleland thought that portfolios become vehicles for reflection in which learners examine where they have been, where they are now, how they got there, and where they need to go next. They stressed, “A portfolio is comprised of a collection of artifacts accompanied by a reflective narrative that not only helps the learner to understand and extend learning, but invites the reader of the portfolio to gain insights about learning and the learner” (p. 23). Crafton (1991) stated, “When learners have a chance to reflect on their reading, writing, language experiences, they can assume an altered stance on their learning and see it in a new way. They also become aware of and learn to value the strategies they are developing” (p. 314).

The American Psychological Association (APA) (1992) suggested that higher-order strategies for “thinking about thinking” facilitate creative and critical thinking and the development of expertise. Learners’ awareness of their personal control over thinking and learning processes promotes higher level of commitment, persistence, and involvement in learning. Reflection can provide a place for the learner to exercise that control over their own thinking.

Porter and Cleland summarized the advantages of reflection through their studies with their own students in the following aspects:

1. Reflection allows learners to examine their learning process.
2. Reflection allows learners to take responsibility for their own learning.
3. Reflection allows learners to see “gaps” in their learning.

4. Reflection allows learners to determine strategies that support their learning.

5. Reflection allows learners to celebrate risk-taking and inquiry.

6. Reflection allows learners to set goals for future experiences.

7. Reflection allows learners to see changes and development over time.

(pp. 37-50

When students reflect on and interpret their learning experiences, according to Porter and Cleland, paths for personal inquiry about learning emerge. Students are no longer completing an assessment for the teacher or the letter grade because they will need specific information or skills when they get to a higher level. Instead, they are motivated by the need to satisfy their individual inquiries. Through reflection, students are able to discover how they are different and appreciate the interactions that supported them in their endeavors to understand.

During the reflection process, as Porter and Cleland stated, “the responsibility for learning shifts from teacher to student” (p. 37). Learning becomes a personal responsibility because self-evaluation determines the instructional decisions made for future learning experiences. This is not something that teachers can do for or to students. It is the learners’ responsibility to sort through and examine the artifacts of their learning, then try to make their own sense out of it. The responsibility for interpretation is theirs.

When students and teachers are actively involved in learning, it is sometimes difficult to see areas they have avoided because they became caught up in something else. According to Porter and Cleland, reflection allows them to “step back” from this active
involvement and provides the distance they need in order to observe what they were doing as learners. Therefore, reflections can highlight not only what has been done, but what has not been done.

“Through reflection, learners are able to get inside their thinking to discover the support systems that allow them to grow; they can become respondents to and judges of their own work” (Wolf, 1986, p. 35 as cited in Porter & Cleland, 1995).

Porter and Cleland suggest the fear of being wrong and therefore not taking risks have impeded most learners at one time or another, but through reflection they can see the valuable role that this factor plays in the learning process. When learners explore their natural curiosity through inquiry and then look back on it by using the portfolio as a strategy, achievements can be showcased (Valencia, 1990). Through the use of a portfolio, the interactions that supported learners in their development can be made public. A celebration such as this informs not only the learner, but also others who interact with the author of the portfolio (Porter & Cleland, 1995).

According to Porter and Cleland, learning is never complete; one experience is connected to the next. When learners look back at the interactions that changed them, the person they need to become can be put into personal perspective. As a learning strategy, the portfolio becomes a part of the curriculum that informs interpretative evaluation, which in turn informs curriculum (Goodman, 1989, p. 9 as cited in Porter & Cleland, 1995). The answer to the question, “What needs to be done next?” can only be determined when individual strengths, weaknesses, needs, and questions are brought to the conscious level of both student and teacher. By returning to previous work as far back as their very beginning, students are able to validate their growth and alleviate their fear.
As Porter and Cleland found in their study, reflection over time can provide support that students periodically need when it seems they have been in the same place for an extended period of time. The use of reflection can serve as their personal pep rally. It can shout, “Look what you have been able to accomplish” just at a time when they need it the most. It can provide the concrete evidence they need as they begin to doubt the verbal reassurances from their peers as token attempts to boost their confidence. It is one thing to be told that they are improving, but it is an entirely different matter when they can view the changes themselves.

The most common thread throughout the literature is that learning is complex, multidimensional, and appears to be inextricably connected to the learner’s experiences (Brookfield, 1991; Dewey, 1963; Knowles, 1984). Brown (2002) recommended, “For students creating portfolios, insight may occur through reflecting on and writing about professional and personal experiences and result in greater self-knowledge” (p. 230). The portfolio engages affective and cognitive domains and can initiate a ubiquitous change in individuals’ perspectives and attitudes.

Pedagogically, the assemblage of an electronic portfolio is a classic example of a constructivist activity because the construction of an electronic portfolio enables students to continuously construct and revisit their knowledge, beliefs, and biases about the profession (Foti, 2002). Constructivists believe teaching is an active and learner-centered process. This philosophy recognizes that students build their own understanding of the world by using what they already know to interpret new ideas and experiences. Constructivists emphasize not only what students know, but also what they do (Geier, 2002). Brown (2002) found in his study that developing a portfolio supported not only
identification of prior learning but also led to new learning outcomes. He pointed out that
the portfolio process helped students understand how their learning took place due to the
need to critically analyze, organize, evaluate, and write about their learning from
experiences.

*Evaluation of Electronic Portfolios*

The way an electronic portfolio is evaluated determines its form and content
(Delandshere & Arens, 2003). Research indicates that it is necessary to develop a
systematic plan for evaluating electronic portfolios because clarity about the end product
is the starting point for any excellent teacher preparation program (Campbell, Melenyzer,
Nettles, & Wyman, 2000). Similarly, Drake and McBride (2000) suggest there is little
doubt that the portfolio and an accompanying rubric, which are detailed criteria combined
with rating scales, have important roles to play in any meaningful teacher assessment
program. Based on their experiences in preparing prospective history and social science
teachers and on their participation in a pilot project testing Illinois’ proposed *Core
Standards for Teachers* (1999), which are based on standards developed by the Interstate
New Teachers Assessment Support Consortium (INTASC), Drake and McBride
developed criteria for the evaluation of a portfolio at various stages of a teaching career.
According to them, individuals preparing a summative portfolio can use the rubric and
criteria to gauge the collective effectiveness of the materials they select; administrators
and supervisors will understand and discuss the criteria with their teachers before they
attempt a formal assessment of the completed portfolios. They think the rubric and
criteria will be as helpful to teachers who are reflecting on their performance as it is
useful to those who are assessing the teacher.
According to Drake and McBride, this three-dimensional, analytic rubric, which should be shared in advance with the teacher, allows a reviewer to assess simultaneously a history teacher’s portfolio in each of three interrelated dimensions: 1. knowledge of evidence from content in discipline and pedagogy: facts/supporting details; themes/issues; and purposes/beliefs; 2. reasoning, including analysis, evaluation, and synthesis of evidence and the interplay among pedagogy, habits of mind, and thinking skills as related to performance in the classroom; and 3. communication, which demonstrates knowledge and reasoning through oral, written, visual, dramatic, and mixed media presentations to illustrate disposition toward teaching. Each dimension of the rubric is divided into six levels, with each level defined by several criteria that reflect a teacher’s knowledge, teaching skills, and disposition.

Based on NCATE 2000 standards, Gatlin and Jacob (2002) provided their preservice students an evaluation rubric (Table 2) for the review and defense of the portfolio, which includes the area of artifacts (selection of components), rationale (reason for selection of components to address standards), and presentation (defense of portfolio). They got positive feedback from both students and faculty because students were clear about the strengths and areas of concern in preparing the portfolio since the rubrics were used as a self-assessment tool.

Goldsby and Fazal (2001) developed a four-point rubric (Table 3) at Iona College to evaluate web-based digital portfolios. They used different examples to illustrate how to evaluate three main elements: form (design and aesthetics), function and usability (ease of use), and components (presence and communication of the required samples). Their rubric was designed to provide an objective, systematic, and reliable evaluation of the
portfolios by the college supervisors. The authors found this rubric increased consistency in the rating of performances, products, and achievements by enabling teachers to focus on what elements of a performance or product are most important and not distracted by subjective concerns.

According to Goldsby and Fazal, the creation and use of rubrics can ease the burden of portfolio evaluation. Rubrics should include key elements, traits, or dimensions to be evaluated. Criteria discriminate among different levels related to the understanding of content, proficiency of a skill or process, and/or quality of a product or performance. Rubrics place a value on the information that is gathered using assessment tools such as projects, products, and performances. They stressed that “rubrics must be valid, reliable, systematic, and practical if they are to be used” (p. 609).

Delett, Barnhardt, and Kevorkian (2001) found that portfolios were most useful as tools for assessing progress in language development by establishing a partnership between teachers and students in the language classroom. However, they thought that portfolios could only be an effective measure of progress if a systematic process was followed. Therefore, they suggested establishing criteria for assessment. According to them, the portfolio measures progress toward goals by using a consistent system of assessment. Rubrics provide this consistency. They mentioned that teachers and students should develop criteria that will be used to assess portfolio entries and to evaluate the portfolio as a whole before the portfolio process begins.

Once the criteria are established, the teacher chooses a rating scale to measure the extent to which a learner met the criteria. Rating scales use descriptions such as
Table 2

Scoring Guide for Portfolio Review

Name of Student __________________  Semester/Year ______________
Faculty Reviewer _________________  Course ________________

Candidate must score at least seven points to proceed to student teaching.

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Little/No Evidence (1)</th>
<th>Some Evidence (2)</th>
<th>Target/Goal (3)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Artifacts</strong> (Selection of Components)</td>
<td>Minimal written or visual documentation of performance outcomes. Product lacks organization, no evidence of thought given to components.</td>
<td>Documentation of performance outcomes is fairly clear and logical. Some evidence of thought given to components that are clearly presented.</td>
<td>Written and visual artifacts are carefully selected, organized. Critical analysis performed in selection and portfolio is easy to use.</td>
</tr>
<tr>
<td>Score ______</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Score ______</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Presentation</strong> (Defense of portfolio)</td>
<td>Preservice teacher was not prepared or focused in reflecting on practice.</td>
<td>Preservice teacher was ready to defend portfolio and was focused. Candidates answered questions with reflection and made connections between artifacts and practice.</td>
<td>Preservice teacher was well prepared for defense. Questions were asked and thoroughly answered that provided evidence of reflective practice and growth. Candidate drew conclusions and insights from artifacts and teaching practice.</td>
</tr>
<tr>
<td>Score ______</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total Points __________

<table>
<thead>
<tr>
<th>Score</th>
<th>Form-Design and Aesthetics</th>
<th>Function and Usability</th>
<th>Presence and Communication of the “Components”</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td><strong>Very Appealing and Imaginative</strong></td>
<td><strong>Very Easy to Navigate and Use</strong></td>
<td><strong>Complete and Extremely Well Communicated</strong></td>
</tr>
<tr>
<td></td>
<td>Main Points clearly presented; creative, attractive, appealing graphic elements included appropriately; good color combination; well organized page layout; well divided sections; neat; has the biblio-diddly (BD)” factor.</td>
<td>Links make excellent use of the web’s timeliness, colorfulness and resources; layout is easy to navigate; suitable download time; no errors.</td>
<td>All relevant components presented in an extremely coherent, organized, and well-scripted fashion.</td>
</tr>
<tr>
<td>3</td>
<td><strong>Appealing</strong></td>
<td><strong>Somewhat Easy to navigate and Use</strong></td>
<td><strong>Complete and Communicated Adequately</strong></td>
</tr>
<tr>
<td></td>
<td>Followed guidelines-contains all the required elements of a good design but does not have the “BD” factor.</td>
<td>Links are somewhat effective; presence of no outdated links; somewhat longer but acceptable download time; convenient navigation.</td>
<td>All relevant components presented in an adequately coherent and organized fashion.</td>
</tr>
<tr>
<td>2</td>
<td><strong>Somewhat Unappealing</strong></td>
<td><strong>Somewhat Difficult to Navigate and Use</strong></td>
<td><strong>Incomplete and Inadequate Communication</strong></td>
</tr>
<tr>
<td></td>
<td>Some errors in formatting; dull color combination and layout; plain; somewhat messy presentation; random use of graphics; some omissions from guidelines.</td>
<td>Few links and/or errors in links; some navigation difficulties and awkwardness; long download time.</td>
<td>Some components missing; not well written; presented in an unorganized and unpolished fashion.</td>
</tr>
<tr>
<td>1</td>
<td><strong>Very Unappealing</strong></td>
<td><strong>Extremely Difficult to Navigate and Use</strong></td>
<td><strong>Significantly Incomplete and Awkward Communication</strong></td>
</tr>
<tr>
<td></td>
<td>Significant errors in formatting; inappropriate color combination and layout; messy presentation; inappropriate use of graphics; significant omissions from guidelines.</td>
<td>Critical errors and omissions in links; definite navigation difficulties and awkwardness; extremely slow in downloading.</td>
<td>Significant omissions of components; presented in an awkward and poorly written fashion.</td>
</tr>
</tbody>
</table>

*Biblio-diddly is our special word for the special essence that sets the product above the rest.

rarely/sometimes/often/always or numerical sequences such as 1 to 5 to distinguish degrees of performance. To choose the scale, the teacher determines how many levels of performance are appropriate for the task.

Problems of Electronic Portfolios

The literature review showed that electronic portfolios not only have many benefits but also have problems to be considered.

Problem one: Deficient hardware and software

According to Purves (1996), when students are dealing with the problems of input, problems of access, problems of copying and production, they need both hardware and software that are flexible enough to allow for all sorts of material to be put into digital form easily and then for editing software that allows them to be manipulated once they are in. Bartlett (2002) found equipment problems in her study. Her students complained, “All the equipment (video camera, computer with movie making capabilities) isn’t available to everyone” (p. 93).

Problem two: Considerable investment of time and effort

Research suggests that the implementation of electronic portfolios requires considerable investment of time and effort from both the instructor and the student (Bartlett, 2002; Cole et al., 2000; Linn & Baker, 1992; Wright, Ray, & Stallworth, 2002).

Read and Cafolla (1999) concluded in their research that developing and implementing multimedia preservice teacher portfolios was an enormous responsibility and task. They recommended that besides the cooperation of students, faculty, staff and
administrators, financial support for equipment and technical support to maintain equipment was essential if the project was to succeed.

Campbell and Brummett (2002) also pointed out the amount of time consumed in developing electronic portfolios. They found, “No portfolio is ever done; it will always be a work-in-progress. As skills develop, knowledge expands, and becomes more refined — so, too, will the portfolio” (p. 27). According to them, a portfolio should always be thought of as a collection of documents that is living and subject to modification.

Problem three: Insufficient attention and instruction on reflection

Reflection is an essential part of the electronic portfolio process. However, reflection is a learned process (Ellsworth, 2002). Ellsworth suggested that specific strategies for reflection should be taught to preservice teachers because they could not be presumed to know how to engage in productive reflection. Mullen, Doty, and Rice (2002) indicated in their study that many preservice teachers struggled with a coherent fit between the standard, the artifact, and the rationale. They found many students treated the rationale and artifact as isolated items with little reflection to each other. They thought it would take time in the program to teach students how to “think” about their work in portfolio terms.

Similarly, the result of Cunningham and Benedetto’s (2002) study indicated that students spent a great deal of time selecting video clips to communicate their growth, but less on reflection of the performance captured in the video segment. They thought “the greatest influence on program-wide integration is the realization that the creation of a meaningful and reflective video takes a great deal of time; not because of technology, but
because critical reflection is a skill that teacher candidates are just beginning to develop during their programs” (p. 552).

In addition, Rose (2002) reported in her study about the reluctant students and overworked faculty members. She found the students didn’t see the value/need for creating electronic portfolios because they were very comfortable with the tried and true lecture and didn’t want to have more work creating electronic portfolios for the course. At the same time, faculty in her study worked more than expected in designing, developing and grading portfolio assessments.

Conclusion

The literature review suggests that developing an electronic portfolio is one of the effective ways of carrying out constructivism learning theory in teacher education because it helps students to construct their individual knowledge and skills. The power of reflection helps students and teachers move beyond seeing the portfolio as a mere alternative to traditional assessment to appreciating its value as a learning strategy (Porter & Cleland, 1995). Developing and creating electronic portfolios not only force students to examine their learning process, determine learning strategies, but also allow them to set goals for future learning. Through this process, students effectively use technology to construct knowledge.
Chapter Three: Methodology

Introduction

The purpose of this study was to understand the learning processes that occur as Master of Education students assemble their electronic portfolios at a large midwestern university. The study will describe the experiences of Master’s students in developing their electronic portfolios, and interpret how these experiences affect their learning. Therefore, qualitative methodology was used for the current study.

Qualitative research is an umbrella concept (Punch, 2000) covering several forms of inquiry that help investigators understand and interpret the meaning of social phenomena with as little disruption of the natural setting as possible (Merriam, 1998). Qualitative researchers study people, things and events in their natural settings (Punch, 2000), and attempt to make sense of or interpret phenomena in terms of the meanings people bring to them (Guba & Lincoln, 1994). A qualitative case study forms the methodological framework of this study because “properly conducted case studies, especially in situations where our knowledge is shallow, fragmentary, incomplete or non-existent, have a valuable contribution to make” (Punch, p. 155). This research studies a group of unique students, who were professionally trained in design and in advanced technology skills, in developing their electronic portfolios. Therefore, a case study is appropriate for understanding and interpreting their uniqueness.

According to Punch (2000), a case can be defined as a phenomenon of some sort occurring in a bounded context. The case may be an individual or a small group of people. The basic idea of case study is that one case will be studied in detail, using whatever methods seem appropriate. The general objective is to develop as full an understanding of
that case as possible. The case study aims to understand the case in depth, and in its natural setting, recognizing its complexity and its context. Thus, the overall goal of this research was to study a group of Master’s students as completely as possible and the learning processes that occurred when they developed electronic portfolios.

Stake (1994) described a case study as the process of learning about the case and the product of our learning. The case study results in a rich and holistic account of a phenomenon anchored in real life situations, offers insight, and illuminates meanings that expand the reader’s experiences (Merriam, 1998) in their construction of knowledge (Stake, 1994).

The case study was an appropriate method of inquiry for the current study since the researcher’s goal was an in-depth understanding of a particular phenomenon — that is, the learning processes in developing electronic portfolios — in its natural setting. An in-depth case study could provide an understanding of the important aspects of the learning processes that occur in assembling electronic portfolios. This case study investigated the important features, explained students’ understandings of them, and conceptualized them for further study.

Multiple sources of information were used to gather data for the study. Sequential in-depth interviews were the main sources of data, as well as direct observations and document analysis. Multiple sources of information were sought and used because no single source of information could be trusted to provide a comprehensive perspective (Patton, 1990). Moreover, multiple sources increase the credibility of the study. As Patton (1990) suggested, “by using a combination of observations, interviewing, document
analysis,” the researcher is able to use “different data sources to validate and cross-check findings” (p. 224).

With the help of the program faculty, the researcher identified seven Master of Education (M.Ed.) students who chose to create electronic portfolios instead of writing a research paper. In their electronic portfolios, they used different kinds of artifacts to demonstrate that they met the ISTE standards and the requirements of their major, Computer Education and Technology. During the process of developing electronic portfolios, many technical skills were involved. The students not only had to review what they had learned in class, but also had to explore new ways to combine their different artifacts into an integrated and compatible format. Although several studies have been conducted on how to assemble portfolios or electronic portfolios, scant knowledge has been acquired on student learning that occurs in this process. Because of this need, this research focused on the learning processes that occurred as the Master’s students assembled their electronic portfolios.

**Researcher**

The researcher of this study is a doctoral student in Instructional Technology. She is an international student from P. R. China and has taught English at the university level for 14 years in China. As a doctoral student in a college of education, majoring in Instructional Technology, and having experience in both traditional learning environments and constructivist learning environments, the researcher believes that integrating technology into the classroom is very important in teacher education. Education about technology should go hand in hand with giving students an opportunity for hands-on experiences with technology (Jonassen et al., 1999). These experiences are
more effective if students are given a chance to implement the use of technology in an authentic situation. Developing electronic portfolios is an excellent opportunity to achieve that goal.

The researcher’s interest in this study started in fall 2001 when electronic portfolios were first introduced in a practicum class. Dr. Helen Barrett, a well-known consultant in electronic portfolios, was invited to hold an electronic portfolio workshop in the college. The lecture gave the researcher and her classmates very detailed information about what an electronic portfolio is, what to include in it, how to prepare it, and what software to use.

During the fall quarter 2001, the researcher and her classmates went through the whole process of creating electronic portfolios and experienced various problems. It was teamwork that helped them to succeed in developing their electronic portfolios. Through this process, many learning activities occurred which enriched their knowledge and skills. The researcher felt that the skills learned in various courses were applied in assembling electronic portfolios, and there were opportunities to acquire more skills beyond what had been gained in classes. When there was a problem in converting projects to a compatible format, for example, the researcher and her classmates would try different ways to get things done. Sometimes, it would take them days to solve the problem. As a result, they went through different means and explored different functions of the software. They learned from mistakes and their experiences. They found that they became skillful in using the software and remembered the skills clearly. Because of this experience, the researcher became very interested in the learning processes and learning experiences that
occur as students assemble their electronic portfolios. She conducted a pilot study from spring 2002 to winter 2003.

_Pilot Study_

A pilot study on learning processes that occurred as M.Ed. students created their electronic portfolios was conducted for the purpose of getting to know more about students’ experiences in developing electronic portfolios, shaping the research questions, testing and modifying the interview questions to focus more effectively on the research questions, and planning the research design. The researcher interviewed six M.Ed. students who finished their electronic portfolios, and observed all of the presentations in the public showcases. She recorded all the interviews and presentations, transcribed them afterwards, and analyzed them. The experiences of the M.Ed. students were similar to what the researcher had experienced.

1. They were proud of and satisfied with their products because electronic portfolios gave them a chance to take advantage of their expertise in showing their hard work and achievements in all aspects. A couple of students stated, “You can show them how you’ve improved and how hard you’ve worked.” One international student said, “In my country, we are not used to writing. It is difficult for us to write something. Since my computer skills are very strong, I thought it would be easier for me to create a portfolio instead of writing a thesis.” However, he did not acknowledge that writing a research paper could improve his writing.

2. Although developing electronic portfolios was really time consuming, they said that it was worth the time and effort because electronic portfolios showed their
achievements over time and would help them in job hunting. All of them agreed that file management was very important because it would save them a lot of time if they could access files easily afterwards. Students mentioned, “The hardest part should be collecting suitable, appropriate materials for each standard,” and “It’s not a difficult project, but if you want it to look nice and well-prepared it’s time consuming.”

3. Students talked about the experience of learning from the reflection, learning from their past experiences, learning from their mistakes, and learning from their peers.

   a. The pilot study found that reflection stimulates student learning. Most students stated that selecting and reflecting on the artifacts gave them a chance to self-assess their progress, and they got a chance to revise their artifacts to make them better. As one student said,

      For example, standard II says that learning environment is going to be different if you use technology. I look at my paper, it does not quite match the requirement. I changed it so as to emphasize the importance of teachers’ and students’ roles in the paper. Also, I look at my other two papers. I found similar findings. Therefore, I said in my reflections, if you want to use technology in the learning environment, we should change the role of the teacher and students.

   b. The pilot study also found that learning from experience is a very important learning strategy in assembling electronic portfolios. One student stated how he learned from his experience. He recalled,
At the very beginning, I did not know how to put the projects I designed in PhotoShop to this PDF file. Then, I suddenly remembered that I could insert images into PowerPoint. I created a PPT file with all the images created in Photoshop and converted the PPT file into a PDF file.

c. All students admitted that they had learned most from peers. As one student mentioned, “First of all, I am trying to solve my problem myself. If I am not successful, I must ask other people. If I have a problem first I am asking my friends, actually, instead of going to professors. I prefer to ask my friends.”

d. All students had the experience of learning from mistakes. One student reported,

I think that the best way to learn is from your mistakes, especially in technology. If you make a mistake, you will never forget. That’s why this is the most effective learning strategy. For example, when you create your project on D drive of your computer but when you show it in another computer’s F drive, your project won’t work, so next time you have to avoid this because this causes you so much trouble and causes you a lot more time to do it, so you won’t have this problem again.

According to the pilot study, students started to develop the final products in the last quarter because 1) they did not have enough time to do it early when they were taking other classes; and 2) they had to wait for the artifacts from the final quarter. They
also said that they would share their electronic portfolios with other students and peers, and they would use them in their future classes.

In spring 2003, the researcher presented findings from her pilot study at the Society for Information Technology and Teacher Education (SITE) 2003 conference. This annual conference offers opportunities to share ideas and expertise on all topics related to the use of information technology in teacher education and instruction about information technology for all disciplines in preservice, inservice, and graduate teacher education as well as faculty and staff development. At this conference, she got a chance to exchange knowledge about what happened in the current research on electronic portfolios with other scholars. The interest in her study from the audience at the conference reinforced the researcher’s determination to carry out this study.

Based on the experience in the pilot study, the researcher changed her interview schedule from one time to two times and added specific interview questions. Hence, this pilot study not only helped the researcher to learn about her research process, interview questions, observation techniques, and herself (Glesne, 1999), but as a form of grounded theory helped the researcher infer her ideas about student learning in portfolio development.

Based on the pilot study, the following research questions were formulated:

1. What are the learning experiences of the Master’s students in developing their electronic portfolios?
2. What meaning do they give to these experiences?
3. What are the learning processes encountered by the Master’s students when developing electronic portfolios?
This chapter describes the research design that was used to collect and analyze data to answer the research questions, including the research setting, participants, role of the researcher and ethical considerations, research methodology, data collection, data analysis, and summary.

Research Setting

The research setting is a rural university in a small midwestern college town. The main campus has about 17,000 undergraduate and 4,000 graduate students, including about 1,100 graduate and undergraduate international students. The student to faculty ratio is 21:1. There are 276 majors from which to choose and 201 buildings on 1,700 acres. There are five regional campuses located in nearby towns. The university is a residential campus; that is, almost all the students live on campus in one of the university’s 40 residence halls or near campus. All first and second-year students are required to live in the residence halls.

The university is committed to providing technology support and technology tools for learning for the students to succeed in academics, social and professional life. Every residence hall room is equipped with its own high-speed computer, printer and network connection. In addition, there are 56 computer labs around the main campus. Since 1999, the university has been using Blackboard for Web-based course management.

The College of Education is organized into three departments: Counselor and Higher Education, Educational Studies, and Teacher Education. These undergraduate and graduate programs lead to careers in teaching, counseling, public school administration, and higher education administration. The Department of Educational Studies includes the
programs of Cultural Studies, Educational Administration, Educational Research and Evaluation, and Instructional Technology.

The Master's program in Computer Education and Technology serves educators in K-12 schools and technical and community colleges who wish to pursue advanced preparation in computer education and technology. The program prepares classroom teachers to use technology more effectively in their teaching and to become technology leaders in their schools or districts. Graduates of the program who hold a state teaching license qualify for the state’s multi-age endorsement in Computer Education and Technology.

Beginning in the fall of 2001, Master of Education students majoring in Computer Education and Technology in the Department of Educational Studies were given the option of 1) assembling an electronic portfolio as their graduation assessment, or 2) writing a seminar research paper. Those who choose to create an electronic portfolio would develop an individual, standards-based learning portfolio on CD using appropriate multimedia tools.

As described in the syllabus for the Master’s Portfolio (Appendix A), electronic portfolios provide an opportunity for students to synthesize what they have learned in the Master’s program, show their growth over time, and document that they have mastered the National Educational Technology Standards for Teachers (NETS·T) developed by the International Society for Technology in Education (ISTE). The syllabus further states:

The aim of the Masters Portfolio is to move from description to reflection.
The task is to determine how various insights are instrumental in understanding professional growth in a more comprehensive way. While
reflecting on our past actions, we generate knowledge that will inform our future actions. (p. 1)

The requirements for the electronic portfolio include a title/cover page that expresses the student’s personality, a table of contents to help navigation in the portfolio, and an introduction including a statement of the student’s professional goals, philosophy of education, and résumé. The main part of the portfolio is the evidence of NETS·T for teachers’ standards with reflections and future learning goals. Under each standard students list sample artifacts that provide evidence that they have met this standard and its link to the actual artifact. Along with this artifact, students write a reflective paragraph discussing how the artifact they have selected illustrates their growth in meeting this standard and state their goals for future learning related to this standard.

Examples of artifacts they might select, according to the syllabus (2002-03), include:

1. Research papers, tests, projects, reports, etc. that are indicators of your growth.

2. Annotated bibliography of theorists you have determined as important to your understanding.

3. Analysis of important books, monographs, videos, audio tapes, articles that you have read, seen or heard.

4. Sample segments of your teaching or of presentations you have made (at least one video clip is required; limit clips to two minutes each).

5. Exhibits of your use of technology personally.

6. Exhibits of your use of technology as a teaching tool.
7. Exhibits of your integration of technology into teaching.

8. Exhibits of your leadership in the use of technology in educational settings.

(p. 2)

Students are required to demonstrate their portfolio in a public showcase for the program faculty and students during finals week of the quarter of graduation. Students who create Master’s portfolios register for three credit hours in the final year of their program. However, they are expected to work on their portfolios throughout their program of studies.

Students in Educational Studies are offered the latest instructional technology and access to state-of-the-art computers, software, and educational materials all facilitated through the Curriculum and Technology Center. There are two computer labs in both platforms of Macintosh and Windows in the college. Students have access to productivity software, educational software, digital cameras, camcorders, scanners and other equipment. There were six students who showcased their electronic portfolios since 2001 (Table 4) when students started to have the choice of creating an electronic portfolio or writing a research paper through March 2003. There were nine students who presented their electronic portfolios in June 2003.

Table 4

<p>| Summary of M.Ed. Graduates November 2001 - June 2003 |</p>
<table>
<thead>
<tr>
<th>Nov. 01</th>
<th>Mar. 02</th>
<th>Jun. 02</th>
<th>Aug. 02</th>
<th>Nov. 02</th>
<th>Mar. 03</th>
<th>Jun. 03</th>
</tr>
</thead>
<tbody>
<tr>
<td>Graduates with EP*</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Graduates with P*</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>unknown</td>
</tr>
<tr>
<td>Total Graduates</td>
<td>2</td>
<td>1</td>
<td>5</td>
<td>4</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

Notes: Graduates with EP refers to those M.Ed. students who created an electronic portfolio. Graduates with P refers to those M.Ed. students who wrote a research paper.
Although developing an electronic portfolio was a relatively new option as the data indicate, it had been in place for two years. Consequently, it was an appropriate time to examine the experiences of graduates of the program. The information gathered can provide insight for further studies or for modifications in the program.

**Participants**

In the winter quarter of 2003, the researcher got a list of four students who would finish their electronic portfolios in spring 2003 and was introduced to them by the program faculty. The researcher explained the purpose of the interview and made an appointment with them individually for the interviews. On June 12th 2003, there were nine students who presented their electronic portfolios in the public showcase. After the showcase, the researcher contacted another three students to get their permission for an interview. As a result, there were seven M.Ed. students in Computer Education and Technology in the Department of Educational Studies who participated in this study. Four of the seven participants were full-time teachers while studying in this program. The other three were full-time students. Among these three, two of them were college language teachers before entering this program. Background information about each participant will be provided in Chapter Four.

**Role of the Researcher and Ethical Considerations**

In this study, the researcher had many roles such as an interviewer, observer, storyteller, evaluator, and interpreter (Stake, 1995). According to Stake, researchers deliberately or intuitively make decisions about how much emphasis to be given to each role, and role choices have implications on the meanings they will develop. “No matter how qualitative researchers view their roles, they develop relationships with the
participants” (Glesne & Peshkin, 1992, p. 117). Bogdan and Biklen (1998) mentioned that participants expect reciprocity from the researcher in return for their participation. To show reciprocity, this researcher provided technical support to her participants during the participant observations. At the end of each interview, the researcher gave each participant a CD with his/her presentation on it as a gift to thank them for their participation in this study. They said that they were all very glad to have this CD because it reminded them of their accomplishments.

According to Creswell (1998), the biases, values, and the judgment of the researcher must be explicitly explained. Bogdan and Biklen (1998) discussed the influence of subjectivity:

Acknowledge that no matter how much you try, you cannot divorce your research and writing from your past experiences, who you are, what you believe and what you value… The goal is to become more reflective and conscious of how who you are may shape and enrich what you do, not to eliminate it. On the other hand, do not be so headstrong about who you are and what you believe that it leads to being unreflective and to losing your self-consciousness. It is fine to shape your study, but you need to be open to being shaped by the research experience and to having your thinking be informed by the data. (p.34)

The researcher adopted this point of view as her guideline in her approach to the research, with regard to the issue of subjectivity. She took fieldnotes, which included reflections of the researcher’s thoughts and feelings and subjectivity (Bogdan & Biklen, 1998). As Bogdan and Biklen note, recording one’s subjectivity presents a way of
accounting for and dealing with it in order to allow the research experience to shape one’s view. The researcher attempted to do this by recording her personal feelings and thoughts in a reflective journal that she kept along with her fieldnotes. According to Patton (2002), when the researcher has direct contact with and gets close to the people, situation, and phenomenon under study, “the researcher’s personal experiences and insights are an important part of the inquiry and critical to understanding the phenomenon” (p. 40). Therefore, the researcher’s personal experiences with electronic portfolios provided her with valuable insights in assessing student learning.

According to Stake (1995), “Most case studies are not evaluation studies, but some interpretations made by the researcher will be evaluative in nature, so at least in that sense the case researcher is always an evaluator” (p. 96). Stake further stated that the case researcher recognizes and substantiates new meaning. He said, “Whoever is a researcher has recognized a problem, a puzzlement, and studies it, hoping to connect it better with known things” (p. 97). That means the researcher of this study was an evaluator and interpreter. In addition, this study was conducted from a researcher-as-instrument position; in other words, the researcher both collected and analyzed the data (Janesick, 1994).

Bogdan and Biklen (1998) suggested that informed consent and the protection of subjects from harm are the “two issues that dominate the traditional official guidelines of ethics in research with human subjects” (p. 43). In compliance with the University’s Institutional Review Board requirements, consent forms (Appendix C) were given to the participants in the first interview. The nature of the study and the nature of the students’ participation were explained in detail.
Taylor and Bogdan (1998) suggested ensuring confidentiality and anonymity in writing or verbal reporting for protecting participants in a study. Pseudonyms have been used for the participants in this study. For the same reason, the names of the people and the places in the appendixes were changed where applicable.

**Theoretical Framework**

The theoretical framework that guided this research study was constructivist learning theory as discussed in the literature review. Constructivist learning theory helps the researcher to understand the learning of her participants. At the same time, this study also used the phenomenological approach to guide in interpretation of the meaning that students gave to their experiences. Because all knowledge and experience are connected to phenomena, according to Moustakas (1994), inevitably a unity must exist between ourselves as knowers and the things or objects that we come to know and depend upon. This phenomenological approach was designed “to understand … phenomena from the actors own perspective” (Taylor & Bogdan, 1998, p. 3). According to Bogdan and Biklen (1998), “researchers in the phenomenological mode attempt to understand the meaning of events and interactions to ordinary people in particular situations. … What phenomenologists emphasize is the subjective aspects of people’s behavior. They attempt to gain entry into the conceptual world of their subjects in order to understand how and what meaning they construct around events in their daily life” (p. 23). Patton (1990) also stated, “phenomenological inquiry focuses on the question ‘what is the structure and essence of experience of this phenomenon for these people?’” (p. 69). Similarly, the researcher is mainly interested in understanding the structure and essence of the students’ learning experiences in developing electronic portfolios from their own perspective.
Phenomenology is an interpretive method where participants interpret their experience and the researcher interprets the data; it seeks to uncover the meanings within experience and translate felt understandings into words (Creswell, 1998; Moustakas, 1994). Therefore, phenomenological study is appropriate to provide answers to the research questions in this study because only an in-depth phenomenological study can provide understanding of the important aspects of the learning process that occur in assembling electronic portfolios.

**Data Collection**

Bogdan and Taylor (1984) and Patton (1990) have stated that qualitative methods consist of three types of data collection: in-depth, open-ended interviews, direct observation, and written documents. Moustakas (1994) also stated that typically in the phenomenological investigation the long interview is the method through which data is collected on the topic and question. Therefore, data collection in this study included semi-structured, in-depth, face-to-face individual interviews, observation, and analysis of documents such as syllabi and students’ electronic portfolios.

Data collection from interviews, according to Rubin and Rubin (1995), Creswell (1994), and Patton (1990), elicits interviewees’ views of their worlds, their work, and the events they have experienced and observed. To reconstruct and understand the interviewees’ experiences and interpretations, researchers seek thick and rich descriptions of the cultural and topical arenas they are studying and try to develop an empathetic understanding of the world of others. The objective of an interview in this study was to allow the interviewees to tell their stories and share their experiences in developing electronic portfolios.
The interview is one of the main data collection tools in qualitative research as described above. It is used to access people’s perceptions, meanings, definitions of situations and constructions of reality. It is also one of the most powerful ways we have of understanding others (Punch, 2000). Seven M.Ed. students were interviewed individually to describe their experiences in the process of developing electronic portfolios and what meaning they gave to these experiences in order to understand the learning processes encountered.

According to Punch (2000), there are different types of interviews, including structured interviews and unstructured interviews. “In structured interviews the respondent is asked a series of pre-established questions, with pre-set response categories. There is little room for variation in response, though open-ended questions may sometimes be used” (p. 176). An unstructured interview is “the non-standardized, open-ended, in-depth interview, sometimes called ethnographic interview” (p. 178). Researchers select the interview type based on research purposes and questions because the type of interview selected influences the practical aspects of the interview, and how the process is managed.

The interview type used in this study was the semi-structured interview, which is more flexible than a structured interview, but with its development still under the researcher’s control. Therefore, interview questions were not preplanned and standardized, but instead there were general questions to establish rapport, get the interview going and keep it moving. Specific questions then emerged as the interview unfolded, and the wording of those questions depended upon the direction the interview
took (Punch, 2000). Although the researcher developed in advance a series of questions aimed at evoking a comprehensive account of the person’s experience of the phenomenon, these were varied, altered, or not used at all when the interviewee shared the full story of their experience in response to the main question (Moustakas, 1994). Therefore, the questions were only a guide to the interview.

Although the researcher conducted semi-structured interviews, she still prepared two interview protocols (Appendix D & E) to direct the discussion. The overall topic was divided into several related questions in a way that provided unity to the interview. According to Rubin and Rubin (1995), the main questions should cover the overall subject, flow from one to the next, and match the research design. “The wording of a main question should be open enough to encourage interviewees to express their own opinions and experiences, but narrow enough to keep interviewees from wandering too far from the subject at hand” (p. 146).

When responses lacked sufficient detail, depth, or clarity, the researcher probed to complete or clarify the answer or to request further examples and evidence (Rubin & Rubin, 1995). Probes signaled the interviewees that she wanted longer and more detailed answers, specific examples, or evidence. Probes encouraged the speaker to keep elaborating. Probes asked the interviewee to finish up the particular answer currently being given, and indicated that the researcher was paying attention. According to Rubin and Rubin (1995),

Main questions create a scaffolding for the interview, keep the questioning on the topic, and link what is asked in individual interviews to the overall design. Probes clarify and complete the answers, making them intelligible,
and signal the interviewees about the expected level of depth. They also show the interviewee that the interviewer is interested in the answers. The purpose of follow-up questions is to get the depth that is a hallmark of qualitative interviewing by pursuing themes that are discovered, elaborating the context of answers, and exploring the implications of what has been said. (pp. 150-151)

Based on the experiences of the pilot study that students began to assemble their electronic portfolios in their final quarter, there were two rounds of interviews during the spring quarter in this study. Before the first round interview, the researcher obtained permission to audiotape the interview with the participant. The researcher recorded all the interviews on cassette tapes because recordings would be the first-hand materials for transcription afterwards. All interviews took place in the Media Center because it was quiet there and easy to record. Each interview was about 30-40 minutes so that the researcher had an opportunity to get detailed information.

The first round interview. The first round interview was conducted during the fourth week in the spring quarter because at that time students had decided the classes they took and started working on their electronic portfolios. The purpose of this interview was to gather information about the students’ life history, their personalities and learning styles, previous experiences regarding the usage of technology along with their timeline for developing electronic portfolios, as well as their expectations on electronic portfolios. The data from these interviews were used to inform the researcher of students’ background, such as technology skills and experiences before they entered this program. From this interview, the researcher was able to plan the schedule of her further interviews
with each interviewee. Four participants who had declared their intention to graduate in spring were interviewed in the first round interview.

As shown in the pilot study, students made the decision of creating an electronic portfolio at the beginning of the program and started saving artifacts from the first course they took. The last quarter was the time they put these artifacts together under the relevant standard and designed the layout of their electronic portfolios although they had their own timelines in developing electronic portfolios. This first round interview revealed who was at what stage and whether it was possible for the researcher to observe their work in the computer lab.

The second round interview. The second round interview took place at the end of the spring quarter when students had presented their portfolios in the public showcase and the researcher had analyzed their electronic portfolios. The researcher analyzed each student’s electronic portfolio by looking at their reflections and the artifacts they selected for meeting the standards. Through analyzing students’ products according to the characteristics of constructivist learning theory, the researcher identified what made them an active and independent learner, and how reflection helped their thinking and learning. When she interviewed students after analyzing their products, she focused on the above characteristics in students’ experiences and tried to see if what she saw in the products was consistent with what they told her. She also added a few unique questions for different students. For example, Mary told the researcher in the first round interview that she did not want to see any samples before she finished her portfolio. The researcher prepared two extra questions especially for her.
Near the end of spring quarter, the researcher became aware that some students who were planning to graduate in the summer would present their electronic portfolios at the same time with these four students. On June 12th, there were nine students who presented their electronic portfolios. In order to get more information on students’ learning experience and learning processes, the researcher intended to expand her participant pool. After the showcase, she contacted another three students to get their permission for an interview. Thus, the researcher interviewed seven students in the second round of interviews. She combined both sets of interview protocols into one for those three extra participants (Appendix F).

The purpose of this round interview was to gather information about students’ experiences in creating electronic portfolios, such as: the learning processes they went through, how they reflected, the problems they encountered, and the procedures they used to deal with these problems. This interview allowed the researcher to probe deeply, to uncover new clues, to open up new dimensions of a problem and to secure vivid, accurate, inclusive accounts from informants that were based on personal experience (Holstein & Gubrium, 1995). The researcher chose this time to interview her participants because she felt that students would feel relaxed and comfortable with being interviewed after they finished all projects. As a result, the interviews were very productive.

All interviews were transcribed, analyzed and coded right after the interviews took place in order to form the next round interview questions as follow-ups for further clarification. Notes were taken and questions were either reworded, new questions added or taken out during the process. This allowed the researcher to revisit and clarify issues for data collection and analysis. The researcher had participants’ words in interviews
transcribed verbatim without editing for grammar or sentence structure in order to display their original ideas.

Observation

Observation is a very important way of collecting data by observing real activities, behaviors, actions, conversations, interpersonal interactions, and other aspect of observable human experience (Patton, 2002). Observation gives the researcher a chance to know what her subjects are doing. She can find out whether what the subjects do is the same as what they say they do.

Qualitative approaches to observation are not necessarily structured (Punch, 2000). In this study, the researcher did not use predetermined categories and classifications, but made observations in a more natural open-ended way. The observation is a means of familiarizing the researcher with the various activities that the participants are involved in and as potential means of establishing further leads to further sources of information (Punch, 2000). The data gained through the observations also serve as a ground for the formulation of interview questions. In other words, some of the questions she asked during the second round interview were based on information she gathered as she observed the participants. The researcher observed participants in two settings.

One setting was in the computer lab, where students worked on their electronic portfolios. In this setting, the researcher observed the activities and external experiences participants went through. She paid much attention to such things as: what learning procedures occurred, what kind of problems students encountered, and how they solved the problems. The researcher observed two participants because they were the only ones
who assembled their electronic portfolios in the lab. The other five participants finished their projects at home. The researcher observed Lucy three times, over 15 hours in total, while she collected and selected artifacts, converted different files, and designed the layout of her portfolio. She observed Jane twice, over 6 hours in total, when she was scanning her hard copies to make up for her missing files and when she converted her HyperStudio projects. The researcher took brief notes in observing, which were developed into fieldnotes afterwards, because as Patton (2002) said, the detailed descriptions of people’s activities, behaviors, actions, and the full range of interpersonal interactions and organizational processes that are part of observable human experiences are first-hand data.

Bogdan and Biklen (1998) described the participation/observation continuum. According to them, the appropriate level of participation and how to participate have to be calculated with the particulars of the study in mind. The researcher of this study was involved a lot in her participants’ work when she was conducting the participant observations in the computer lab. During the observations, the participants not only asked the researcher for various technical support but also asked her idea about choices of artifacts and other design issues because they regarded her as an expert in developing electronic portfolios. They often asked, “How do I convert this project? Do you think I can use more HyperStudio projects as artifacts?”… and the like. The researcher’s role in these observations was more like a knowledgeable peer, a source of immediate support, rather than a researcher. Both the participants and the researcher felt comfortable and natural in this relationship. This relationship served the purpose of promoting her
research goals. Thus, the participants she observed worked very naturally on their products, which was very important in qualitative study.

The second setting for observations was students’ electronic portfolio presentation showcase. The researcher observed the entire presentation showcase, video and audio taped the whole presentation, and kept brief notes at the same time. She focused on the participants’ explanation of what kind of artifacts they chose, how they selected their artifacts and why they thought they met the standards. Right after the showcase, the researcher converted the videotape into a QuickTime movie and burned it on CDs. Later, she had the audiotape transcribed and developed the notes into detailed field-notes. Along with the field notebook, the researcher also kept a reflective journal in which she recorded her own thoughts, feelings, ideas, and concerns that came up in the field (Bogdan & Biklen, 1998).

Document Analysis

The relevant documents, such as the Master’s Portfolio syllabus, the National Educational Technology Standards for Teachers (NETS·T), and students’ electronic portfolios on CDs, were collected and analyzed. Collecting data from multiple sources strengthens the veracity of the findings. Reviewing the syllabus and standards gave the researcher a clear idea about the project requirements. Analyzing students’ electronic portfolio CDs helped the researcher understand whether students learned in this process, whether the artifacts students selected were proper to meet the standards, whether their reflection did reflect their achievements and future goals or were just a description of what the artifacts were.
Based on Gatlin and Jacob’s *Scoring Guide for Portfolio Review* (Table 2) and Goldsby and Fazal’s *Rubric for Portfolio Web Page* (Table 3), the researcher created the following criteria for reviewing her participants’ electronic portfolios:

1. Whether the student summarized the artifact that documents the experience.
2. Whether the reflection clearly addressed the characteristic of the artifact and the purpose of choosing it.
3. Whether the reflection indicated how the artifact contributed to learning standards.
4. Whether students described how the artifact reflected their growth.
5. Whether the standards were thoroughly addressed by the artifacts.
6. Whether the future goals were clearly stated.
7. How effective the electronic portfolio design was in meeting the standards.

These criteria guided the researcher in analyzing students’ electronic portfolios.

In conclusion, data triangulation was accomplished by providing multiple data sources such as interviews, observations, and document analysis. Triangulation was used in this study for securing an in-depth understanding of the phenomenon in question (Denzin & Lincoln, 1994). Students’ interviews were combined with researcher observations of students’ developing their electronic portfolios to provide multiple means of assessing and describing students’ experiences. Analysis of documents and electronic portfolios provided additional data to support what was gained from interviews and observations.
Data Analysis

According to Patton (2002), the purpose of data analysis is to transfer the process of interviews, observations, documents, and fieldnotes into findings. In relation to qualitative research, Marshall and Rossman (1995) defined data analysis as the process of bringing order, structure, and meaning to the mass of collected data. They contend that qualitative data analysis is a search for general statements about relationships among categories of data. Data analysis procedures, which may be divided into the categories of “organizing the data, generating categories, themes and patterns, testing the emergent theory against the data … and writing the report” (p. 152), were adopted for this study.

Rubin and Rubin (1995) argued, “Social research is not about categorizing and classifying, but figuring out what events mean, how people adapt, and how they view what happened to them and around them” (p.34). Thus, the researcher used an interpretive approach to analyze the data. Concerning this approach, Rubin and Rubin (1995) explained that interpretive researchers seek thick and rich descriptions of the cultural and topical arenas they are studying and try to develop an empathetic understanding of the world of others.

The first stage of data analysis in this study was organizing the data. The researcher put together each participant’s reflections for each standard, interview transcription(s), presentation description, and researcher’s observation if applicable. As Glesne and Peshkin (1992) pointed out, data analysis in qualitative research involves organizing what the researcher has heard, seen, and read in order to make sense of what is learned.
The second stage of data analysis was generating categories, themes and patterns. The researcher read all the interview transcripts, description of observations, reflection of each participant, and viewed their electronic portfolios on CDs for the first time to get a general idea about the data. Then she read them for the second time to generate themes and patterns from each data segment. Wolcott (1994) stated that analysis addresses the identification of essential features and the systematic description of interrelationships (of the observations made by the researcher and reported to the researcher by others) among them, in short, how things work.

The next stage was testing the emergent theory against the data and themes that had emerged in the pilot study. The researcher read each participant’s data again to expand and modify the themes generated before; made a list of topics and subtopics merged from reading; and combined the topics with overlapping meanings. Punch (2000) indicated that this stage in the analysis is the most difficult to describe, because it typically involves a number of different analytical processes, which may be used simultaneously rather than sequentially, and which cut across and combine with each other. In other words, several things are going on at once. The aim of this stage is to integrate what has been done into a meaningful and coherent picture of the data.

The final stage was classifying the topics into major categories/themes that directly related to the purpose of the study and comparing with the themes resulting from pilot study. The results were then reported according to the identified themes.

Summary

In conclusion, this study was a case study that used constructivist learning theory as its theoretical framework, used phenomenology as its methodology, and used multiple
methods of data collection to obtain qualitative data about the students’ learning experiences in creating electronic portfolios. This study provided lengthy descriptions to illustrate the meaning students gave to the experiences of their electronic portfolio development, thus enabling readers to understand the learning processes that occur in assembling and creating electronic portfolios.

The data were collected through in-depth interviews, observations, and document analysis. Analysis and interpretation of the data were conducted through the methods of generating categories, themes, and patterns; giving interpretation and possible explanations, and searching for alternative explanations (Marshall & Rossman, 1995).
Chapter Four: Findings

Introduction

The purpose of this research study was to investigate and describe the learning processes that occur as Master of Education students assemble their electronic portfolios. The study sought to understand the experiences of students related to the development of their electronic portfolios, and how these experiences affected their learning.

The researcher describes in this chapter the learning experiences and learning processes in developing electronic portfolios and analyzes the meaning students gave to their experiences. The themes identified in the analysis of data were based on in-depth interviews, observations, and students’ written reflections.

The primary findings of the study are reported according to the following eight themes that emerged from the data analysis:

1. Participants
2. Reasons for choosing electronic portfolios
3. Learners’ role
4. Learning by doing
5. Learning from peers
6. Learning from reflection
7. Learning from synthesize
8. Problems encountered in developing electronic portfolios

First of all, the researcher will describe each participant’s life history in detail so that readers will get a whole picture of participants’ background. Secondly, the reasons why students chose to create electronic portfolios instead of writing a research paper will
be reported under the topics of: meaningful, creative and open-ended, showing growth over time, providing evidence of their technical skills, helping integrate technology into teaching, and easy to do in some aspects. This section would help the researcher to understand students’ learning experience in developing electronic portfolios. Thirdly, learners’ role will be reported according to the topics of: active and independent learners, motivated and creative learners, and lifelong learners. It is very important to study the learner’s role in developing electronic portfolios so as to understanding their learning processes and experiences.

Themes from 5 to 7 are the learning experiences and learning processes that occurred in developing electronic portfolios. Learning by doing includes the whole process from organizing files, selecting artifacts, converting artifacts, creating the final portfolios, to presenting in the public showcase. Learning from peers includes viewing peers’ samples and collaborating with peers. Learning from reflection includes what reflection meant to students, how students reflected, how reflection helped students’ thinking, how reflection helped students’ learning, how reflection helped students recognize the change in teaching, how reflection helped students see their growth over time, and how reflection helped students’ self-assessment. Learning from synthesis reported how synthesizing each part of the project together helped students’ learning. Finally, problems encountered in developing electronic portfolios will be reported.

Participants

The participants in this study were seven M.Ed. students in Instructional Technology in the Department of Educational Studies who finished their electronic portfolios in spring 2003. Four of the seven participants were full-time teachers while
studying in this program. The other three were full-time students. Background information about each participant follows in order to help readers understand their learning experiences. Pseudonyms have been used to protect the participants’ identities.

Table 5

*Participants’ Background Information*

<table>
<thead>
<tr>
<th>Name</th>
<th>Gender</th>
<th>Nationality</th>
<th>Teaching Ex</th>
<th>Job</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lucy</td>
<td>Female</td>
<td>Chinese</td>
<td>5 years</td>
<td>Full-time Students</td>
</tr>
<tr>
<td>Mary</td>
<td>Female</td>
<td>American</td>
<td>15 weeks</td>
<td>Full-time Students</td>
</tr>
<tr>
<td>Jane</td>
<td>Female</td>
<td>Honduran</td>
<td>7 years</td>
<td>Full-time Students</td>
</tr>
<tr>
<td>Tom</td>
<td>Male</td>
<td>American</td>
<td>25 years</td>
<td>Full-time HS Teacher</td>
</tr>
<tr>
<td>Rick</td>
<td>Male</td>
<td>American</td>
<td>6 years</td>
<td>Full-time HS Teacher</td>
</tr>
<tr>
<td>Beth</td>
<td>Female</td>
<td>American</td>
<td>9 years</td>
<td>Full-time MS Teacher</td>
</tr>
<tr>
<td>Cathy</td>
<td>Female</td>
<td>American</td>
<td>17 years</td>
<td>Full-time ES Teacher</td>
</tr>
</tbody>
</table>

Notes: HS refers to High Schools; MS refers to Middle School; and ES refers to Elementary School.

Lucy

Lucy was an English teacher at a college in a southern city of China, where she taught college students English for five years. She came to the United States in 2001 and studied in an English program for a year before she entered this program. She started this program in the summer of 2002 and finished it in five quarters. Her future goal is to earn a Ph.D. in Instructional Technology. Her hometown, Shenzhen, is in the mid-southern coastal line of Guangdong province. It adopts the Reform and Open Policy to the outside world. Instructional technology is a “hot” area in her hometown because there is a need
for Chinese schools to integrate technology into their curriculum. Lucy thought that gaining a degree in this area would entitle her to a higher position and provide her an opportunity to earn more money than before.

Before entering this program, Lucy had a little technology background. She used word processing, Excel, and simple PowerPoint presentations in her teaching. She seldom searched information online because there was no internet access in her office. During the past year of studying in this program, Lucy worked as a graduate assistant for six hours per week in the computer lab. She said that in this capacity she had many opportunities to deal with technical problems. In addition, she got chances to talk to her classmates about the software they learned in various courses, which helped her to practice what she had learned in class.

According to Lucy, although she is very competitive in technology-related classes, she is not very confident in expressing her ideas in front of others because English is her second language. She said that she had to devote more time and energy to her study because she was using a foreign language to learn new knowledge. Compared with the native speakers, she mentioned that she was not on the same starting line. However, she said that she learned a lot in this program and would start her doctoral program at the same college.

Mary

Mary has worked for the last five years to receive her bachelors and Master’s degrees from this university. She said that she was now anxious and full of ideas for her first year of teaching and was just interviewed for a teaching job in a nearby city. She
pursued a Master’s degree in Computer Education and Technology because she realized how important computers were in students' current lives. She wants to be an educator that helps to build students’ futures. She explained, “Technology is becoming an essential part of the society; therefore, I feel it is important to incorporate computers and technology into the students’ educational journey.”

According to Mary, she wanted to be an educator since she was a young girl because of her second-grade teacher who made her proud of learning. She had a five-week internship in an elementary school so that she experienced the importance of the position of a technology coordinator and the importance of incorporating the different software and the different programs into the math class. Her later 10 weeks’ teaching experience in Australia made her realize that she needed more training in technology to be beneficial to her students.

Before Mary entered this program, she had used Microsoft Office Suite in her undergraduate studies, such as Word, PowerPoint, and other applications that college students typically use. Mary mentioned that she was very confident with her skills in using most of the educational software at the end of this program.

Jane

Like Lucy, Jane is an international student but her English is very fluent and she likes to express her ideas in class. She received a Fulbright scholarship for her study in the U.S. so she can devote all of her time to study without worrying about the tuition and living expenses.
She had worked as a teacher of English at the university level in her country for seven years before she came here. Her university basically trains English teachers for secondary schools. As a teacher, Jane mentioned that she was interested in technology applied to language teaching. That was why she chose to earn her Master’s in Computer Education and Technology.

Before she entered the program, she had basic computer skills, such as word processing, downloading information from the web, saving files and things like that. In the past two years, she has not only taken all the required classes related to computer education and technology but even more because her scholarship required her to take 15 credits per quarter. She usually took four courses per quarter and that was more than 15 credits. Sometimes it was 16 or 17 credits, so she got a chance to take classes from the Linguistics Department and the Telecommunications Department. According to Jane, she has taken more classes than are required as far as the requirements of this program are concerned. Therefore, she said that she is very confident in technology now.

Tom

Tom is a full-time teacher at a high school while studying in this program. He has taught in the classroom for 25 years. He earned two Master’s degrees in the past three years. The first one was in Environmental Studies. This is his second one.

Tom began to use Blackboard and make digital photographs three years ago. It was the time he started his first Master’s degree in Environmental Studies. According to Tom, he took classes in education and technology during his first Master’s degree
because he found that it helped him to do what he wanted to do in his first Master’s degree.

Before he started the program, he had also used old Apple IIe computers and a spreadsheet to keep attendance. However, he seldom typed his papers because he typed very slowly, “much slower than other students,” as he said. Therefore, he said that he would rather hand write his papers.

Rick

Rick has taught history and social studies at a rural high school for six years. While studying in this program for the past two years, he has also been working full-time in his school. He has to drive 45 minutes one way to take classes and the same time to go back home. Rick mentioned that classes in this program were offered in the evenings so he could continue his teaching job. Rick got promoted as the chairperson of the history department in a different school district just before he graduated. He got married and his first child was born during the program. “A lot of things have occurred in this program,” in his words.

Before entering this program, Rick was using computers to allow his students to do research. He purchased things like School House Rock History Rock CDs and different pre-packaged software for his social studies class to use for information. There were three networked computers in his classroom so that he encouraged his students to search information on the internet but in a limited way. He said that the computer was really more of an electronic textbook in his class than it was a resource. So he wanted to earn his Master’s and wanted it to be something that has meaning to him — something
useful. Therefore, Rick chose this program because it exactly fit his needs. He said that it was something he could use in his classroom and something he was very interested in.

Through two years of study in this program, Rick mentioned that he integrated technology into his teaching much more than before. For example, he created a couple of WebQuests, put students in groups, and allowed his students to do the research like before, but “with a little twist to it.

Beth

Beth has been teaching 7th and 8th grade reading and language arts at a middle school since 1994. She also taught the talented and gifted students in grades 5-8 in reading and mathematics for one year.

Beth works full time while taking this program. She is a single mother who takes care of a nine-year-old son. She is involved with her local union at school as well as with the technology committee. She has been in this program for two years.

She said that she was competitive in studying and had a lot of self-discipline and self-motivation. She finished her electronic portfolio in April, two months before the deadline. Rick said, “She is our overachiever, and everybody tries to match her. She was my motivation on a lot of stuff.” Among her peers, she is an authority for the new technology.

According to Beth, she didn’t know much about computers before entering this program because her school is one of the poorest in the state. She said that their computers were very old and she could only do basic word processing. She even couldn’t make PowerPoint slides. She reported that now things had improved at school and she
had her own computer at home with all necessary software so that she could do almost everything on it.

*Cathy*

Cathy has been in the field of education since 1986, from a teacher's aide in an elementary school to a learning disabilities tutor. She began teaching sixth grade at a local school in 1991. In 1998, Cathy became a National Board Certified Teacher. She was one of the first 1800 teachers in the United States to achieve certification and the first in the local district. Now she is teaching science and language arts.

Cathy used technology in her room before entering this program. She had about five or six computers in her classroom. She served as the school’s building technology facilitator but she didn’t have any formal training. According to Cathy, part of her reason for coming into the program was to get some formal training so that she knew what she was doing with it. Cathy said that she used technology probably more than the average teacher, but she didn’t necessarily use it well.

Cathy started this program in 2000 but she did not take classes in the following year because she had to teach some classes at a university. She re-enrolled in the fall of 2002 and finished all the classes in one year while keeping a full-time job.

In conclusion, all students who chose the portfolio option had taken several classes related to technical skills before they assembled the final products, such as: website design, digital imaging, desktop publishing, multimedia software creation, and video and audio editing. At the time when they produced portfolios, they were familiar with most of the software used in portfolio creation, such as: FrontPage, Dreamweaver,
Photoshop, QuarkExpress, HyperStudio, KidPix, and iMovie. They were skillful in using Microsoft Office Suite and familiar with PDF. They all had experience in website design and video and audio editing. All the mentioned skills were useful in developing electronic portfolios.

**Reasons for Choosing Electronic Portfolios**

Beginning in the spring of 2002, Master of Education students majoring in Computer Education and Technology in the College of Education at a midwestern university were given the following options in completing their Master’s work: 1) assembling an electronic portfolio as their graduation assessment, or 2) writing a seminar research paper. Since that time, more and more students have chosen to create electronic portfolios as their final projects. In spring 2003, nine students presented their electronic portfolios in the public showcase at the end of the quarter. Among these nine students, seven of them participated in this research study. Exploring the reasons why students chose to create electronic portfolios helped the researcher understand their learning experiences. According to the data gathered through the interviews, there were many reasons why students chose to create an electronic portfolio rather than write a research paper.

**Meaningful**

Participants reported in the interviews that creating an electronic portfolio was much more meaningful than writing a research paper. They indicated that they started writing papers in middle school and continued through university. Most of the students said that writing a research paper required them to do a lot of research and helped them to
learn more about that topic, but once they finished a paper, their job was done. The paper was filed and they might not think about it any more if they did not continue their interest in that topic. Therefore, they thought that writing a paper was a kind of learning bounded within a period of time. In contrast, they reported that creating an electronic portfolio was life-long learning because developing portfolios was an on-going project. They had to keep working on it. The fact that “everything I learned I was able to apply” and “I was able to actually use what I learned” helped them to improve their portfolios as they collected new artifacts. As a result, they would set new learning goals based on the artifacts they added. This process not only gave them a chance to refresh their memory about the skills they had learned but also provided them with opportunities to learn new things. According to them, creating electronic portfolios was a very positive experience. Additionally, in talking about why developing a portfolio was more meaningful than a paper, Jane said,

It gives me opportunities to think of what I did. It helped me to really fix problems that I encountered. A thesis would not help me do that. If the research and data analysis is fine then the paper will be fine, but doing a portfolio is a different story. You have to really think of how you are going to solve a problem when you find it. You have to go back to your notes and books and you have to ask for help, or you have to go to your instructor and ask why it is not working. Those little things are the things that made the difference.

Jane’s words represented the majority of participants’ experiences in developing their electronic portfolios. They stated that it was a more effective way to show what they had
learned than a paper because creating portfolios caused them to think, to ask, and then to do.

*Creative and Open-ended*

Students said that electronic portfolios were not only effective but as an open-ended project, students could be more creative than writing a research paper. Every student wanted his/her electronic portfolio to be unique and different from others in some way. Each of them tried their best to apply what they had learned in classes to their portfolios. Some of them even taught themselves how to use new software to create more appealing features. For example, Beth taught herself how to use Microsoft Movie Maker to make a movie with the photos and images she saved to summarize her growth over time. Rick made a Flash movie as an introduction at the beginning of his portfolio. Viewing participants’ electronic portfolios, I could see how creative each student was. Each portfolio was very attractive in its own way. For example, one of Beth’s artifacts was her teaching video to show how she incorporated technology and traditional teaching in her classroom. She explained in the presentation that the original video of her teaching seemed “a little bit dull.” So she edited it and made it “a little bit more entertaining.”

In conclusion, creating electronic portfolios made students as creative as they could be and provided them opportunities to explore more features of the software than they knew in order to display a complete picture of their capability and knowledge.

*Showing Growth over Time*

All participants indicated that electronic portfolios showed their growth over time and gave readers a comprehensive picture of their capabilities. Rick mentioned to me that
he chose to do a portfolio because he wanted to show his audience, and more importantly himself, that he did learn something in this program because he could apply all the knowledge and put it together in an exciting way to present to his audience. Lucy said that her portfolio would help her future employer get to know more about her. Jane expressed her opinion in the interview,

Creating a portfolio can have a lot of benefits. It can show your work career purposes. It can show what you’ve done throughout the Master’s program; it can show your skills; it can show what your progress is; it can be a way to train other people through your portfolio. It can be a way to devise or use it as a sample or as a model for learning activities. It has a lot of applications.

In various ways, the other participants expressed the same idea as Jane’s in how an electronic portfolio showed their growth over time.

Providing Evidence of Their Technical Skills

Participants reported that portfolios not only documented their growth over time but also provided evidence of their technical skills. As Rick indicated in the interview, “Using the portfolio, I’m applying the techniques and the things they taught me in this program.” Tom added to this point, “The nice thing about the electronic portfolio is the accumulation of the learning you had. It is an opportunity to showcase how you have progressed through that learning.” Most students included their multimedia projects, such as the projects designed in Authorware, JavaScript, HyperStudio, KidPix, QuarkExpress, PowerPoint, Morph, iMovie, and the like.
The majority of students not only included the multimedia projects in their portfolios but also applied the skills they gained in each class to their portfolio design. For example, Lucy designed her cover page image in Photoshop and inserted in FrontPage; Beth designed her cover page in PhotoShop and converted to PDF. In addition, Beth’s summary was created in Windows Movie Maker and Rick’s introduction was made in Flash movie.

*Helping Integrate Technology into Teaching*

Seeing their portfolios, you would not only find the evidence of their capabilities in using technology but also their understanding of teaching and learning theories, as well as how to integrate technology into their teaching so as to create a constructivist learning environment. As six out of seven participants in this study were teachers, the majority of projects they had designed for each class were related to their teaching areas such as the following examples from their artifacts: the products Jane designed in different classes with different software were all related to teaching English as a second language; Tom’s artifacts were all related to environmental education; and Cathy’s projects were about language arts and science teaching. They designed projects that could be used directly in their teaching. In fact, the four full-time teachers, Beth, Cathy, Tom, and Rick, reported that they did use the projects they designed in this program in their current teaching with good results.

Tom reported that a computer lab he designed for one of the classes was used in his school. He purchased the hardware and software for that lab. He actually used the technology he learned from this program directly into his teaching. As he wrote in his
reflection, “It is not just on the paper, it actually is a working model.” Similarly, the majority of the participants felt that they were technologically literate enough to be able to instruct others in current technology. Additionally, they were confident in having enough knowledge to provide technology-rich lessons to their students that would increase their knowledge and enhance their learning.

*Easy to Conduct in Some Aspects*

At least two students reported that they chose to create an electronic portfolio because they perceived it as much easier to create a portfolio than to write a research paper. Tom complained how hard it was for him to finish his thesis for his first Master’s degree. As a full-time teacher, he had to spend most of his spare time searching for a topic and the materials to get started and then spent a lot more time to finish it. He said creating an electronic portfolio was much easier because he had all artifacts saved on Zip disks throughout the whole program. His purpose was clearly identified, to match the standards with these artifacts. He said,

All I have to do is show that I can meet those standards with what I’ve learned so far… Electronic portfolio will not be near as difficult. I have a stack of CDs about that tall. Zip drives about that tall. I have lots and lots of information collected. What I need is to select the proper artifacts to match the six standards. It will be much easier than my thesis.

In the second interview, Tom told me that he worked on his project about two to three hours every day for “a solid month and a half” and sometimes “got stuck” in the
process. In fact, creating an electronic portfolio was not as easy as he expected. But “it still ended up being an enjoyable experience.”

As an international student, Lucy thought an electronic portfolio could provide her an opportunity to demonstrate her strengths in technology skills, especially her design talents, and avoid her weak points in language application. Thus, she thought creating an electronic portfolio would be much easier for her than writing a research paper.

In conclusion, students preferred creating an electronic portfolio to writing a research paper because: 1) creating an electronic portfolio was more meaningful for them than writing a paper; 2) creating electronic portfolios was an open-ended project so that it allowed students to be more creative than writing a paper; 3) an electronic portfolio could show a student’s growth over time and give the audience a comprehensive picture of the student’s capabilities; 4) electronic portfolios provided evidence to their technical skills and helped students to integrate technology into their classroom; and 5) creating portfolios was easier than writing a paper in some aspects.

Learner’s Role

“We cannot judge what people are learning until we truly understand who the students are and the experiences they bring to learning” (Rice, 1996, p. 11). It is very important to study the learner’s role in developing electronic portfolios so as to understanding their learning processes and experiences. Students reported that their role as a learner changed to be more active, more independent, and more motivated in creating electronic portfolios and they became a lifelong learner.
Active and Independent Learners

According to Simons (1997), active learners are engaged and involved in instructional content and learning processes such as thinking, questioning, reflection, and exploration. My data analysis indicated that students played a very active and independent role in developing electronic portfolios.

First of all, it was the students who decided to create an electronic portfolio or to write a research paper. Students reported that they only got a list of the standards and a syllabus with a list of the things they should include. As Mary described the syllabus, “I didn’t really view it as a checklist, but more as guidelines.” Therefore, students had freedom to create an electronic portfolio according to their own understanding and designed the portfolio according to their own styles. Mary expressed her idea on this issue, which was very typical among the participants. She said, “I think they [faculty] wanted us to have very few guidelines and see what we would do with it.”

As a result, students had to think about the procedure they would go through and plan their timeline to make sure that they could finish the final portfolios in time. It was the students who decided what kind of artifacts to select and how to display them in their portfolios. They had to think why and how the artifacts they chose met the requirements of the standards and wrote the reflections for each standard. When converting artifacts and designing their portfolios, they decided how to solve the technical problems they met: to explore the solution by themselves, to ask for help from peers, or to consult their teachers.

Jane indicated in the interview that she became “a more active learner from a more passive learner.” Creating the electronic portfolio forced her to make decisions by
herself, such as what artifacts to choose and how to design the layout of her final portfolio. She told me, “I designed the homepage that I thought was going to be the final portfolio, but I changed it. My initial portfolio was not the final one.” She mentioned that she had to question herself why certain steps in her project just did not work as she expected, she had to explore the solution to the problems she encountered. She said, “It is really hard to reason and to think about learning. I think I have become more aware of the importance of being an active learner, and the importance of encouraging active thinking in the classroom, and problem solving.”

It was the students’ choice about whether to discuss with peers about the ideas and technical problems, whether to view some samples to help them clear up their own ideas and make plans. Students reported that developing electronic portfolios not only encouraged their own interests and their desire to learn but also enabled them to take responsibility for their own learning. As Mary commented in the first interview that in developing electronic portfolio, students were on their own. She said, “I was on my own. It was me and my computer and that was it.” Students had to set their own timeline and they had to set their own due dates.

Beth described her role in learning as an independent learner because she liked to “work at my own pace” and “learn on my own just for the sake of learning.” When I asked her what was the best way to support her learning in developing electronic portfolios, she answered,

I think the best way to support it is it teaches you the skills you need, but gives you enough independence that you can go off on your own. I think this program did a good job. They taught what they needed to teach and then said,
“You need to do this.” And they were available to help if you wanted, but if not, they did not stand over your shoulder and say, “Let me see what you have done.” They kind of let you go.

She mentioned that she had a lot of freedom in creating her portfolio which gave her a chance to learn new skills in applying her knowledge to practice. Nearly all participants indicated that they were very active and independent in creating electronic portfolios. Although they viewed samples and collaborated with peers, they had to individually make decisions on what to do at each stage of developing their portfolios, such as what artifacts to choose and what format to use.

Motivated and Creative Learners

Students mentioned that developing portfolios created the opportunities and experiences which encouraged their motivation, curiosity, and creativity so as to foster learning. Because of the freedom they had in developing electronic portfolios, most of participants indicated that they were not afraid of trying new things. Beth mentioned in the interview that she might not have learned how to use Windows Movie Maker if she didn’t create electronic portfolio. She also mentioned that she was competitive. She said, “If it was just me doing it myself, I wouldn’t do as good a job. I need a little competition.” Motivated by her competition and the desire of creating an appealing portfolio, Beth taught herself a few other software during developing her portfolio. She said, “I like to learn different things. I didn’t take the last class where you learned Dreamweaver and Flash. I am trying to teach myself that right now.” She indicated that she became curious and creative in developing her portfolio.
Students reported that they wanted to create a portfolio which would provide a comprehensive picture of their achievements in this program so that it could become a tool for them to market themselves to potential employers after graduation. The motivation made them to be creative in creating their electronic portfolios. They used every means they learned from class or by themselves to make their portfolios attractive.

Students were motivated to learn because the learning activities involved in creating electronic portfolios were meaningful and the knowledge was useful. In addition, electronic portfolios provided a means of achieving their desired goals. Such learning activities also provided a stimulus to reflective inquiry and continuing intellectual development of students. Tom indicated that he became a motivated learner because he had gained a lot of knowledge of how to use different varieties of technologies — software, hardware programs so that he could not only install hardware but install many programs for his school and use them in teaching. Beth finished her portfolio in April, two months ahead of due date. She said in the interview, “I like to get everything done. I think you have to have the discipline to get it done. Otherwise you are too stressed-out.” Her words expressed other students’ ideas that they needed a lot of self-discipline and self-motivation in doing this project.

*Lifelong Learners*

Participants indicated in interviews that learning in creating electronic portfolios became an ongoing, lifelong process of education that stimulated greater thoughtfulness and reflection and promoted the continuing growth of students' capabilities and powers. Beth mentioned that she had learned many meaningful things from this process. She said,
“They are things I use with my students, things I use at home, and things I wouldn’t have learned had I not done this. I think it was a wonderful experience.” Although she could use her projects with her students and at home now, projects she created in a lower version of the software might have problems displaying in the newer version of the same software in the future as technology improves quickly every day. Only if she kept an open mind to the new features and new technologies, could she keep pace with the development of knowledge, especially technologies.

Using the learning experience in creating portfolio, Tom felt that it helped him to learn some very solid foundations for what he currently knew. As technology is constantly changing, he is hoping that the learning curve is getting less steep. Tom said,

With a good foundation in technology now, we will be able to pick up new technology much faster. That’s what I hope to take to my students. I don’t expect to be able to keep up with the ever changing technology, but I do expect to be able to adapt to it when it comes out.

Students indicated that they couldn’t learn everything in one class and the professor couldn’t teach them everything in one class, but the most important thing learned from this experience was that they had learned how to solve a problem, how to learn new things based on what they had learned from this program. That made it easier for them to gain new knowledge in lifelong learning. Cathy described her experience in her reflection,

I did not take the Photoshop class, but through the use of other technologies, I am now able to go in and do some basic work in the program. Many of the software programs that we used over the course of the degree program have
some similar capabilities. I was able to transfer some of that knowledge to learn a new skill.

Similarly, Jane described her opinion on how technology made her a lifelong learner, which was representative of other students’ perspectives on technology and how it helped them continue to learn. She said,

In my case, technology is not my strength, but it’s something (pause) that this Master’s program has helped me look at technology as a friendly tool. Sometimes I can be a little bit scared of some technology tools, but at the same time, it’s helped me be more open-minded towards technology and see technology as a learning tool and a teaching tool. And also, I like it. And I think it’s a way to keep learning about it, so I’m gonna be, even if I’m not studying, I’m going to continue learning.

Learning by Doing

Either in interviewing each participant or observing them in the computer lab or their presentation showcase, the term I heard most was “learning by doing.” This study showed that those students who chose electronic portfolios considered themselves as hands-on learners. They all volunteered that they like learning by doing because hands-on activities helped them learn best by trying to make sense of something on their own. For these students, to truly understand how to do something was to do it. Beth’s opening remarks in her presentation expressed her belief in learning by doing. She said,

I would like to start with a quote from Mark Twain, who once said, “A man who holds a cat by its tail can learn something that he can learn no other way.” Now, we can assume the guy holding the cat by the tail didn’t have a
very good learning experience. However, he learned by doing, and he learned
by experience – which are the most powerful ways to learn anything.

Beth’s experiences provided evidence of her learning by doing and learning by
experience in this process. For instance, Beth played a very attractive movie in her
presentation to show her progress in this program. This movie was made in Windows
Movie Maker which she taught herself through trial and error. When I asked her about
this learning process, she said,

I think a lot of trial and error — learning through mistakes, learning through
others’ mistakes. I don’t use textbooks a lot. I just do it. I just play with it,
make some mistakes, and learn in the process. It’s longer to learn it that
way.

Although it took Beth a long time to make the movie work as she expected, she said she
could remember the skills clearly and would not “make the same mistake twice.” In
addition, she learned many skills from trial and error and applied these skills in her
portfolio. A couple of other participants described similar experiences of learning by
doing. Rick said, “Whenever they [instructors] allowed me to go out and experience it,
that’s when I learned and really understood what was going on.” One student stated that
he “definitely learn more by having the objects in front of me and working with different
manipulatives.” Tom described how he learned best,

If I can sit down with somebody around and I can start moving through the
technology and get as far as I can with what I can remember, then if I get
stuck, if somebody’s right there I can ask them important questions and that’ll
usually move me beyond the mistake stage. One of the things I’ve found
extremely helpful is to use the help menus because they actually let you search for exactly the question you have. That was one thing I had to get over and that was a helpful thing, but the learning by hands-on is probably my best [strategy].

As described by Tom, although students learned in different ways, learning by doing was the best way. Through analyzing data collected through interviews and observations, it was clear that hands-on activities were important in learning for students in the technology program. Students understood and remembered what they learned through applying it in a project. Although instructors gave all the necessary instruction, it still didn’t make much sense until they actually did it in a real project. The majority of students reported experiences that when a teacher taught a new feature of the software, it seemed that they understood it, but once they applied this feature in a real project, they would come across many problems. Sometimes it worked fine for one student but just didn’t work for another student. Only practice and practice again helped students become familiar with details of the applications they had learned.

Learning by doing was one of the most important learning strategies students used in creating electronic portfolios. Based on the data analysis, learning by doing in this study covers learning from experiences, learning from mistakes, and learning from trial and error because these learning strategies connected very closely and overlapped with each other so that it was very hard for the researcher to separate them clearly. Therefore, the researcher will put them in one category of learning by doing. The findings will be reported according to their learning process in organizing files, selecting artifacts, converting artifacts, designing the final products, and presenting in the public showcase.
Organizing Files

This study showed that the first thing students learned in creating electronic portfolios was to be organized. Nearly all participants mentioned that they had to start organizing files from the very beginning of the program; otherwise, it could be really messy and frustrating because they had a lot of files from each course they took. If these files were on different disks or they were disorganized, it could be really time consuming to organize those files later. Observing Lucy when she selected her artifacts provided evidence of what other students described in interviews.

It was 10:20 pm when Lucy finished her class and came to the lab to start her work on selecting artifacts. She didn’t show any sign of tiredness but she was very hungry because her class was from 6 pm – 10 pm and she came to school in the early afternoon. This was the only time she had time to have her dinner, which was just some Chinese snack. While eating, Lucy started to take out her Zip disks, CDs, and floppy disks. There were about ten Zip disks, which were used for her original class assignments. Her CDs were kept in a black CD bag. She told me that she burned her assignments to CDs in order to keep them safer. There was also a red box, which was a floppy disks case. Immediately, the table was covered by her Zip disks, CDs, and floppy disks beside the computer. All Zip disks and floppy disks were labeled with course number, such as EDCT 501, EDCT 602, etc. Lucy inserted one of her Zip disks into the computer and opened a file, which was an outline she made for the content of her electronic portfolio. She selected her artifacts according to this outline.

The first artifact she selected was a personal website. When she opened the index page, she found that some links did not work. "I didn’t know that all related [linked] files
should be in the same folder at that time [when she took that class] so that some links won’t work now. This is my first homepage. How simple it is!” She laughed at her first design when she had problems finding the files. As she had many versions for her first website, she had to check all folders before she found the right one. “If I knew the organization of files is so important at the first class I took, I would not have so many problems in finding the right folder and links.” She complained while she continued clicking. After quite a while, she found the right version and dragged that folder to the desktop.

She took this class last summer and hardly remembered the versions she saved. “I have many versions because I was afraid of losing my files. You know it is very easy to lose your files. I had two Zip disks damaged when I was revising my projects. I lost all the files on those Zip disks. From then on, I kept saving my files on different Zip disks and burn them on CDs once I finished that course.” She explained to me when she took out one zip and inserted another one.

It was true that having several different versions for each file would make it safer. But it was hard for her to recognize which was the one she needed because she didn’t label them very clearly. It took her a long time to find the right file. Sometimes, she had to open and close different folders and files four or five times before she could get what she needed.

Similar to Lucy, other students also mentioned that they were not trained to organize their files at the start so that they had to learn it from a very painful experience. Students indicated that collecting artifacts was not a problem for them. However, how to organize these files was a problem for a couple of them at first. Their files were scattered
on different floppies or Zip disks without clear labels on them. It cost time for them to select artifacts from all these files. The worst thing was that if the floppy disk or Zip disk was damaged or their home computer crashed and all files on them would be lost. Beth said that she lost her HyperStudio and other projects because her home computer crashed and she had no way to recover her projects. Almost every student had the experience of losing files because of their floppy disks or Zip disks becoming damaged. After going through these experiences, students learned how important it was to organize files and burned them on CDs. Jane mentioned the importance of organizing files in the second interview,

> If we put files in specific folders and label those folders and burning CDs from the very beginning, and working in the right platform without switching from Mac to PC that would help a lot. That is something very basic and simple, but it gives us so many problems when we start the program. We are not trained in organization. You are thrown into the classes and you start organizing your files and sometimes you have to learn the hard way. When we started losing files, and damaging files, it makes it harder. The files are the base for the portfolio and they must be organized.

*Selecting Artifacts*

Participants reported that it took them considerable time to select suitable artifacts for each standard. They had even more trouble if they lost the most suitable file. To replace the lost electronic files or projects, a couple of students scanned their hard copies if they had one or used other files as substitutes. Jane was one of the students who
scanned their hard copies to replace the damaged electronic files. She explained that the hard copy was even better than the electronic file because hard copies had the instructor’s evaluation on them. I observed Jane when she was scanning her papers. This was the first time I got a chance to observe Jane because she worked mostly at home. I was very glad that I had this opportunity because this would give me an idea about how other students created their electronic portfolios besides Lucy.

The paper she was scanning had 28 pages. Jane started to scan her paper and saved it as GIF one by one in a folder. She was planning to insert these GIF files in a word file and then converted the word file into a PDF file. I suggested to her to save her scanning directly as a PDF file because it would save her time. She wanted to save some time in scanning but she was not sure about the result in PDF. So she scanned only one page and saved it as a PDF file and then compared it with the GIF file, we found that her PDF file was 1.2 MB and her GIF file was 110 K. There must be something wrong because PDF file size should not be so big. When we checked her scanning procedure, we found that there were multiple choices for scan types. The default type for PDF was bitmap, which made the file size very big. After she changed the scan type to Text and Image, not only the file size became much smaller but the page quality was better.

After comparing the different results between GIF and PDF, Jane decided to scan her paper directly to PDF format. Scanning the file directly to PDF format would also save her time because she could scan all pages of one document in one file. In contrast, she had to save each page as an individual file in GIF format. She was very glad to find an easy way to finish her scanning. At last, she scanned over a hundred pages including her course syllabi. She saved them all in one file.
Jane saved a lot of time by scanning all documents in one file but she had to spend time in separating these documents. Only then, she realized that it would have been better if she had saved each document as an individual file.

There was another episode during her scanning which reflected how she learned from doing. It happened when she finished scanning her first research paper about 28 pages. She stopped scanning and opened the file in PDF to check the result. All pages were very clear. She was satisfied with the result and continued to scan other papers and syllabi. About half an hour later, she checked the result again and found that they were not as clear as the earlier ones. She was so confused with the result because she did exactly the same as she did before but the result was different. In order to find out what caused this problem, she scanned another page and checked every step carefully. Then she found that the scan type changed to True Color automatically when she selected the scan area. Once she changed it back to Text and Image, she got the desired result. Looking back, she found that the last 35 pages were not as clear as the first 28 pages.

This was a painful lesson she learned: you had to check every detail before taking the second step in technology. If you missed a single detail or step, the result would change and it would give you trouble to fix it. It was really frustrating. All participants mentioned this kind of lesson they “learned by doing” in interviews. This kind of mistake was very common in web design and file conversion. Later in the second round interview, we talked about what she learned from this experience and Jane said,

We had to get used to those things and be relaxed about things that don’t work and we can’t change them. At the beginning I would panic when things didn’t work, but then I learned to relax. If there is a problem that we can’t
solve, we have to learn to relax about that. Portfolio learners have to learn to reduce anxiety as much as possible. … Another thing I learned is that when we save a file in a particular software application we have to make sure that we give the right extension. Otherwise, when we try to work with that application in a different platform it doesn’t work. Sometimes working on older versions can give you a problem when trying to open them in a newer version.

In order to save time, some students just used other projects or papers as substitutes if they found that they would spend a lot of time on re-doing an artifact. Cathy told me, “I did lose things. But I chose something else. We did so many things. The requirement was three or four [artifacts] for each standard so you couldn’t put everything in.”

**Converting Artifacts**

Compared with converting projects into compatible formats, what Jane experienced in scanning was really a piece of cake because it would cost her more time and energy to make things work as desired. As she mentioned later,

Another thing I learned is that we have to be knowledgeable of the different software we use. If you are going to use HyperStudio, then you have to remember how to save HyperStudio. Sometimes if you have to save HyperStudio in Mac, you have to use a certain number of characters — 8 characters at the most — and you have to include the extension STK so you will be able to read them in PC. It can get really messy if you save them incorrectly and try to open them in PC.
The second time when I observed her in the computer lab, she was converting her HyperStudio projects to EXE files. It was another example of learning by doing because she had not done this before.

Normally, students should include a HyperStudio player on their CDs within the folder so that their HyperStudio project would be displayed on the computer without HyperStudio software. However, this procedure was not always reliable. Sometimes, it just didn’t work. The alternative way was to convert it into an EXE file. An EXE file could be displayed on any PC with a QuickTime player.

Jane designed her HyperStudio projects on Mac so she started to convert her projects on Mac. However, she couldn’t find the function of Save As EXE on Mac because the Mac does not use EXE files. So she took her Zip disks to PC and converted them there. It was very easy for her to save these files to EXE format on PC. When she checked her projects in EXE format, all projects worked perfectly except one, which included a Morph movie that did not show. She tried it again and again, but the movie still refused to display. She changed to another computer and converted it for a second time. She got the same result. By looking back at the procedure she went through, she found that there was no extension at the end of her movie. This was because PC would automatically add an extension to the end of the file name but with Mac the author had to add an extension by themselves. So she went back to Mac, opened her original file and added the extension of MOV to her movie file. She copied this new file back to PC and checked her HyperStudio file to make sure everything worked fine. Then, she saved this new file as an EXE file. She checked it again and got the desired result: everything worked fine including her movie.
She was so glad that she wanted to try it on another computer which didn’t have HyperStudio. She opened her EXE file on this computer, she was asked to install QuickTime player. She installed QuickTime player on that computer and tried it again. Everything worked fine but her Morph movie refused to show. She took a deep breath to express her feeling of powerlessness and went back to the first PC she used to convert her files. She opened her file and clicked the movie link, to our surprise, it didn’t work any more. There appeared to be no reason for this. But it just didn’t work.

Jane discussed her problem with Lucy. Lucy showed Jane how she converted her projects, which was exactly the same as Jane did. Lucy’s project including her Morph movie worked perfectly on any computers. Lucy even converted Jane’s project to make sure that every step was correct. But the movie still didn’t show. At last, they gave up because they thought that the only factor that made the difference was that Jane designed her projects in a lower version of HyperStudio. Jane took this class a year earlier than Lucy. So she couldn’t get the desired result as Lucy’s. As a result, Jane downloaded a PC HyperStudio player and included it on her CD. It worked on the PC with HyperStudio software. It took her about three hours to achieve this result.

Jane was not the only person who came across this problem. The majority of students described similar problems in converting different projects, such as projects made in Authorware, KidPix, PowerPoint, QuarkExpress, and Photoshop. However, they learned what worked and what did not in solving these problems. They regarded these experiences as one of the benefits of creating electronic portfolios because they synthesized their technology skills through solving various problems. They learned more in this process than in class because they had to apply what they learned in class to their
final portfolios. For example, most students designed their portfolios either in FrontPage or in Dreamweaver. They mentioned what they learned in class might not be so practical in creating electronic portfolios so they had to figure it out from doing it. As Jane described in the second interview,

The tips I learned in Dreamweaver were not exactly tips for web design.

Basically we used Dreamweaver as a medium to show other applications, like animation grammar [a project she designed for teaching grammar], JavaScript, Flash, and other things. I didn’t really learn tips for web design specifically. Web authoring this quarter helped me learn some tips I could use for my portfolio. Then I used some other things like roll-over images and hide-and-show-laters and things like that in developing my portfolio.

Creating electronic portfolios helped students to learn many little details in design. Observing Lucy when she converted her projects provided evidence for what Jane and other students told me in their interviews. One basic skill that was common knowledge for one student might not be common knowledge for another student.

When I observed Lucy as she selected artifacts according to each standard in the lab, I saw how she dragged the folder, with all artifacts she selected in it, to the trash can after she burned it on a CD so that nobody could access it later. To my surprise, instead of emptying the trash can, she double clicked the trash can to open it, selected one of the folders in the trash can, right clicked the mouse, and hit delete. She was deleting the files and folders in the trash can! “Why don’t you just empty the trash can? That will be much easier,” I said to her. “How?” she asked. I told her instead of double clicking the trash can to open it, she could right click the trash can and select empty trash can. She followed my
instruction and emptied the trash can in a second. “Waaa… I didn’t know that. Nobody told me this function before. Thank you, thank you.” She was patting my shoulder and kept thanking me. She was very excited to learn a new feature.

Emptying trash can is a very basic skill but she didn’t know how to do. However, she knew very complicated applications and created very attractive multimedia projects. From this we can see that everybody has something to learn however familiar she/he is with the computer.

From what I have observed and from what they described in interviews, creating electronic portfolios helped students to practice what they had learned in class, especially to synthesize the skills they had learned from different courses, and it motivated them to learn new applications. Another outcome was that they learned how to learn in developing electronic portfolios.

**Designing the Final Portfolios**

Students mentioned in interviews and in presentations that they learned a lot by creating the final product. After collecting, selecting artifacts, and reflecting on how these artifacts met the standards, students had to design their final electronic portfolios. The layout of their electronic portfolios depended on how much time they were willing to spend. If they wanted to design an appealing and sophisticated portfolio with many multimedia artifacts, they had to spend a lot of time and energy in it. They might even have to learn new software or the advanced features of the software they used. There were many examples described in the previous sections and in the following section. However, if the students were not willing to take extra trouble and spend extra time on it,
they could use the basic feature of the software they were familiar with to design a simple and plain portfolio with more paper artifacts than multimedia projects and convert everything into PDF files. Whatever portfolios they designed, they gained some kind of knowledge respectively. It is obvious that those who were willing to spend more time on it would gain more knowledge in this process.

Through learning by doing and learning by mistakes, some students taught themselves new software in order to make their portfolios more attractive and more meaningful in displaying their technology skills and capabilities. Beth taught herself Dreamweaver and Windows Movie Maker in this process. She told me her experience in the interview. She said,

I learned on my own. When I first made it I did not realize you couldn’t convert Windows Movie Maker to QuickTime or anything else. If you don’t have WMM you can’t see it, which I didn’t like. I would have rather done it in QuickTime probably. I would have done it in iMovie if I had to do it again. But I was already done before I realized that…. I’ve learned so much.

In explaining how creating portfolio helped his learning, Tom mentioned that he borrowed a book to review what he had learned in class when creating his portfolio. For instance, when using Adobe Photoshop, he had to go back and “learn things again.” Even though he had the class before, he had to go back and learn how to put it into his portfolio. He told me in the second round interview that he actually would call the Adobe Company and ask them for advice. From this process, Tom got to know more features of the software applications. Later, he told me what he learned in another experience, “Once you create an Adobe PDF and you have web links in PDF, they don’t work. You can’t
Different from them, Mary used more papers than multimedia projects in her electronic portfolio. According to Mary, her papers fit the standards more than her multimedia projects. Mary designed her portfolio in FrontPage. But she converted all of her artifacts into PDF format, including her word files, PowerPoint files, and Photoshop designs. Compared with other portfolios, hers was relatively simple and plain. But she said that she learned a lot of technical skills in designing her final project. In the second round interview, as we discussed this, Mary said, “I took more time to develop those [papers] for a classroom setting. I felt they reflected more of what I could do with the technology in relation to the classroom.”

Presenting in the Public Showcase

A couple of participants told me that technology, sometimes, was just out of control whatever you did to try to control it. During the presentation showcase, a couple of participants experienced problems in correctly showing their products. For instance, there were broken links or the movie would not to open. Although they checked their projects before the presentation, they still encountered unexpected problems. The most common problem was the long downloading time.

Just take a few examples from students’ presentation: Lucy had trouble in opening her HyperStudio project. Although the file was converted to an EXE format and worked perfectly on all other computers, it was very slow in opening. Because she was very proud of her skills in design, she was very eager to show her project. However, she had to
give up but the file opened right at the time when she closed that window. So she had to
open it again. This problem made her very nervous in the later presentation. Cathy had
the worst experience in presentation showcase because all of her links were broken and
the appearance of her pages changed. She closed the program and started it again, and it
didn’t work. Her advisor helped her to find the right file from her CD. It seemed to work
fine at first but failed right after she clicked the first link. She changed to another CD but
it was useless. At last, she followed her peer’s suggestion and dragged the whole folder to
the hard drive and opened the page from the hard drive instead of her CD. It worked at
last. It took her about five minutes to get things ready. In the interview, she said it was
really embarrassing “but it was memorable.” As an experienced teacher, Cathy set a good
example for her classmates in dealing with this kind of situation: she was humorous and
made people laugh. She calmly started introducing herself while working on her problem.
In the interview, she told me, “There was nothing to do but laugh or cry. I chose to laugh.
It [portfolio] worked on every other computer but the one we used.”

Through creating and presenting their electronic portfolios, all participants
realized that “anytime you bring a non-human factor into a process, such as computers,
you are going to have problems.” It was just all the tiny things that cost you a lot of
trouble. For participants, the only disadvantage of creating electronic portfolios was the
fact that “there is so much more that can go wrong.” Rick mentioned this in the
interview, “There are so many pieces of it, and trying to get all of those pieces to come
together to form a uniform thing is a difficult thing sometimes.” Cathy’s experience in
presentation was a good lesson for other students. Mary expressed her feeling about it,
“I’m glad that I finished it two weeks before. If I did run into major problems it was OK and I wasn’t going to go into a deep panic because I still have time.”

In conclusion, participants learned differently from different stages of developing electronic portfolios. Whether their final products were simple or sophisticated in design, they had learned something from the process.

Learning from Peers

The next main learning strategy students used most was learning from communication, interaction, and collaboration with peers, which included discussing design ideas and solutions to technical problems with peers, attending electronic portfolio presentation showcases in previous quarters, and viewing former students’ products. The findings in this section are organized in two categories: learning from viewing peers’ samples and learning from collaborating with peers. Viewing peers’ samples occurred at the orientation meeting at the beginning of each school year, at the students’ presentation showcase, and by borrowing students’ electronic portfolio CDs. In these instances, students learned by interacting with the products rather than interacting with a person. Collaborating with peers refers to the communication and interaction among the students. This section discusses students’ experiences and attitudes on viewing samples and collaborating with peers, and how these two strategies helped them to learn in developing electronic portfolios.

Viewing Peers’ Samples

At the beginning of each school year, there was an orientation meeting for new students. The program faculty explained to the students that they had the choice of
creating an electronic portfolio as a culminating project. They distributed the syllabus and explained its requirements. They demonstrated some samples from former graduates. Although students had a syllabus with all the detailed requirements on it, getting started was still very hard for nearly all of them. As one student said, “I didn’t know what I wanted it to look like.” Nearly all participants wanted to seek samples to get more ideas about what their portfolios could look like. They also talked to their classmates, their professors, and the students who had created electronic portfolios. Cathy mentioned in the interview that she encountered various difficulties in each stage of creating electronic portfolios, but getting started was the hardest time for her. She said,

Getting started was very hard for me because I did not know what I wanted it to look like. Working through the design was hard in its own way and then trying to figure out what matched the standards was hard in a different way. They were both almost equally difficult to get started. Once I got started, things went smoothly. It was just that initial getting started. …Getting started and figuring out how to begin was my biggest challenge. I spent a lot of time thinking about it without doing any work.

Cathy indicated that talking to her peers and seeing samples helped her get through this initial barrier. A couple of students indicated that they needed more information because the samples shown on the orientation meeting were displayed very briefly. Lucy explained, “If I just depend on that orientation, I cannot finish my own portfolio because I need more information about the standards and about how to match.” Although students had the syllabus, they still felt not sure what was expected and how to do it. They said that talking to peers and viewing samples not only made
them clear about what was expected but stimulated their creativity in their own product. Lucy reported,

If I do my own [portfolio], I need to see other students’ portfolios carefully about what they did and how they did it. For me, I like to see other students’ project to figure out how they did it and how I can do it? That’s my learning style. I need a model to elicit my own product. I didn’t copy theirs but get ideas from their designs. I will be creative after I saw some models. This is because I was taught that way. I got some ideas from portfolios I had seen before I created mine.

Attending students’ presentations helped participants understand what a portfolio is and gave them an idea of what kind of format they could use. Many students used the things they viewed as a basis of what they could do. Rick told me that the idea of using a Flash movie for his introduction came from a showcase he attended. He thought an introductory movie would not only display his growth over time but help him to learn a new skill. He recalled, “It was a reference point. I think it really helped me a lot. Before then I was floating out in space. You can go anywhere with electronic portfolios, which makes it great because you have the different kinds of portfolios.”

Although students learned a lot from former students’ presentations and samples, they wanted to have their own styles, to personalize their electronic portfolios. When we discussed how helpful the showcase was for her, Beth said,

I like them and I don’t. I like it because I can see what they did but I also like to have my own ideas. When I see someone else’s I have a tendency to copy that. The ones I saw were all done in Adobe [Acrobat], and that’s why I did
mine in FrontPage — just to be a little different. I was afraid I was doing just
what they were doing.

Mary was different from all of other participants in that she refused to see any
samples before she finished her own electronic portfolio. After the showcase, I asked her
opinion on viewing samples.

SW: After seeing your classmates’ showcases, how do you feel about not
seeing any samples before your design? Do you feel glad or regret not seeing
those before?

Mary: No. I am glad I did not view others showcases. I feel that my e-portfolio
provided insight to my learning and my skills. I did the best I could and
even if I had seen others, I would not have wanted to add any more to
mine. … These are the ideas I had at the time and these are the projects I
am proud of. I provided a full portrayal of my skills.

Mary was unique among the seven participants because she was the only person
who refused to see samples, didn’t compare with others, was very satisfied with her
product, and didn’t want to make any improvement on her electronic portfolio after it was
done.

However, all other participants regarded talking to peers and seeing samples as a
helpful learning strategy in creating their own projects and they mentioned the
improvements they wanted to do to their portfolios after the showcase. Tom told me in
the second round interview, “I really wanted my portfolio to be a lot more technology-
literate than what it turned out to be. … I really wanted to include more movies, more
movie clips, more images, and more artifacts that show the experience I had.”
Although students had different ideas about seeing samples, they did collaborate among themselves or interact with teachers during the process of developing electronic portfolios. Among seven participants, two small groups were formed informally according to their interests and experiences. Lucy and Jane talked a lot about their portfolios because they were both international students and mostly worked on their projects in the computer lab. Cathy, Beth, Tom, and Rick communicated with each other because they were all experienced full-time teachers and took the same class in the spring quarter. Only Mary seldom discussed her portfolio or design idea with her peers; instead she interacted with her advisor throughout the whole process.

In the interviews, these two groups reported positively about their collaborative relationship with their peers. They indicated that for the most part it was peer critiquing that helped them the most. Among peers, they discussed the artifacts they could use to match certain standards. They talked about the technical problems they met. But they had never showed each other their products because everyone wanted to keep it as personal as possible. They stated that if they showed the portfolio to others before the due date, they would give away the information that they wanted to keep for themselves. So students became secretive about their portfolios. Beth indicated this in the interview,

I think, as a group, we are all competitive so we were secretive about what we were doing. But we did talk a little bit about how we were going to set it up and what artifacts we were using for certain areas. For the most part we didn’t really show each other our portfolios a lot until the very end.
My analysis of the data showed that students were reticent on the design part, that is, the visual layout of their portfolios, but they were very open about the technical skills, that is, providing solutions to the technical problems in dealing with certain applications. Although they didn’t want to share their electronic portfolios before they finished, they did say that they learned a lot from talking with peers. Cathy explained in the interview how collaborative learning with peers helped her to troubleshoot. She said, “My peers and I got together a couple of times to troubleshoot, to figure out how to perceive the standards. While we weren’t working on each other’s projects, we were getting together and troubleshooting peer to peer.” She also mentioned that she emailed her peers or advisors a lot to solve different problems and figure out the standards while working at home. She was very comfortable in that learning environment but she “can see how others may find it more helpful to work as a group.”

Similarly, Rick described his experiences of communicating and interacting with peers in every class. He said, “I only had one class this quarter on Monday evenings. So every Monday we were discussing it. ‘Where are you? Have you started yet? What have you got?’” When Rick lost a Zip disk with his HyperStudio project, his peers gave him confidence. Rick describe their communication to me,

I just talked to people about that. I said, “Well, I’m not going to have Hyperstudio.” And somebody else said, “Well, that’s OK. I’m not going to have it either.” “Are you doing Adobe? Are you using Dreamweaver?” So there was a lot of talking about it. But then again we have done that for everything. Even outside Electronic Portfolio for all of our projects. I think one of the benefits of a program such as this is the fact that you have more or
less the same people in every course. There is a bond there and we are always pushing each other.

Jane and Lucy helped each other a lot in file conversion and other technical problems. They also discussed what artifacts might be suitable for the standards. Jane told me, “I learn a lot while talking to other people and while telling the other people my problems and helping other people fix certain problems. I also learn when I explain.” Students reported that they had forgotten a lot of things they had learned from the very beginning because they did not have the time to practice them after the classes. Since sharing their own products was not taken into consideration during the process, a lot of opportunities to reinforce skills were missed. Jane said, “If we had sharing sessions and demos before the final presentation, then we can remember, share, show, and explain. That is an enriching process.”

In addition to discussing ideas with peers, some students also interacted with their advisors about their ideas on the projects. They wanted to make sure that they were on the right track. Although they didn’t want to show their products to their peers, they did show them to their advisors in order to make sure that they were doing the right thing. Once they got a positive answer, they were very confident in doing it by themselves because they had a list (the course syllabus) of what they needed to do and “it was pretty well detailed.” Mary told me, “I stayed in contact with my advisor regularly and worked with her on a weekly basis: double-checking questions, and is this looking OK, and are my reflections on the right track?”

Creating electronic portfolios was an individual action. Nearly all students felt confident and thought they were on the right track because there was no right or wrong
answers in developing an electronic portfolio. In Mary’s words, “Their products are cool. Mine is too.” Jane expressed her idea on the focus of developing electronic portfolios. She said,

Well, you know everybody’s different so everybody has a different level of skills and also different personalities for creativity. So I’ve learned that the portfolio expresses your personal style and sometimes you can be, you can design the portfolio to the best way you think, the way you want. And it has to do with the resources you have on hand and what you’ve learned so far. Some of them are not, like, very sophisticated, but they’re focused more on the content, not on the look of the portfolio. Those [electronic portfolios] are kinds of, I think, a little bit high tech, but they also focused on the content, right? And I think that should be the most important thing for me to give, to show the expertise up to one point, but to give more importance to the content and what you’ve done and how the artifacts connect to the standards and if they are relevant to the standards and if every link is connected to the right file and it’s working fine, and if everything runs smoothly and there are not broken things.

Despite the different ideas on seeing samples and sharing with peers, it is clear from the data that collaboration, communication, interaction among peers and teachers did help students’ learning in developing electronic portfolios.

As a participant observer who also had gone through the entire process of creating an electronic portfolio, the researcher became involved in Lucy and Jane’s learning process when she observed them in the computer lab. Both Lucy and Jane expressed their appreciation for the presence of the researcher because they regarded the researcher as an
instant supporter on-site, or even one of their peers, “which was really helpful,” as they said later. Sometimes they asked for help in dealing with technical problems, especially in converting files; sometimes they asked her ideas about the artifacts to select for a certain standard.

When Lucy selected one of her websites as an artifact, she found a line with strange characters on the top of the page, which is obviously an error. The page was designed in FrontPage, but now she opened it in the Netscape browser. It was obvious that the easiest way of editing it was to do it in Composer. However, she had never used Composer. So she asked me, “How can I delete it [the line on the top of her page] in Composer.” I told her the steps of editing the page. She followed my direction step by step and deleted the sentence. “Oh, that’s so easy!” She was so excited to learn a new skill.

Once she got to know how to use Composer to edit her page, she kept practicing it in editing other pages. She opened an HTML page with all of her Photoshop projects inserted on that page as thumbnails. If she clicked the thumbnail, the large image would appear in the second window. The problem was that the page format changed from her original design. She wanted the thumbnails in several columns instead of in one. I suggested that she use a table. She created a table and dragged the thumbnails into the table. It looked fine in Composer but she was not satisfied with the result in the browser because her animation did not move. As she couldn’t solve the problem now, she noted it down on her outline and told me that she would ask for help from other students later because she knew who did the same kind of project and they might know the solution.
Then she continued editing her table with the images. The first time, she created a
table with three columns and four rows above the thumbnails and then dragged the
thumbnail images to the table one by one. The thumbnails became even smaller than the
original one after they were moved to the table. In order to avoid this change, she created
a new page inserted a table, copied the thumbnails on the original version and pasted
them to the new page. It worked fine in Composer but changed in the browser. It had
been about 20 minutes since she started working on this page. She decided to give up
making any changes because this was only the first standard and she had many artifacts
to select for the other five standards. She used an alternative version and dragged it to her
portfolio folder on the desktop. Although she did not solve her problem, she learned from
this process how to use Composer to edit her pages.

Then we went through her projects in HyperStudio and PowerPoint. She asked for
my help in converting a HyperStudio file into an EXE file and how to convert
PowerPoint slides into HTML files and PDF files. During the second and third time when
I observed her in the lab, I also provided help in editing her movies and converting
QuarkExpress files into PDF files. These skills were not very hard but if she had never
used them or had forgotten them, it would have taken her a lot of time to figure them out.
When I was there, we could try different methods together and solved the problems
quickly.

In fact, observing Lucy and Jane’s working on their portfolios and providing
technical support and suggestions when needed benefited both of us. My role was more a
peer than an observer because I went through all these processes so that they regarded me
as an authority in creating electronic portfolios. It was a learning experience for them,
and it was also a learning experience for me because it helped me to refresh my memory and learn new things from the process.

The researcher liked the role she played in these observations: a peer, an instant support instead of a researcher because the participants she observed worked very naturally on their products which was very important in a qualitative study.

*Learning from Reflection*

Participants indicated that reflection was the most important part of their learning experiences in developing electronic portfolios. It allowed students to examine their learning processes, to take responsibility for their own learning, to see the strong and weak points in their learning, to see their growth over time, and to set their future learning goals. The findings in this section included these topics: what reflection meant to students, how students reflected, how reflection helped students’ thinking, how reflection helped students’ learning, how reflection helped students recognize changes in their teaching, how reflection helped students see their growth over time, and how reflection helped students’ self-assessment.

*What Reflection Meant to Students*

During the interviewing, every participant was asked the question of what reflection meant to them. They provided different answers according to their own understanding. Their answers are included here because they provide insight to the meaning they gave to reflection.

Cathy: reflection is not describing what you do but reflecting on what you did and analyzing it. … Reflection to me is looking back over the things and seeing
where my growth has occurred and what I learned from it or what I foresee the students learning from it.

Beth: It means to take time. A lot of times we don’t take time to think on a deeper level what you’ve done, why you’ve done it, the motivation behind it, and what you’ve learned and how you can connect that to what you already know. It is kind of (pause) like how all of the pieces fit together. …I think it makes you learn more by thinking about it.

Rick: I think it is a way of putting everything into order and understanding what you’ve done. We do things and take for granted what we are doing. The reflection is a way of looking back at where you started and where you ended and seeing the growth and it really makes you feel good whenever you reflect and see something positive there. You see that you’ve grown professionally and even as a person. …Reflection, to me, is very much needed because it shows you where you’ve been. It makes you feel good. It also helps you reassess where you are going.

Jane: I think that a reflection is a critical part of a portfolio. More than the technology of things, I think that the reflection is what’s going to give you sense or purpose to the portfolio. … So the reflection for me is to look at the good and the bad things of a particular learning activity. The good things will be what I’ve learned through this particular activity or application and what I can apply for my particular needs as a teacher. The bad thing about a reflection is that sometimes you have to be honest and you have to say what your weaknesses are. So you have to admit, ok these are my strengths and
these are my weaknesses, and I need to keep working on those weaknesses.

… So I think that reflection is a way to point out the good things and look forward to improving the weaknesses.

Mary: I think reflecting takes the time to think about what has happened, what’s happening now, what you’re planning on happening in the future, so it’s putting that timeline of separate events into one situation for your brain to comprehend, for you to learn.

Lucy: For me it showed what you learned and what you need to learn.

Tom: The reflection means, what courses I took, how will they help me for the future and how have I benefited from those particular classes and the coursework.

Although they used different language to express their understanding of reflection, the main ideas were the same:

1. Reflection is a thinking tool, which provides you time to think about what has happened, what is happening now and what is planned for the future.

2. Reflection is a learning tool, which helps you to understand what you have learned and how you can connect that with what you are learning.

3. Reflection helps you to see where you had started and where you had ended, to see your growth over time.

4. Reflection is a self-assessment tool, which helps you to look at the strength and weaknesses of a particular learning activity and consider how to improve the weakness.
How Students Reflected

The participants reported that when they wrote their reflections, they first read the standards carefully so as to understand what they asked, and then looked at the artifacts they selected for that standard to think why and how these artifacts matched this particular standard. A few examples from the interviews will illustrate this process.

Cathy stated, “When I reflect, I looked at what the standards ask. I didn’t describe what the standards did. I found an artifact and said this is how they meet it and how it affected me personally — my growth.” In addition, Rick described this experience, “I looked at each individual standard. I looked at how it applied to me before the program. … And then reflected on the growth and how they have affected me as an educator.”

Mary’s description represented the majority of participants’ experiences in writing their reflection. She said,

Once I linked all my artifacts in I stepped away for a day or two and came back, looked at the artifacts, and looked at the standards and said to myself, “Why did I pick these? Why does this go with this?” And I took the time to talk about each artifact and about how they relate to each other and how they relate to the standard and how they work in the classroom. Not only about the artifact itself, but its relation to the classroom, which is the degree — its relation to the standard which is necessary in the portfolio, and its relation to other artifacts.

Viewing students’ portfolios, I found that in most cases, students reflected on why they chose these artifacts, how they met the standard, how they were used in teaching, and what the results were.
How Reflection Helped Students’ Thinking

According to Dewey (1963), learning is a mental process involving thinking, using intelligence, making judgments, and looking for meanings, connections and possibilities. In other words, in the process of learning, one uses the mind to organize activities, and intelligence to direct them. Similarly, Jonassen et al. (1999) indicated that students cannot learn from teachers or technologies. Rather, students learn from thinking - thinking about what they are doing or what they did, thinking about what they believe, thinking about what others have done and believe, thinking about the thinking processes they use - just thinking.

Consequently, the participants in this study explained how reflection helped their thinking. Students’ reflecting process involved looking at the standards and the artifacts again and again so that they would understand what their artifacts were and how and why their artifacts met the standards. Through these processes, students realized what they had learned, identified their strong and weak points, articulated their future goals in order to improve their weaknesses, and considered how they could apply their knowledge to their job. A couple of examples will illustrate how these processes helped students to think.

In her reflection, Cathy described how she made technology learning meaningful in her own classroom by integrating technology into content areas through the projects she designed in her program. Then she concluded, “As I have gone through the program, I have begun to entirely rethink the way I presently instruct in the classroom, and I plan to integrate technology daily in the coming years.”

Additionally, in his reflection, Rick described how his workshops in training teachers to use technology in classes were useless at first. Even if he provided them
handouts, they forgot how to utilize the tools soon afterwards. For one of the courses in the program, he created a Flash tutorial that took teachers step by step through the process of opening a remotely housed file with Filemaker Pro. The entire building relied on that program, yet many teachers could only open the “lunch” file. Rick tried to explain to them that by using the same process, only selecting “discipline” or “inventory,” they would open the needed file and would be able to complete the task at hand. It seemed to be the same teachers who repeatedly needed help, so he took the opportunity to make that tutorial available to them. The tutorial appeared to be working, as he had fewer and fewer problems with this aspect of the system. He reflected, “I did, however, come to a realization while using these programs, and that realization is that technology can make anything easier if you are willing to give it a try.”

Now that he had seen that providing reference material to the teachers seemed to work, he spoke to a couple of other technology people in his building about creating an online depository of handouts, movies, lesson plans, and websites to allow teachers to glance at the various materials at their leisure so that by making this available to them 24 hours a day, more teachers would incorporate technology into their teaching. For example, one lesson plan was about using Excel for compiling, analyzing, and graphing various information.

Finally, in the second round interview, Tom told me his perspective on how the reflections helped him to think:

I was able to look at all of the things that I put together and learned during the course of this program and it helps me to see what things I really am good at, what things I really would have a struggle with [to] incorporate
Reflection was also a part of learning. What the students learned led to new goals. After reflecting on the progress she made in this program, Cathy set her future learning goals as follows:

I am very aware of the growth that I have made. I can see that I have a level of technological knowledge that surpasses many of my colleagues. I am also aware that there are still new technologies that I must stay current with. I plan to do this by using current periodicals, such as T.H.E Journal and Converge, to keep myself informed about these technologies.

Participants indicated that the whole process of reflection was the process of thinking. Jane’s description on how she reflected demonstrated how reflection helped her thinking. “I learned to think about myself – what I had done and what I did well or not well. It reminds me of my strength and weaknesses as a learner.”

Hence, reflection stimulated students’ thinking and “thinking mediates learning. Learning results from thinking” (Jonasson et al., 1999, p. 2).

How Reflection Helped Students’ Learning

All students interviewed in this study admitted that reflection did help their learning. Reflection helped them to think about themselves and what they had accomplished and what they did well or not so well. Reflection reminded them of their strong and weak points as a learner. Jane’s definition for reflection provided a succinct
summary to this process: reflection is a way to point out the good things and look forward to improving the weaknesses.

Jane expended on the benefits of reflection in the second round interview. She said,

I think doing a portfolio helps you do a lot of problem solving, critical thinking, and reflection on what you did well and poorly. … You have to be honest and you have to say what your weaknesses are. So you have to admit, ok these are my strengths and these are my weaknesses, and I need to keep working on those weaknesses.

Mary described how reflection helped her learning in the second round interview:

I think creating the portfolio is learning. It is the process. For me, it was taking the one-on-one time with myself to write the reflections and write the learning goals and look through my artifacts again and read my research papers again and dissect my lesson plans and really understand what I put into them. When you go through the process of reflection, it kind of sums up that section of the learning.

In her synthesis, Cathy indicated how this process helped her to learn. She indicated that,

Revisiting theories about how students learn, has again reminded me what is the best type of teaching. It is easy to slip into old habits, and take the easy road while at work. Being reminded that student learning increases when they are actively involved has helped me in the classroom through this process.
As I take some of the skills that I have developed through this program into the classroom, I hope to be able to discover what technology-based learning works best with students to improve their learning. I then hope to discover how I can aid other educators in overcoming their fear of and inappropriate use of technology so that technology can become an integral part of every classroom, for every child. While this could be a daunting task, I feel that it is important so that education is improved with technology use, not burdened by it.

The above testimonies were only some examples abstracted from students’ interviews and their reflections. Other students expressed similar views on how reflection helped them in learning.

_How Reflection Helped Students Recognize Changes in Their Teaching_

A couple of students mentioned that reflection helped them to realize the change in their educational philosophy and in their way of their teaching. After reflecting on the how his artifacts met the standards, Tom realized that he saw “a whole new way to teach.” He mentioned in the interview,

I don’t have the same attitude about teaching as I did when I started the program. I feel that there is a much better way to reach all of my students than the one-faceted way I had before. Now I am multi-faceted. I have multiple ways of reaching students. I knew it was possible to teach students more than one way, but it was very difficult for me to figure out how to do that. With technology the answer is at your fingertips. If you learn enough
about technology, you have multiple ways to reach students with different learning styles. That is what this program really helped me with.

Additionally, Rick talked about how reflection helped him to see the change in his teaching philosophy in the interview.

It helped me put everything into order so I knew where I was heading. My educational philosophy before the program, as opposed to now, is considerably different. Up until the time I was reflecting, I did not realize it was different. Then, once I did my reflection, I thought I had changed.

Rick then gave me an example of how he had changed through this program:

I have always believed that I want to be an educator and not a teacher. That is the first thing. I believe there is a difference. A teacher is someone who shows somebody how to do something. An educator is someone who shows somebody how to use a skill to continue to do things and progress upon themselves. Before the program, I thought that by standing in front of my class and lecturing and giving notes and giving homework, but trying to be funny at the same time was a good, positive thing. It seemed to work. I had a lot of fun with it. After the program, my educational philosophy changed a lot, in that there has to be a lot more student-based learning. As a student myself, when I had to just sit there and listen to somebody talk, I wanted to bang my head against the table. But whenever they allowed me to go out and experience it, that’s when I learned and really understood what was going on. Just through the process of being a student, and working with the technology, [it] helped me to improve things. My philosophy changed from “I’m helping the kids by
“lecture” to “They need more. They need to be a very active part, active learning.”

If Rick had not taken time to write the reflection in his portfolio, he would not have recognized this change in his teaching.

*How Reflection Helped Students See Their Growth over Time*

All participants mentioned that reflection was a very important tool to see their growth over time because it gave them a chance to see where they had started and where they had ended. Like Cathy said in the interview, “At the beginning I thought I was pretty cool at web design until I got into the advanced web design and realized that some of my early stuff really stunk. You think you are so good at first. Reflection to me is looking back over the things and seeing where my growth has occurred and what I learned from it.” In her reflection, Cathy gave an example of her growth. She wrote,

> The collage is a piece that I did in Adobe Photoshop for the title page of my WebQuest. It is a good representation of the growth I have experienced in the program. I did not take the Photoshop class, but through the use of other technologies, I am now able to go in and do some basic work in the program. Many of the software programs that we used over the course of the degree program have some similar capabilities. I was able to transfer some of that knowledge to learn a new skill.

This was only one of many examples students mentioned in the interviews and in their reflections. All participants described and reflected their academic growth over time with various artifacts. Half of them described their growth in their current teaching because the
projects they created in this program were integrated in their classrooms. Tom indicated in the interview that reflecting on the artifacts made him realize that he made a great deal of progress in the past three years. He felt very confident and thought he was in the top 5% of his high school. He felt that he was a leader in technology. From reflection, he was clear about his strong points and the areas he needed to improve. Additionally, Rick described his growth in his synthesis,

I have received a renewed outlook on my profession, and have acquired a strong desire to prove to the less than supportive to technology people that technology can indeed help in the curriculum. My passion for computers has turned into a passion for instructional technology. I have sponsored present inservices, and have worked with our technology coordinator on the district technology plan. It is very apparent to all of my colleagues that I have found an inspiration that was lost a few years ago.

Through reflection, students not only saw their great progress in technical skills and teaching theories but also examined their progress in integrating technology into their classrooms as well as their progress in teaching philosophy. Using Rick’s words to conclude the benefits of reflection, “I see the portfolio was a way of me putting more of a reflection on the program. I put high value in it. I think the process made me a better person.”
How Reflection Helped Students’ Self-Assessment

Half of the students mentioned how reflection helped them to self-assess. Self-assessment for them was to think and analyze the strong and weak points of what they had done, and look at the good and the bad things of a particular learning activity.

Through reflection, students understood what they knew and what they needed to know. This self-assessment helped them to set their future learning goals. Jane expressed that reflection gave her a chance to assess her work. She said,

Basically it’s a self-assessment. It’s a way to be honest and true to yourself and say, ok this is what I think I did good and I liked this project, I like it because it’s creative, because of the background for example, I like the way I put the colors in it, or I like the way the layout, I chose the layout, or whatever. Then you can be honest and say, ok this I don’t think is working that well, but I need to improve that. I think that’s what it’ll be doing in a broad way.

Once students recognized their weak points or identified the artifacts which were not as good as they expected during the reflection process, the majority of the students set those as future learning goals. However, a couple of students changed their artifacts immediately if it didn’t take them a lot of time. Observing Lucy in the computer lab, I saw she made many changes to her artifacts if she thought that artifact was not as good as she expected.

Learning from Synthesis

Students reported that synthesis was one of the most important times when they had learned most. According to them, synthesis referred to the process when they
synthesized all parts together to show what they had learned. When interviewing Cathy, I asked her during which stage in developing her electronic portfolio she learned most. Cathy said,

I would say either the planning or the synthesis. The planning — trying to figure out how I was going to pull this monumental task together. And finally realizing I would have to break it up into chunks. The synthesizing — trying to figure out how to pull the chunks back together so it shows what I learned. Those are where my learning style changed the most. During those two stages is when I was the most organized. Those stages required the most thinking.

Cathy’s experience reflected the majority of other participants’ opinions that they had learned from synthesizing their final products. During the synthesis process, students had to review their artifacts again and again so as to find out how to put them together in a meaningful way so that their final products would show what they had learned through this program and how they could use this knowledge in their careers, as well as, what were their future goals.

In talking about how collecting data, converting files, reflecting on artifacts, and synthesizing the final product influenced learning, Mary said,

I think they are all part of the learning process. … I think each step in developing the portfolio builds upon that learning process. We didn’t just do these projects and the quarter is over. We went back and looked at what we did do during the quarter and how it is affecting what we are here to learn and what we are expected to learn throughout the program.
Additionally, through synthesis, Beth realized her growth through the program. She wrote in her portfolio,

For not having too many expectations at the beginning of the program, I am happy to say that I learned more things than I thought were possible. The things that I learned that were most beneficial to me as a teacher were learning design strategies, getting a chance to review educational software, being exposed to Adobe Photoshop, learning how to use different types of presentation software, making and editing movies using the computer, participating in web designing, learning Mac and PC and knowing how to move across those platforms with ease, technology budgeting, using the Lego/Logo programming and Lego MindStorms, and creating an electronic portfolio. These are all things that I can use in my classroom and are skills that I can teach my students.

She went on to write that,

I felt that I learned things that are beneficial to my professional and personal development. Professors were knowledgeable, willing to help and patient. The students involved in the program were motivated because it is a fascinating field. It was enjoyable to experience not only my own growth, but that of my classmates as well.

One of the participants expressed that reflecting on what they learned from this program made them realize that “this program was not only a growth period in my profession but also a growth period in my personality.” Three out of seven participants mentioned that they were going to begin a Ph.D. program in the coming school year in
the area of Instructional Technology. This was because they had a very exciting and
productive experience in this program and became more and more interested in this topic
and would like to learn more knowledge in this area.

The participants indicated in their interviews, whether they would continue to
pursue a higher degree or work in a technology related field, they would continue
learning to keep up with the pace of technology development. For example, Beth’s
comments on technology in her synthesis statement in her portfolio illustrated this point.
She wrote,

The field of educational technology is truly a field that endorses lifelong
learning. With new things to experience all the time, teachers in this field will
be on a nonstop road to unique learning experiences and will be able to pass
along the knowledge to their students. This knowledge will be able to help
motivate students to learn more, become productive citizens in society, and
start down their own road to lifelong learning.

Different from the reflection discussed in the previous section which focuses more on
each individual standard, the synthesis section of the electronic portfolio reviewed the
whole learning process of the program. Thus, synthesis helped students see a complete
picture of their growth through this program, realize their learning and teaching style
change, set their future goals based on what they had achieved.

Problems Encountered in Developing Electronic Portfolios

Students reported that they encountered problems in each stage of the process
from the time they started to organize their files until they presented their products in the
public showcase.
The problems they encountered in the stage of collecting and selecting artifacts were disorganized files and lost files, which cost students’ trouble to find the right files they needed, recover or replace the lost ones. When they converted their multimedia artifacts to compatible formats, they encountered the problems caused by lack of or improper extensions and the problems caused by different versions of the software or different operating platforms. When they started to design the final layout, they found it was very hard to get started. It was hard for them to decide what software and what format to use for designing the portfolio, how many multimedia and paper artifacts to use because they could not use them all, where and how to use them to make the portfolio meaningful and attractive. During the presentation, they encountered the problems of long downloading time, broken links, and the layout change. However, it was these problems that provided students with more opportunities to review and remember what they had learned in the program or by themselves. The process of solving these problems was the process of learning, as discussed in the section of learning by doing.

In addition to the above problems, students mentioned the problem of how to use their time properly. Although all participants started collecting artifacts from the beginning of the program, they were different in the steps that they took to finish their final products. Some students started working on the project very early and finished their portfolios weeks before the presentation date. Beth finished hers in April; Mary finished hers two weeks early, and Tom finished one week before the due date. However, some other students had been working on their projects till very late because of different reasons. For example, Lucy and Jane took 15 credit hours in spring quarter, which prevented them from concentrating on this project earlier. They could only focus on their
portfolios in the last week. Lucy told me her timeline when I observed her in the computer lab. She said,

During the past few weeks, I went through the standards and made the contents. Tonight I will select the artifacts I listed in the outline. I will put them together in one main folder and burn it on a CD. Then I will start writing my reflections. As you know I am taking four courses this quarter and it is near the end of the quarter. I have lots of final projects to finish. Therefore, I will design my portfolio format, the connection part, after I submit and finish my other course’ works. I can only concentrate on my portfolio at that time.

Lucy worked to 2:30 am that night in the lab when she finished selecting her artifacts. Different from Lucy and Jane, Cathy told me she finished her portfolio later because of her “learning style.” She said, “I did it the way I always do — at the last minute. That is one of my learning styles — to wait, wait, wait and then all of a sudden do it.” So she finished her portfolio two hours before her presentation. As a result, she was the only presenter who encountered major problems in displaying her portfolio. Therefore, students indicated that with technology which was often out of control, you should start early and finish early enough to leave some time for running into problems.

Another problem was insufficient presentation time. More than half of the participants expressed their dissatisfaction with the time allotted to each presentation. They had only seven minutes to present their electronic portfolios in the public showcase. Beth’s words typically expressed their opinion on this issue. She said, “I wish we would have had more time. Seven minutes isn’t a lot to show everything, … I had it
pretty well spelled out what I was going to do, but once I got up there, I ended up scrapping two or three things because I thought we had ten minutes.”

When observing their presentation, I had a feeling that every presenter was pushed by their instructor who had a time card in hand. She would give notice to the presenter two minutes before the end and asked him/her to stop at the 7th minute. Viewing what they had on CDs afterwards, I realized that the majority of the students had many excellent artifacts which demonstrated their achievements both academically and technically. Then I understood why they complained that they didn’t have enough time for their presentation in the showcase.

**Summary**

The purpose of this study was to investigate and document the learning experiences of M.Ed. students and their learning processes in developing electronic portfolios and the meaning they gave to these experiences. The participants in this study were seven M.Ed. students majoring in Computer Education and Technology who chose to create electronic portfolios as their final projects. Participants in this study indicated that the reason they preferred creating an electronic portfolio to writing a research paper were: creating an electronic portfolio was more meaningful than writing a paper; it made students more creative because the project was open-ended; and creating electronic portfolios provided evidences of students’ technical skills and knowledge and showed their growth over time. In addition, creating an electronic portfolio was easier in some aspects than writing a paper.

Findings from this study indicated that all participants were hands-on learners and learned from doing. Their role as a learner changed in developing an electronic
portfolio. They were active, independent, motivated, and became lifelong learners. They described how they learned by doing, learned from viewing samples and collaborated with peers, learned from reflection, and learned from synthesis of their final products. Findings from this study also indicated that creating electronic portfolios were beneficial to students. Even if they encountered many problems in the process, they learned a lot from solving these problems.
Chapter Five: Discussion and Recommendations

Introduction

This chapter summarizes the conclusions reached in this study and examines the findings in relation to the existing literature. Additionally, the chapter discusses the implications from the study and suggests areas for future research.

The study examined how M.Ed. students understood their learning experiences and learning processes in developing electronic portfolios; how students understood reflection upon their learning experiences and learning processes; and what meaning they gave to their learning experiences and learning processes. This study described how engaging in the electronic portfolio process helped students to develop technology-related knowledge and skills; how students used course assignments along with outside experiences as potential artifacts to demonstrate competency in national standards, and how students expected to use the experience of creating electronic portfolios in their own teaching. This study was a qualitative case study guided by a constructivist learning theory and a phenomenological approach to investigate and answer the following research questions:

1. What are the learning experiences of Master’s students in developing their electronic portfolios?
2. What meaning do they give to these experiences?
3. What are the learning processes encountered by Master’s students when developing electronic portfolios?
To explore students’ learning experiences, the study employed in-depth semi-structured interviews, observations, and analysis of documents such as the course syllabus, standards, and students’ electronic portfolios on CDs.

The interpretation of the research findings was guided by constructivist learning theory and the literature reviewed in Chapter Two. As the theoretical framework of this study, constructivist learning theory regards learning as an active process. Constructivists believe that students must be given opportunities to construct knowledge through their own experiences in a meaningful context because learners learn best when they actively construct their own understanding. According to them, hands-on experience is necessary for learning, especially in the technology field, but it is not sufficient. Mental activities must also included because learning is a mental process involving thinking, using intelligence, making judgments, and looking for meanings, connections and possibilities. They view motivation as a key component in learning.

Therefore, in a constructivist learning environment, the learner’s role is changing from passive to active; learners are independent and motivated, and become lifelong learners; higher order skills such as problem-solving, reasoning, and reflection are taught in the classroom; learners are enabled to learn how to learn; more open-ended evaluation of learning outcomes is used, and cooperative and collaborative learning skills are engaged in class activities (Fosnot, 1996; Hein 1991).

The interpretation was also guided by the phenomenological approach in interpreting the meaning that students gave to their experiences. Phenomenology helped the researcher to understand the structure and essence of the students’ learning experiences in developing electronic portfolios from their own perspective. As an
interpretive method, phenomenology helps participants to interpret their experience and
the researcher to interpret the data; it seeks to uncover the meanings within experience
and translate felt understandings into words (Creswell, 1998; Moustakas, 1994). In
interpreting the data, the researcher tried to respect students’ voice and their
understandings of the learning experiences they encountered in assembling electronic
portfolios.

*Implication of Students’ Learning Experiences and Learning Processes in Developing
Electronic Portfolios*

Learning experiences refer to the physical activities such as the activities in
selecting artifacts, designing portfolios, and presenting to peers and faculty. Learning
processes refer to the intellectual process that students encountered through their
experiences which include thinking, questioning, reflection, and exploration. Normally,
learning processes happened after learning experiences because students had to think
about what they had done and what that experience meant to them. Without this mental
process, the experiences were meaningless. Learning experiences and learning processes
are closely related to each other. Therefore, the findings regarding learning experiences
and learning processes will be reported together.

*Electronic Portfolios as a Form of Authentic Assessment*

Describing the characteristics of electronic portfolios will help readers to
understand why electronic portfolios were adopted in a constructivist learning
environment. According to the online *Educational Technology Encyclopedia* (2001),
alternative/authentic assessment means variants of performance assessments that require
students to generate rather than choose a response. The characteristics of this type of assessment are: the student is involved in meaningful performance tasks; there are clear standards and criteria for excellence; there is an emphasis on metacognition and self-evaluation; the student produced quality products and performances; there is a positive interaction between assessor and assessee.

Findings from this study showed that creating electronic portfolios was a meaningful task for students to perform because electronic portfolios provided an opportunity for students to synthesize what they had learned in the Master’s program, showed their growth over time, and documented that they had mastered the National Educational Technology Standards for Teachers (NETS-T) developed by the International Society for Technology in Education (ISTE). The whole process of developing electronic portfolios involved metacognition and self-evaluation because after artifacts were selected students had to synthesize the artifacts and reflect on what they learned, how and why these artifacts met the standards. They had to self-assess what their strengths and weaknesses were and set their future learning goals. During this process, they had a chance to review what they had learned from this program and think how they could integrate technology into teaching. It was this reflection that made the electronic portfolio meaningful. As creating portfolios was an on-going project, it motivated students to continuously improve their portfolios based on the new artifacts they selected in order to produce quality products. Students communicated and interacted with their advisors and peers during the process of developing their portfolios. They used critical thinking and problem-solving skills in this process and they were creative in illustrating their growth over time.
An important feature of constructivist learning is its active process. According to Dewey (1916), “Learning means something which the individual does when he studies. It is an active, personally conducted affair” (p. 390). By this, he meant that learners should be encouraged to invent their own solutions and to try out ideas, and they build their knowledge through experience. Findings in this study clearly show that learning was an active process in which students used sensory input and constructed meaning from it. Through hands-on activities, such as organizing files, converting artifacts, and designing the layout of their portfolios, students learned how to apply what they had learned to a specific project, how to solve the problems they encountered, how to learn new features based on the knowledge they had, and how to integrate technology into their classroom. Additionally, students indicated that they learned through trial and error, through countless mistakes when they encountered problems in converting their artifacts from different formats to compatible ones and in designing their final products. Therefore, they learned how to learn when they were learning. Hence, it was a physical and mental experience. This is consistent with Bruner’s first dominant model of learners’ minds. This model sees students as imitative learners and focuses on passing on skills and know-how through example and demonstrative action.

The crucial action of constructing meaning is mental: it happens in the mind. Dewey argued, in the process of learning, one needs mind to organize activities and intelligence to direct them. Findings in this study indicated that hands-on experience was necessary for learning, but not sufficient; activities which engaged the mind need to be provided. Consequently, students reported that they learned a great deal through hands-on
activities and reflection. This study also indicated that students needed knowledge to learn. Nearly all of the participants stated that it was not hard for them to learn a new function of software or learn an entirely new program. As Tom said, “With a good foundation in technology now, we will be able to pick up new technology much faster.” Similarly, Cathy mentioned, “A lot of the ideas are the same as any other web page program.” This finding is consistent with Hein’s (1991) point of view. He stated that it was not possible to assimilate new knowledge without having some structure developed from previous knowledge to build on. Therefore, the more one knows, the more one can learn. This finding is also consistent with Piaget’s idea: exploring interesting things within a classroom encourages students to become active constructors of their own knowledge through experiences that encourage assimilation and accommodation.

According to Piaget, students need a rich environment for exploration to assimilate and accommodate new knowledge. This means that learners do not immediately understand and use information they are given. Instead, they construct their own knowledge based on prior knowledge. They learn by fitting new information together with what they already know. Findings from this study indicated that developing electronic portfolios created a rich learning environment for students to explore where they had opportunities to assimilate and accommodate new knowledge. They reviewed what they had learned from each class and selected the suitable artifacts for each standard. Then they reflected on them, and designed the layout of their portfolios. The whole procedure required students to learn how to fit new information or knowledge together with what they already knew. Then they set their future learning goals.
Learning from Communication, Interaction and Collaboration

In constructivist learning, a rich learning environment alone is not enough for students to learn. They need to communicate, interact, and collaborate with their peers and teachers. Vygotsky claimed that it was the collaboration between people that caused learning to occur, not just a rich, interesting environment. Similarly, Dewey believed that learning required some outside guidance from teachers, peers, or social institutions. Bruner’s third model of learners’ minds stressed the value of discussion and collaboration. This model revolved around how students make sense of their world. The findings from this study imply that nearly all of the students collaborated with peers or asked advice from instructors at each stage of creating their portfolios. Among the seven participants, two informal groups were formed as discussed in Chapter Four. They exchanged ideas of what kind of artifacts they could use for certain standards. They solved technical problems they encountered when converting artifacts and designing the final products. A couple of students showed their rough draft and explained their design idea to their instructors to make sure that they were on the right track. They stated that it was the help from peers and advisors that made their projects easier than they expected. This is consistent with Hein’s argument that constructivism recognizes the social aspect of learning and uses conversation, interaction with others, and the application of knowledge as an integral aspect of learning.

In addition, the majority of the students indicated that viewing samples from former students helped them to develop their own idea for designing the final products. For them, these samples were just like the references in writing a paper so the more
samples they viewed, the more creative they became. Findings from this study imply that communication, interaction, and collaboration between people caused learning.

*Learning from Reflection*

Dewey (1963) stressed that students did not learn from experience but learned from reflecting on experience. Similarly, Bruner (1996) said, “Thinking about thinking has to be a principal ingredient of any empowering practice of education” (p. 19). Findings from this study imply that reflection helped students’ thinking and thinking encouraged their learning. They stated that reflection required them to think about the standard and the artifacts to meet this standard. The students thought about what the artifacts were, why they chose them and how the artifacts connected with each other. Reflection also helped them to rethink the way they presently instructed in the classroom. This study documented that reflection provided a place for the learners to exercise that control over their own thinking. Through reflection, students were able to discover how the knowledge gained from this program made them different and thus they were motivated by the need to satisfy their individual inquiries. Reflection highlighted not only what has been done, but what has not been done so that students were aware of the growth and the direction of their improvement. Finally, reflection helped self-assessment so that students would see their change over time. Overall, findings from this study imply that the process of reflection was the process of thinking, the process of learning. This is consistent with the findings by Jonassen et al. (1999). They found that “students learn from thinking - thinking about what they are doing or what they did, thinking about what they believe, thinking about what others have done and believe, thinking about the
thinking processes they use - just thinking.” They stated, “Thinking mediates learning. Learning results from thinking” (p. 2).

As discussed in the literature review (Campbell, Melenyzer, Nettles, & Wyman, 2000, based on Van Wagenen & Hibbard, 1998), reflection in creating electronic portfolios should be guided by the following three questions. 1) What? 2) So what? and 3) Now what? They further clarify the meaning of these three questions. According to them, the student would firstly summarize the artifact that documents the experience. That is the answer to the question “What?” Then, the student would reflect on what he/she learned and how this leads to meeting the standard, which answers the question “So what?” Finally, the student would address implications for future learning needed and set forth refinements or adaptations, in order to answer “Now what?”

Findings from this study imply that nearly all of the participants were guided by these three questions in reflecting on their artifacts. They first read the standards carefully so as to understand what they asked for, and then looked at the artifacts they selected for that standard to think why and how these artifacts matched this particular standard. They asked themselves, “Why did I pick these? Why does this go with this?” They took the time to think about each artifact and about how they related to each other and how they related to the standard and how they worked in the classroom. Students indicated that these reflections helped them sort those things out so they knew which things were going to be beneficial right now and which things they needed to learn more before they could incorporate into their classrooms. Then they set their future learning goals. This study showed that students learned most in reflection because reflection helped them to understand what they had learned and what they need to learn so that they were clear
about their future goals. It is consistent with Barrett’s point that this final step of setting future learning goals turns electronic portfolio development into a powerful tool for professional development.

The benefits of reflection that emerged in this study are consistent with those found by Porter and Cleland (1995) in their study in which they summarized the advantages of reflection as: reflection allows learners to examine their learning process, to take responsibility for their own learning, to see “gaps” in their learning, to determine strategies that support their learning, to set goals for future experiences, and to see changes and development over time. In addition, findings from this study imply that the portfolio did not just substitute for a research paper, instead, the portfolio provided opportunities for students to connect professional and classroom experience and to reflect on interpretations and judgments which most assessments did not allow. This is consistent with Porter and Cleland’s (1995) statement that the power of reflection helped students and teachers move beyond seeing the portfolio as a mere alternative to traditional assessment to appreciating its value as a learning strategy.

*Learner’s Role in Creating Electronic Portfolios*

According to constructivist learning theory, the learner’s role when they construct their own knowledge on the basis of interaction with their environment is active, independent, motivated, and lifelong. Findings from this study imply that the role of learner shifted from passive acceptance of knowledge to active involvement in learning. In creating electronic portfolios, students had to decide by themselves the steps to take, the artifacts to select, the format to use, and the timeline to follow. Therefore, they were not only active learners but became independent and motivated learners. Collaborating
with peers made them interdependent learners. By setting future learning goals, they showed that they expected to be lifelong learners.

The finding that creating electronic portfolios helped students to be a lifelong learner is consistent with other research studies. Campbell and Brummett (2002) found, “No portfolio is ever done; it will always be a work-in-progress. As skills develop, knowledge expands, and becomes more refined — so, too, will the portfolio” (p. 27). According to them, a portfolio should always be thought of as a collection of documents that is living and subject to modification.

Delett, Barnhardt, and Kevorkian (2001) indicated that portfolio assessment was an ongoing, interactive assessment that actively involved both the teacher and the students in the process of learning. In the environment of electronic portfolio, both teachers and students found themselves in new roles with new responsibilities. “Well-designed portfolios offer students the opportunity to become actively involved in the learning process by contributing to instructional planning and assessment” (p. 560). Findings from this study indicated that both teachers’ and students’ roles changed. Teachers totally moved from the “sage on the stage” to a guide on the side. It was the students who made decisions at each stage of the whole process. During the process of developing electronic portfolios, they communicated and interacted with their peers more than with teachers. They only asked for help from teachers when they encountered problems and could not solve these problems by themselves. Findings from this study imply that students controlled their learning processes in developing electronic portfolios.
Benefits of creating electronic portfolios discussed in the literature review also were evident from this study. The benefits discussed in the literature review are:

1. Electronic portfolios increase students’ hands-on technology skills and enable them to demonstrate effective and appropriate use of technology;

2. Electronic portfolios document students’ progress and encourage improvement;

3. Electronic portfolios motivate involvement in learning;

4. Electronic portfolios motivate self-assessment; and

5. Electronic portfolios motivate reflective learning.

Participants in this study indicated that creating electronic portfolios were more meaningful than writing research papers because it not only provided them opportunities to increase their hands-on technology skills but also motivated their involvement in learning. Creating electronic portfolios required them to be creative in its layout design and in dealing with their multimedia projects, which provided them opportunities to review what they have learned in class and learn new applications when needed. As one student said, “It gives you enough independence that you can go off on your own.” When developing this on-going, open-ended project, students stated that they got an opportunity to continuously reflect on their achievements and their improvements in professional preparation. After graduation, they could not only provide their potential employers with a more complete picture of their achievements, but they could also integrate what they had learned from this program directly into their teaching. Students felt that the electronic
portfolio was a valid and useful assessment, which provided them with the opportunity of seeing their growth over time and motivating their desire of improving the weakness. This is consistent with Testerman and Hall’s study. They stated, “The portfolio can become the foundation repository for future uses such as employment applications or demonstrations of comprehensive technology skills, knowledge, and synthesis. …The skills acquired through preparing and presenting an electronic portfolio provide graduate students the ability to develop other useful applications for personal and professional improvement” (p. 202-205).

One of the unexpected patterns that emerged from this study was that electronic portfolios helped students to see the change in their own teaching. Through reflecting on and synthesizing their artifacts, the four full-time teachers indicated that they recognized important changes in their teaching and teaching philosophy. They reported that since they entered this program they started to integrate technology into their own classrooms and could foresee how their students would learn from it. As six out of seven participants were teachers and four of them were currently teaching full-time at a middle or high school, it was very natural for them to connect their electronic portfolios with their teaching. Nearly all of the participants reported that they used some of the projects designed in this program in their teaching or internship, and saw how those projects helped their students in their learning. This encouraged participants to change their students’ learning environment to be more active and student-centered than before by integrating technology into their teaching. This finding is similar to Ring’s (2002) study in that the development of the portfolio enabled students to step back from their assignments and reflect on what they were learning and its relevance to their teaching.
Another unexpected pattern that emerged from this study was that it was easier to create an electronic portfolio than writing a research paper. A couple of students indicated that one of the reasons they chose to create an electronic portfolio was because it was easier to do so than writing a paper. This finding is inconsistent with literature review. Rose (2002) reported in her study about the reluctant students and overworked faculty members. She found the students didn’t see the value/need for creating electronic portfolios because they were very comfortable with the tried and true lecture and didn’t want to have more work creating electronic portfolios for the course. At the same time, faculty in her study worked more than expected in designing, developing and grading portfolio assessments. The difference between Rose’s study and this one may be caused by the difference in the participants’ background. The participants in her study were undergraduates in teacher education and they were not as familiar with technology as the participants in this study. In contrast, students in this study were Master’s students majoring in Computer Education and Technology and they were familiar with most educational software, had exceptional technology skills, and had confidence they could solve technical problems.

Participants in this study did admit that they spent a lot of time in creating electronic portfolios, like other studies reviewed in the literature. It took them a lot of time to organize the disorganized files, to convert different formats of artifacts, to design the layout of their electronic portfolio. As one student said, “Searching for all the documents you needed and then converting them was the time consuming part.” Additionally, if they missed one single detail or step in design, the result would be changed from what they expected and it would take students hours to fix it. Findings
from this study imply that creating a portfolio for my participants was not a difficult project, but it was time consuming if they wanted it to look professional. Different from former studies (Bartlett, 2002; Cole et al., 2000; Linn & Baker, 1992; Wright, Ray, & Stallworth, 2002) which regarded time as a major problem in creating electronic portfolios, students in this study didn’t regard these time consuming tasks as a barrier or a problem. In contrast, they regarded it as one of the benefits because they learned a lot in this on-going procedure. The more time they spent in it, the more time they had to reflect on their problems and their progress. From these processes, they not only learned technology knowledge on the different versions of software, different operating platforms, and the skills in converting and designing projects, but also learned to be patient when things did not work. As one student stated, “Of course, there were frustrating times when things didn’t go as planned but those failures are opportunity to learn as well.” Furthermore, they liked hands-on activities and felt that the time flew when they were working on computers because they enjoyed it.

In addition, findings from this study didn’t show the problem of deficient hardware and software (Bartlett, 2002; Purves, 1996) and the problem of insufficient attention and instruction on reflection (Cunningham & Benedetto, 2002; Mullen, Doty, & Rice, 2002). Similar to the last problem, the reasons for the difference may be because of the participants’ background and the different settings. There were two fully equipped computer labs in their department and all equipment in the labs was available to the students. In addition, all participants in this study had their own computer at home and they had the software they needed in creating electronic portfolios. As they were familiar in using most of educational software, they could get the same result in different ways.
So even if they didn’t have all necessary software at home, they could use other software instead. For example, Rick used Flash and Beth used Windows Movie Maker to make their own movies to display their growth in this program. This may not be realistic for undergraduates in majors other than Computer Education and Technology. As for the second problem, more than half of the participants were current full-time teachers at middle or high school. They described themselves as very experienced reflectors because they often reflected on their teaching. Reviewing their reflective narrative in their electronic portfolios, I can tell that they really took time to reflect on what they had selected for each standard, why they were there, how they were related to or used in their teaching, and what were their future goals.

One of the problems they reported was that they were not trained to organize their files at the beginning of the program so that they spent a lot of time in selecting artifacts later. Another thing which they regarded as a problem was the very short time allotted for their presentations. Nearly all of the participants implied that they worked very hard in developing their electronic portfolios. They began to collect artifacts when they started the program. They spent a lot of time in selecting artifacts, converting and reflecting, and designing the final products. There were many highlights in their portfolios which they were very proud of. But they didn’t have enough time to show these to their audience. That hurt their feelings.

Students suggested that 20-25 minutes would be proper for presenting their portfolios in order to give the audience a comprehensive view of their achievements in this program. They needed time to briefly introduce their background and teaching philosophy. They needed time to show at least one artifact for each standard and explain
why they chose that and how it matched with the standard. They needed time to conclude
their presentation.

*Meaning of Students’ Learning Experiences*

Students have different learning strategies and work at a different pace. From a
constructivist learning perspective, one can say that developing electronic portfolios
created a rich learning environment where students could actively construct their
knowledge through their own learning strategies. The flexibility in selecting artifacts,
designing layouts, and working out a timeline is an important component for situating
learning for the diverse needs and preferences of students.

The findings of this study confirm that students had a variety of learning
experiences despite the learning strategies they used. They gained confidence and a sense
of ownership of learning through these experiences. Students expressed that these
learning experiences were valuable for them because they were related to real life.

In this study, all of the students showed responsibility and initiative towards their
learning. The students made deliberate decisions to choose creating an electronic
portfolio instead of writing a research paper. They indicated that creating an electronic
portfolio allowed them to be active, independent, and motivated in their learning which
allowed them to focus on their learning goals and control their own learning. The
findings of this study imply that this kind of learning environment could help students to
control their own learning, and set their learning goals by building on their prior
knowledge.

Hein (1991) noted that students must learn to learn as well as accrue knowledge.
Students’ responsibility and initiative that were required in developing electronic
portfolios allowed students to become their own teachers. By being their own teachers, students could concentrate on what they think is important and what they want to learn. Analyzing the problems they encountered, trying out different solutions, and consulting peers were essential for the students in their process of learning by doing. The findings imply that creating an electronic portfolio can enhance students’ ownership of their learning.

The flexibility and self-directed nature of creating electronic portfolios were important for the students and allowed them to be more active and reflective on their learning. The students indicated that creating electronic portfolios gave them the opportunities to think and reflect on their thinking and learning. Students mentioned that reflection helped them to learn about what they learn and how they learn. They thought that creating the portfolios independently would help them retain the knowledge they experienced.

In this study, the students indicated that they needed to constantly remind themselves about the project they needed to work on. Motivating themselves to be organized with hundreds of files from different classes throughout the whole program was difficult; trying to follow their timeline on each stage in completing their electronic portfolios was even more difficult. This was challenging because it required disciplining themselves, managing their time and trying to be on task. Students mentioned that when they realized the importance of organizing files it was already too late. Nearly half of the students finished their final projects just before the due date so that they didn’t have time to check every detail in it. As a result, a couple of them ran into trouble in displaying their portfolios in presentation. This implies that creating electronic portfolios required
students to be self-disciplined, self-motivated, and organized. It also implies that creating electronic portfolios can enhance students’ skills for managing time and self.

The purpose of rich environments for constructivist learning is to help students construct their individual knowledge in authentic contexts and develop skills for critical thinking, problem solving, and lifelong learning. In this study, the students reported that electronic portfolios documented their progress over time and were directly related to their learning and teaching. Specially, students indicated by reviewing and converting artifacts and designing the layout of their portfolios through hands-on activities, trial and error methods, they would be able to retain the knowledge that they gained in this program and construct new knowledge upon their learning. Students felt that they would be able to use the knowledge and skills they learned in developing electronic portfolios in their professional development and teaching in the classroom. The implication of this study with regard to learning by doing in authentic contexts is that it allows students to develop a deeper and richer knowledge structure which is transferable in constructing new information.

Constructivists such as Vygotsky and Bruner believed that learners do not learn in isolation from others, and cognitive psychology has gradually established that people naturally learn and work collaboratively in their lives. Developing an electronic portfolio is an individual activity. It is the students themselves who decide the goals and contents of their portfolios, the artifacts they use to document their learning, and the formats they use to develop and present their portfolios. However, this study found that both peers and teachers played a very important role in this process and students learned most from their peers, especially from those who had similar experiences. The students reported that it
could be hard for them to finish their projects without the collaboration with their classmates. The implication of this study is that creating electronic portfolios encouraged collaboration among students.

According to Jonassen et al., students cannot learn directly from teachers or technologies; they learn from thinking about what they are doing. This study implies that students learned from the experiences of creating electronic portfolios when they were interpreting those experiences based on what they already knew, reasoning about them, and reflecting on the experiences. Bruner (1996) defined this process as meaning making, which is at the heart of constructivism. This study indicated that creating electronic portfolios helped the students to reflect where they had been, where they were, how they got there, and where they needed to go next.

**Recommendations**

This study confirmed that students had a variety of learning experiences while developing electronic portfolios. Findings from this study imply that as educational multimedia, hypermedia, and telecommunications become more and more accessible, electronic portfolios as a means of authentic assessment in graduate programs in teacher education can be meaningful and valuable in constructing knowledge. This study provided evidence that creating electronic portfolios not only helped students in critical thinking, problem solving, and self-assessing, but also made them active, independent, and motivated learners who reflect on their learning.

Findings from this study indicate that although students received information on developing electronic portfolios when they entered this program, they needed more detailed information than that when they started to plan the final products. It would be
helpful if there were a workshop or meeting for students to gather together so that they
get a chance to view a few samples from former students and discuss the design
requirements before their final quarter. It is also recommended that students should be
trained to organize their files in the first technology class.

Students in this study described positively their experience in learning by doing,
learning from trial and error, and learning from peers during the process of creating
electronic portfolios. However, this study showed that a majority of the students would
rather use a paper or a simple project to substitute for a complicated project if they had to
spend a lot of time fixing the problem in the original multimedia artifact. That meant
when they encountered a problem which was not easy to solve, they would give up that
artifact. Therefore, the researcher recommends that easy accessible on-going technical
assistance to students should be provided to students. On-going technical assistance
would not only save students’ time in dealing with a technical problem but give students
more options in their artifacts choices than what they could get now. This study showed
that the problem for one student is probably a common sense to another student. The
interactions between Lucy, Jane and the researcher in the observations were good
examples in showing how important the on-going technical assistance was.

This study showed that communicating, interacting, and collaborating with peers
was vital in dealing with technical problems and design. One recommendation is to set up
an online forum on the topic of electronic portfolios. All interested students could
subscribe to this forum. The forum could be on Blackboard course management system
or through a list serve. Students could post their problems online and get answers from
different perspective. This study showed that students liked to share their technical skills
with their peers because it is a learning process for both the giver and the acceptor. It also benefits those who encounter the same problems. If there is no response to a specific question, the instructor would provide some kind of response so that students know that the instructor is always there ready to help. An online forum would be especially helpful for those full-time teachers who live out of town and cannot come to the campus frequently. Cathy reported that emails helped her in dealing with the problems she encountered in developing her electronic portfolio. But she could only email her peers or instructor, which happened between two points. If communication occurred among multi-points like on forum, it would benefit more students.

Findings from this study indicate that the current guideline for assembling electronic portfolios gives students as much freedom as possible in deciding how to design their final portfolios, which motivates students’ creativity in design. However, findings from this study imply that this freedom became an excuse for those students who did not want to put more effort in developing their portfolios. As one student said, “What I saw from previous ones – they were not that technically advanced. It would be very easy to convert everything to PDF format and link to the HTML page.”

According to the standards, “being prepared to use technology and knowing how that technology can support student learning must become integral skills in every teacher’s professional repertoire” (ISTE, 2000, p. 2). These standards are general guidelines that preservice teachers and current teachers are expected to demonstrate as evidence that they are prepared to provide technology-supported learning opportunities for their students. It is appropriate for them to design simple portfolios with paper artifacts. However, my participants were M.Ed. students in Computer Education and
Technology. They need additional multimedia artifacts to demonstrate their professional training in technology from this program because the program not only prepares them to use technology more effectively in their teaching, but also to become technology leaders in their school or district. Suitable and sufficient multimedia artifacts would be one way to demonstrate their professional training and their capabilities in using technology as well as supporting other teachers in using appropriate technology in their classrooms. A couple of students indicated that paper artifacts could not document their technology skills that they gained in this program. However, they mentioned that with the current syllabus they were not very clear about the final product. Therefore, a rubric for evaluating students’ portfolio is recommended in this program. Research (Campbell, Melenyzer, Nettles, & Wyman, 2000) indicates that it is necessary to develop a systematic plan for evaluating electronic portfolios because clarity about the end product is the starting point for any excellent teacher preparation program.

Based on the findings from this study, the characteristics of developing electronic portfolios, and the M.Ed. students’ professional background, I recommend creating a rubric with four important parts in developing electronic portfolios: design, artifacts, reflection, and presentation. It needs detailed criteria for pass and fail combined with rating scales. This rubric will not only provide students with a detailed guideline in design, an accurate evaluation to their portfolios, but also help them to set their future learning goals.

After a long time of hard working, students finished their final product — the electronic portfolio, which is a systematic and organized collection of evidence concerning their professional competencies and personal growth. There are many
highlights in their portfolios which students were proud of and eager to show to their peers and advisors. The researcher recommends that their presentation time is 15-20 minutes in order to give the audience a fuller picture of what they have learned. Students should have time to show at least one artifact for each standard and have a few minutes to answer questions from the audience.

_Suggestions for Future Research_

This study focused on investigating and describing the learning experiences and learning processes that occurred as Master of Education students assembled their electronic portfolios in order to understand how these experiences affected their learning and how students constructed their individual knowledge in a technology-enriched learning environment. Since the focus of this study was the perceptions of students who chose electronic portfolios as their culminating projects, a question that needs more attention in a future study concerns the perceptions of instructors and the perceptions of those students who choose to write a research. Comparing the different perceptions will add much to our understanding in how creating an electronic portfolio helped students’ learning.

This study is limited to the experiences of seven M.Ed. students majoring in Computer Education and Technology in developing culminating electronic portfolios in a college of education. Therefore, the framework and questions of this study do not necessarily apply to undergraduate students and K-12 students because they may have learned in very different settings. It may not even apply to other M.Ed. students in the majors other than Computer Education and Technology. Therefore, this study could be replicated using a larger sample of M.Ed. students in other majors or undergraduate
students in teacher education in other settings. Additionally, for the students who have less experience with technology, it may be helpful to have a template for developing their electronic portfolios.

Additionally, the researcher did not spend much time and energy in exploring deeply in the following questions. How students’ personalities influence them in choosing their learning strategies? How gender differences influence their learning strategies? What role does cultural background play in students’ learning strategies? More research on these questions would add much to our understanding of how students construct their individual knowledge in the process of developing electronic portfolios.

Conclusion

This study has contributed to our understanding of the learning experiences and learning processes that occurred in developing electronic portfolios. It is apparent in this study that developing an electronic portfolio encouraged students to be active, independent, and creative in their learning; provided students with opportunities to review and synthesize the skills they had learned from different courses and motivated them to learn new applications; helped students to assess their own learning and achievements; and encouraged collaborative learning and high-order skills such as problem-solving, reasoning, and reflection.

The study has implications for learning environments in order to enhance or support collaborative, reflective, and meaningful learning. Viewing samples, collaborating with peers, and communicating and interacting with teachers are important for students in constructing their learning through developing electronic portfolios. Learning how to learn is vital for students in order for them to become lifelong learners.
Assembling electronic portfolios creates a technology-enriched learning environment for students to foster their knowledge and skills.
References


Course Description:
Students will develop a professional electronic portfolio and participate in a public showcase. The portfolio is the culminating experience for students in the Master of Education, Computer Education and Technology program.

Purpose:
Electronic portfolios can be developed for several different purposes:
   a. Learning portfolios - for ongoing professional development to show growth over time
   b. Assessment portfolios - for assessing whether you've met the objectives of a course
   c. Employment portfolios - for marketing yourself to prospective employers

The Masters Portfolio is a learning portfolio. It provides an opportunity for you to synthesize what you have learned in the Masters program, show your growth over time, and document that you have mastered the National Educational Technology Standards for Teachers (NETS·T) developed by the International Society for Technology in Education (ISTE).

The aim of the Masters Portfolio is to move from description to reflection. The task is to determine how various insights are instrumental in understanding professional growth in a more comprehensive way. While reflecting on our past actions, we generate knowledge that will inform our future actions.

Course Registration:
You register for a total of 3 credit hours for EDCT 693, preferably in the final year of your program. You may register for 1, 2 or 3 hr/ qtr but it must total 3 hours altogether. This year Dr. Huang is advising everyone for the Masters portfolio. Regardless of when you register for credit, you are expected to work on developing your portfolio throughout your program of studies.

Assignment:
Each student will produce an individual, standards-based learning portfolio on CD-ROM using appropriate multimedia tools. Each student will demonstrate his or her portfolio in
a public showcase for program faculty and students during finals week of the quarter of graduation.

**Evaluation:**
This is a pass/fail course. The possible grades are CR, PR, or F.

**Portfolio Structure and Contents:**

1. **Title page**
   Design a title page that expresses your personality.

2. **Table of contents**

3. **Introduction**
   Introduce who you are as an educator, a student, and a person. Items in this section that are **required** include:
   - Statement of your professional goals.
   - Statement of your personal philosophy of education.
   - Professional resume.

4. **Evidence of NETS for Teachers Standards**
   Provide evidence to illustrate your achievement or mastery of the national standards in the field of computer education and technology. For each NETS standard, include:
   - Standard - state the standard. Artifacts - list sample artifacts that provide evidence you have met this standard and link to the actual artifact.
   - Reflections - write a reflective paragraph discussing how the artifacts you have selected illustrate your growth in meeting this standard.
   - Future learning goals - briefly state your goals for further learning related to this standard.

Artifacts in this section **might** include:
- Research papers, tests, projects, reports, etc. that are indicators of your growth. Annotated bibliography of theorists you have determined as important to your understanding.
- Analysis of important books, monographs, videos, audio tapes, articles that you have read, seen or heard.
- Sample segments of non-print projects you have developed.
- Video tape segments of your teaching or of presentations you have made (at least one video clip is required; limit clips to two minutes each).
- Exhibits of your use of technology personally.
- Exhibits of your use of technology as a teaching tool.
• Exhibits of your integration of technology into teaching.
• Exhibits of your leadership in the use of technology in educational settings.

5. Synthesis

Reflecting on all that you've learned as part of the Masters program, how has your coursework, both theoretical and practical, helped you to meet your professional goals?

Portfolio Format:
1. Choose your software
   • Word - save as PDF
   • Acrobat - save as PDF
   • FrontPage - save as HTML
   • PowerPoint - save as HTML
2. Link to your artifacts, which may be any kind of files
3. Save all your files on a recordable CD

Recommended Texts and Resources:

Bibliography:


I. Teachers demonstrate a sound understanding of technology operations and concepts.

A. Teachers demonstrate introductory technology literacy knowledge, skills, and concepts (described in the ISTE NETS Technology Foundation Standards for Students).

B. Teachers demonstrate sustained growth in technology knowledge and skills to stay abreast of contemporary and emerging technologies.

II. Teachers plan and design effective learning environments and experiences supported by technology.

A. Teachers design developmentally appropriate learning opportunities that apply technology-enhanced instructional strategies to support the diverse needs of learners.

B. Teachers apply current research on teaching and learning with technology when planning learning environments and experiences.

C. Teachers identify and locate technology resources and evaluate them for accuracy and suitability.

D. Teachers plan for the management of technology resources within the context of learning activities.

E. Teachers plan strategies to manage student learning in a technology-enhanced environment.
III. Teachers implement curriculum plans that include methods and strategies that apply technology to maximize student learning.

A. Teachers facilitate technology-enhanced experiences that address content standards and student technology standards.

B. Teachers use technology to support learner-centered strategies that address the diverse needs of learners.

C. Teachers apply technology to develop students' higher order skills and creativity.

D. Teachers manage student’s learning activities in a technology-enhanced environment.

IV. Teachers apply technology to facilitate a variety of effective assessment and evaluation strategies.

A. Teachers apply technology in assessing student learning of subject matter knowledge and skills using a variety of assessment techniques.

B. Teachers use technology resources to collect and analyze data, interpret results, and communicate findings to improve instructional practice and maximize student learning.

C. Teachers apply multiple methods of evaluation to determine students' appropriate use of technology resources for learning, communication, and productivity.

V. Teachers use technology to enhance their productivity and professional practice.

A. Teachers use technology resources to engage in on-going professional development and lifelong learning.

B. Teachers continually evaluate and reflect on professional practice to make informed decisions regarding the use of technology in support of student learning.
C. Teachers apply technology to increase productivity.

D. Teachers use technology to communicate and collaborate with peers, parents, and the larger community to nurture student learning.

VI. Teachers understand the social, ethical, legal, and human issues surrounding the use of technology in PreK-12 schools and apply those principles in practice.

A. Teachers model and teach legal and ethical practice related to technology use.

B. Teachers apply technology resources to enable and empower learners with diverse backgrounds, characteristics, and abilities.

C. Teachers identify and use technology resources that affirm diversity.

D. Teachers promote safe and healthy use of technology resources.

E. Teachers facilitate equitable access to technology resources for all students.
Title of Research: Learning Experiences in Developing Electronic Portfolios in a Master’s Educational Technology Program: A Case Study

Principal Investigator: Shuyan Wang

Department: Educational Studies

Federal and university regulations require signed consent for participation in research involving human subjects. After reading the statements below, please indicate your consent by signing this form.

Explanation of Study  The purpose of this study will be to investigate the learning process that occurs as Master of Education students assemble their electronic portfolios at Ohio University. The study will explore the experiences in which students go through related to their electronic portfolios, and how these experiences affect their learning. The researcher will interview those Med. students who develop electronic portfolios, observe their learning processes and presentation showcases, and analyze their electronic portfolios. The researcher will audiotape each interview and videotape the presentation showcase as the first-hand materials for transcription afterwards. The research participation will start about February 28th and will continue until the end of the summer quarter, August 28th.

Risk and Discomforts  There are no foreseeable risks for the participants involved with this study.

Benefits  Research in this area will benefit the course instructors for future improvement of their instruction. The information provided in this research will allow student and faculty, especially OU teacher education faculty, to make more reasonable choices about how to utilize the electronic portfolios. This research will provide data for future comparative and empirical research. With the interviews and observations, the research will provide first-hand detailed data, which will be valuable to future researchers. The findings of this study will inform teacher educators and others about the value and effectiveness of electronic portfolios as one option of assessing students’ achievements.

Compensation  There is no compensation for participating in the research.

Confidentiality and Records  The researcher will strive to protect every participant’s confidentiality. No results will be reported using real names or pseudonyms to protect the
participants’ identities. All survey data, video recordings and subsequent transcripts will be kept locked in a secure location and will be destroyed once the analysis is complete.

**Contact Information**  If you have any questions, you may contact Shuyan Wang at 593-6414 or at sw245192@ohiou.edu.

If you have any questions regarding your rights as a research participant, please contact Jo Ellen Sherow, Director of Research Compliance, Ohio University, (740)593-0664.

Please indicate your willingness to participate in the research by signing the notification below. You are free to withdraw your consent and stop participation at any time. You may keep a copy of this document for your records.

I certify that I have read and understand this consent form and agree to participate as a subject in the research described. I agree that known risks to me have been explained to my satisfaction and I understand that no compensation is available from Ohio University and its employees for any injury resulting from my participation in this research. I certify that I am 18 years of age or older. My participation in this research is given voluntarily. I understand that I may discontinue participation at any time without penalty or loss of any benefits to which I may otherwise be entitled. I certify that I have been given a copy of this consent form to take with me.

Signature ________________ Date ________________

Printed Name ______________________
Appendix D

First Round Interview Questions

1. What did you do before entering this program?
2. Tell me something about your background in technology?
3. How long have you been in this program?
4. What technology related classes did you take? How do you like them? Why?
5. Why do you choose electronic portfolios as your final project?
6. What stage are you on?
7. When will you plan to finish it?
8. How do you collect and select your artifacts? Give me an example.
9. What do you think reflection means?
10. How do you expect to show your growth over time?
11. How are you matching artifacts with standards? Give me an example?
12. Describe your experience in creating electronic portfolios up to now?
13. Describe your learning style.
14. What kind of problems do you think you might encounter?
15. What will you do if you come across a problem in creating electronic portfolio?
16. What kind of support do you need in developing your electronic portfolio?
17. Did you attend an orientation meeting about electronic portfolios? Was that helpful?
18. Have you attended a showcase of other students? What did you learn?
19. Have you been consulting with your advisor or faculty? Have you been consulting with other students who finished or currently working on electronic portfolios?
Appendix E

Second Round Interview Questions

1. How do you feel of your showcase?
2. If you will do it again, will you improve anything in your portfolio?
3. Describe the stages you went through in developing your electronic portfolio?
4. Did you follow your time line? If not, why?
5. How did each stage affect your learning? How did you benefit from the process?
6. How did you reflect on your artifacts?
7. How do you value the reflection on your artifacts?
8. What do you think is the best way to support your learning?
9. Describe how your electronic portfolio is evaluated?
10. What were the problems/difficulties in the process of developing your electronic portfolio? How did you solve them?
11. Approximately how many hours did you spend each day on this project?
12. How did your role change as a learner in this environment?
13. What were the learning strategies and activities involved in this process?
14. How do you value your learning experiences in this process?
15. Do you find it more challenging to create an electronic portfolio than writing a paper? Why? Or Why not?
16. How do you feel of choosing an electronic portfolio instead of a master research project? Are you glad or regret of doing so? Why?
17. What are the advantages and disadvantages about creating an electronic
portfolio?

18. What recommendation would you make to other students who plan to do an electronic portfolio?

19. Have you thought of sharing your electronic portfolio with future students? Why?

20. Have you thought of using electronic portfolios in your classroom? Why?
Appendix F

Interview Questions: Combined First and Second Rounds

1. Life history: What did you do before entering this program? How much did you know or use technology before entering this program? Why did you choose this program? What are you expecting from this program? How long have you been in this program? What have you learned? Why did you choose electronic portfolios as your final project?

2. Designing the e-portfolio: Did you attend an orientation meeting about electronic portfolios? Was that helpful? Have you attended a showcase of other students? What did you learn? Have you been consulting with your advisor or faculty? Have you been consulting with other students who finished or are currently working on electronic portfolios? What kind of support do you need in developing your electronic portfolio?

3. Procedures: How do you collect and select your artifacts? Give me an example. How are you matching artifacts with standards? Give me an example? Describe the stages you went through in developing your electronic portfolio? How does each stage affect your learning? How do you benefit from the process?

4. Reflection: What do you think reflection means? How did you reflect on your artifacts? How do you value the reflection on your artifacts?

5. Learning strategies: Describe your learning style. What do you think is the best way to support your learning? How did your role change as a learner in this environment? What were the learning strategies and activities involved in this process? How do you value your learning experiences in this process?
6. Problems: How many hours did you spend each day on this project? What were the problems/difficulties in the process of developing your electronic portfolio? How did you solve them?

7. Why did you decide to choose an electronic portfolio instead of a Master’s research project? Are you glad or do you regret doing so? Why? Do you find it more challenging to create an electronic portfolio than writing a paper? Why or why not? How did you feel about your showcase? If you had time to do it again, what would you change in it? What recommendation would you make to other students who plan to do an electronic portfolio?

8. Have you thought of sharing your electronic portfolio with your students and colleagues? Have you thought of using electronic portfolios in your classroom? Why?