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Making the Case for the Use of Web-Based Portfolios in Support of Learning to Teach

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Abstract

Portfolios have been used in teacher education in different formats, in a variety of ways and for different purposes. Portfolios can be used as evaluation tools, to illustrate good teaching, to demonstrate progress, to integrate collection of work, to share work, and to support reflection and professional growth. In this paper we demonstrate through a review of the literature how portfolios have been used in teacher education and we discuss how hypermedia portfolios have been gaining popularity among teacher educators due to their potential to overcome the limitations of the traditional paper portfolio: failure to capture dynamic and complex processes of teaching and learning, danger of a portfolio becoming a mere exhibition, photocopying and storage problems. We argue that portfolio development, hypermedia authoring, and the Web-based forum combined has the potential to provide a powerful learning tool for prospective teachers. We propose a model of Web-based portfolio in service of supporting reflecting thinking and learning to teach at the elementary school. This model includes two main components: (a) three versions of a personal, evidence-based philosophy about teaching and learning developed and revised over a semester, and (b) a collection of evidence consisted of course assignments.

In recent years, the notion of a "portfolio" has become easily recognizable as a part of the everyday language. Portfolio refers to a collection of work. Financial investors manage stock market portfolios; artists collect and display selected pieces of their work in art portfolios; teachers create teaching portfolios to demonstrate their professional growth; and students develop portfolios for assessment purposes. In areas such as art, music, architecture, and even modeling, portfolios might contain samples of artists' works, musicians' compositions, architects' conceptions, or models' photographs (Olson, 1991, p. 73). Olson (1991) reported that a portfolio was originally defined as a portable case for carrying loose papers or prints, *port* meaning to carry and *folio* pertaining to pages or sheets of paper. Today *folio* refers to a large collection of materials, such as documents, pictures, papers, work samples, audio or videotapes (p. 73). Collins (1992) identified different images of the portfolio:

> For some the term portfolio conjures images of artists displaying their creative products and actors carrying large, black, leather folders of photographs

> representing their theater performances; for others a portfolio is a record of financial investments. There are other images of portfolio, such as the catalogue of a salesperson, which provides evidence of the person's ability to deliver work done by someone else. There is the sash of badges worn by a boy or girl scout which provides evidence of accomplishments done. (p. 453)

Knapper (1995) stated that the central idea of a portfolio is relatively simple and perhaps best exemplified by the traditional way that a creative artist assembles samples of "best work" for presentation and review. However, in education, portfolios have a fairly unique connotation and history.

Portfolios in Education

Yancy (1992) explained that the use of portfolios in schools began with K-12 students constructing portfolios about their writing abilities, and has evolved to serve as vehicles for students to represent what they have learned in a variety of curricular areas (Cole, Messner, Swonigan, & Tillman, 1991; Collins & Dana, 1993; Knight, 1992). Yet portfolios have been used in education in different ways and for different purposes. Some education portfolio uses include assessment of reading and writing (Mathews, 1990; Valencia, 1990), professional development (Cole, 1990), teacher evaluation (Furwengler, 1985), and job searches (Uphoff, 1989). More recently, portfolios have received renewed interest due to their potential to support learning.

According to Dana and Tippins (1998), recently educators have explored the possibilities and pitfalls of portfolios as tools in the education and evaluation of teachers (Adams & Hamm, 1992; Bird, 1990; Geiger & Shugraman, 1988). Wolf (1994) stated that the belief among educators that portfolios can greatly enhance student and teacher learning has fueled an intense exploration of portfolios across a variety of educational contexts (Dana & Tippins, 1998, p. 720). Conference presenters, journal authors, state policymarkers, and school district personnel alike laud the portfolio as an alternative to grading, a means for measuring student learning, and a tool for reflective thinking (Graves & Sunstein, 1992, p. 63).

Portfolios in Teacher Education

Portfolios have been used in teacher education in different formats, in a variety of ways and for different purposes. The diversity of the functions and uses of portfolios have consequently produced multiple definitions depending on the purpose that the portfolio serves. Initially portfolios were associated with a scrapbook that included "things" that had been saved and which could eventually be shown to a prospective employer (Aschermann, 1999). Portfolios also were described as a purposeful, integrated collection of work (Paulson, Paulson, & Meyer, 1991), and as an extended resume (Wolf, 1994).

Portfolios can be used to demonstrate effort, progress, and achievement (Barrett, 1998) and to illustrate good teaching (Aschermann, 1999). According to Wolf (1991) portfolios can

give teachers a purpose and framework for preserving and sharing their work and stimulate them to reflect on their own work and on the act of teaching. Other purposes of portfolio development involve the enhancement and development of teaching skills (Collins, 1990), the encouragement of reflection upon one's teaching (Richert, 1990), and professional growth through collegiality (Shulman, 1988). As Lyons (1998a) suggested, "the portfolio may be considered from three perspectives: as a credential, as a set of assumptions about teaching and learning, and as making possible a powerful, personal reflective learning experience" (p. 4).

Portfolio development in teacher education is a relatively new approach. Although portfolios have a prized history with other professions, they were introduced into teacher education only in the 1980s. The origins of the portfolio idea in teacher education lie in the work of Lee Shulman and the creation of the National Board for Professional Teaching Standards in 1989. The portfolio approach was the answer to the efforts of the Stanford Teacher Education Program to craft a form of assessment that represented ways in which teachers had developed. As Shulman (1998a) noted, "Portfolios permit the tracking of documentation of longer episodes of teaching and learning, encourage the reconnection between the process and the product and institutionalize norms of collaboration, reflection, and discussion" (p. 36).

Wolf (1991) stated that in recent years portfolios have gained fairly wide acceptance in teacher education. Portfolios have been used at every phase of teacher development: during the early stages of preparation, in student teaching and in internships, and in pursuing career-long professional growth and development (Bartell, Kaye & Morin, 1998). Not only have portfolios been widely used in different phases of teacher development but they also have been used for different purposes. Graves and Sunstein (1992) illustrated that conference presenters, journal authors, state policymakers, and school district personnel laud the portfolio as an alternative to grading, a means for measuring student learning, and a tool for reflection.

Portfolios in Support of Reflection and Learning

The ability to engage in reflective practices has been widely addressed in the literature as one of the most important activities associated with teaching. As Dewey (1933) stated, "Reflection is an active, persistent, and careful consideration of any belief or supposed form of knowledge in light of the grounds supporting it and future conclusions to which it tends" (p. 6). Engaging prospective teachers in thoughtful reflection has been identified as playing an important role in learning to teach (Yost, Setner, & Forlenza-Baily, 2000). Many studies have been reported regarding the need for reflective practices in teacher preparation programs (Dana & Tippins, 1998; Dewey; 1933; Dollase, 1996; Schon, 1983). It is increasingly common for teacher education programs to provide a reflective pedagogy in which prospective teachers are encouraged, through a variety of strategies, to develop a critical understanding of their practice and their conceptions of it (Dana & Tippins, 1998, p. 721).

Teacher preparation programs have explored a number of approaches for attempting to support prospective teachers' reflection and learning. Bird (1990) stated that very little support is given to teachers to encourage them to observe and reflect upon their teaching. He suggested that portfolios are a logical vehicle for this type of activity because they provide a systematic,

continuous way of planning, supporting and monitoring a teacher's professional advance (p. 244). A number of other studies also suggest that portfolio development may be a useful tool for supporting thoughtful reflection (Dana & Tippins, 1998; McKinney, 1998; Zembal-Saul, 2001, Wade & Yarbrough, 1996). Through the portfolio development, prospective teachers reflect on their experiences, interrogate their practices, understand their effects on students, and shape their practices (Lyons, 1998a).

Portfolios in Support of Scholarship of Teaching

Portfolio development also can support scholarship of teaching and learning because of its potential to support reflection and make prospective teachers' work transparent (Shulman, 2000). "Scholarship" has three features: (a) public community property, (b) openness to critique and evaluation, and (c) a form others can build on (Hutchings & Shulman, 1999). Making work transparent implies the possibility of peer review, overcoming isolation, and improvement of the quality of teaching. As Shulman (2000) argued, "By engaging in purposive reflection, documentation, assessment and analysis of teaching and learning, and doing so in a more public and accessible manner, we not only support the improvement of our own teaching but our colleagues as well" (p. 50).

Furthermore, portfolio development has the potential to engage prospective teachers in thinking about theories and practices. Shulman (1995) pointed out that to be good teachers, they must understand not only the subject they are trying to teach and the general methods of teaching but they must also understand how to transform the particular concepts in their field into terms that their students will understand (p. 2). During the portfolio development process, prospective teachers are required to make connections between what they learn in university coursework, specifically teacher education programs, and what they apply in their practices. Portfolio development can facilitate connections and reflections between theory and field experiences (Morris & Buckland, 2000).

Portfolios in Support of Knowledge Construction

Growing evidence supports the argument that portfolios have the potential to support knowledge construction. Constructivism frames learning as a process in which learners actively construct their own knowledge (Dana & Tippins, 1998). Hunter (1998) illustrated that the process and production of a portfolio coincides with a constructivist view of learning because prospective teachers are actively challenged to build a personal interpretation of their teaching and to learn how and when to improve their practice. Similarly, Freidus (1998) argued that the theory behind portfolios meshes with a basic Deweyan idea that learning involves an experiential continuum in which new knowledge is built up and mediated by prior knowledge.

Previous Studies on Portfolio Development

Several studies have been conducted to investigate the use of portfolios in teacher education programs. For example, Dana and Tippins (1998) proposed a model of portfolio for science teaching as a form for self-reflection and evidence of the prospective teachers' thoughts and understandings of what it means to learn and teach science to children. For their study, prospective teachers were asked to identify a problematic aspect of science-specific pedagogy, and then collect and select evidence demonstrating what they knew and were able to do about it. In addition, prospective teachers had to organize the evidence for presentation in the teaching portfolio and to engage in conversations with their peers about their thinking, growth and development. The science teaching portfolios were required to have an opening statement expressing the portfolios' purpose, a variety of evidence with tags or captions, and a reflective synthesizing statement (Dana & Tippins, 1998). As the researchers suggested, "The science teaching portfolio framework should be viewed as a flexible mechanism that can be adapted in a host of ways to encourage documentation of knowledge, skills and disposition and promote reflection on professional growth" (p. 724).

Other researchers described the issue of documenting knowledge and skills through portfolio development as well. For example, a study by Wade and Yarbrough (1996) documented how prospective teachers make personal meanings through portfolio development. Prospective teachers created portfolios in order to document their learning and growth in a community service-learning project as part of a social studies methods course. The participants included a wide range of materials in their portfolios, including artwork, cartoons, songs, poems, articles, cards, letters, photos, favorite quotes, and journal entries. Three data collection methods were used in this study: prospective teachers' essays; surveys; and standardized, open-ended interviews. The results of the study indicated that many of the participants noted the personal meaning, satisfaction, and sense of accomplishment that resulted from creating their portfolios. Furthermore, many of the prospective teachers demonstrated reflective thinking in the process of their portfolio construction. Evidence found by the researchers demonstrated that the prospective teachers were making sense of their community service-learning experience, developing new understandings of and recognizing links between different aspects of their life experience, and formulating insights for future options.

As the results of this study suggest, with careful attention to the introduction of the portfolio and guided support throughout the portfolio creation period, many prospective teachers will invest themselves in the process, enhancing not only their abilities to think reflectively but also their enthusiasm for learning about themselves, others, and the process of teaching. However there are some limitations in the development of traditional paper-based portfolios.

Limitations of Traditional Paper-based Portfolios

Shulman (1998a) referred to the danger of a portfolio becoming a mere exhibition; if the notion of exhibition dominates, then style or glossiness begins to take control rather than

substance. A problematic issue related to portfolio development is whether or not it leads to greater reflectivity and to improvement in the quality of instruction of the prospective teacher (Dollase, 1996). Wolf (1991) stated:

> A portfolio can be defined as a container for storing and displaying evidence of a teacher's knowledge and skills. However, this definition is incomplete. A portfolio is more than a container—a portfolio also represents an attitude that assessment is dynamic, and that the richest portrayals of teacher performances are based upon multiple sources of evidence collected over time in authentic settings. (p. 129)

Traditional paper-based portfolios often fail to capture dynamic and complex processes of teaching and learning. Depending on the way that they are used, traditional paper-based portfolios could be nothing more but a container of papers put together to demonstrate knowledge and abilities. Paper-based portfolio development enhances the danger of paying too much attention to the final product rather than on the process. Other drawbacks of the traditional paper portfolios have to do with the substantial photocopying costs (Dollase, 1996) and storage problems (Aschermann, 1999). A solution to these problems appears to be in the use of hypermedia technology.

Hypermedia Technology

Hypermedia is a technology for defining meaningful units of information (nodes) and making meaningful connections (links) among them (Smith, 1994). Jonassen (1996) defined hypermedia as a way of representing and organizing information using electronically connected networks of nodes, which are the basic units of storage in hypermedia.

A large number of studies have looked at the effects of hypermedia authoring on learning (e.g., Hay, Guzdial, Jackson, Boyle, & Soloway, 1994; Jonassen, 1996; Jonassen, Myers, & McKillop, 1996; Landow, 1992; Pea, 1991). Hay, Guzdial, Jackson, Boyle and Soloway (1994) suggested that the most fruitful use of hypermedia in education lies in looking at the effect on the student empowered with technology within a constructionist paradigm. In this paradigm, students are empowered to actively construct multimedia artifacts. Hypermedia presentations use a variety of learning styles and strategies that allow learners to negotiate meanings and construct knowledge based on their own learning style and needs. Hypermedia allows the author to layer meanings onto a text, thereby promoting deeper consideration and understanding of ideas through the creation of broader multimedia intertextuality (McKillop, 1996). Specifically, in teacher education, hyperlinking allows prospective teachers to connect coursework, applications, ideas, and themes through a network of designed nodes (Jonassen, 1996).

Recently, a new hypermedia tool has come to be of great interest while it gains popularity among teacher educators and promises to overcome the limitations of the traditional paper portfolio: the electronic portfolio.

Electronic Portfolios

An electronic portfolio may be defined as "a purposeful collection of work, captured by electronic means, that serves as an exhibit of individual efforts, progress, and achievements in one or more areas" (Wiedmer, 1998, p. 586). Electronic portfolios differ from traditional portfolios in that information is collected, saved, and stored in an electronic format (Barrett, 1998).

Numerous advantages associated with the use of electronic portfolios have been suggested by the literature. Barrett (1998) noted that electronic portfolios are a unique way to document student progress, encourage improvement and motivate involvement in learning. Bull, Montgomery, Overton and Kimball (1999) argued that electronic portfolios promote learner self-evaluation as they maximize the use of diverse learning strategies. McKinney (1998) agreed with this assertion and added that electronic portfolios provide opportunities to seek out and form connections in dynamic, nonconventional, and learner-controlled ways.

Many studies have been reported regarding the use of electronic portfolios in teacher education (e.g., Aschermann, 1999; Barrett, 1998; Glasson & McKenzie, 1999; McKinney, 1998). Morris and Buckland (2000) reported the use of Hyperstudio to develop multimedia portfolios in an elementary teacher preparation program. In this study, prospective teachers were asked to document their work with children with artifacts from their experiences. According to the authors, the prospective teachers were encouraged to select particular products that would showcase their learning, and in a caption, to provide the context of their document and justify their selection with a reflective statement. The evidence that was used in the prospective teachers' portfolios included papers, homework, video, pictures, projects, diagrams, notes, animation, prospective teachers' voices, and music. The findings of this study support the notion that in constructing their portfolios, prospective teachers learn from the development process and the product as well, while they demonstrate their ability to use integrated technology. One of the assertions made from this study was that, "Electronic portfolio documentation using hypermedia software offers better management, storage, and distribution with the added value of providing a tool that promotes higher order thinking and creativity" (p. 4).

Similar conclusions have been drawn by Glasson and McKenzie (1999) who examined the development of multimedia portfolios for enhancing learning and assessment in a science methods class. Their study focused on the portfolio development of a group of four prospective teachers who planned three days of investigative science activities with middle school students. According to the researchers, the activities engaged students in collecting and identifying macro-invertebrates to assess stream quality. The students worked in groups to negotiate pertinent aspects of development along the stream, such as where to locate homes and industry. The prospective teachers collected information and documented their learning and students' learning using a multimedia authoring tool. They included in their portfolios videotaped interactions with students, scanned samples of student work, digitized photographs, curriculum plans, and written assessments of their learning. As Glasson and McKenzie (1999) concluded,

> Developing a hypermedia presentation enabled prospective teachers to construct and develop their ideas about teaching and learning. The portfolios document the progress of prospective teachers as they developed curriculum and taught children at a local stream and in the classroom. (p. 337)

A type of hypermedia portfolios is the Web-based portfolio.

Web-based Portfolio

The Web-based portfolio may be defined as "a user's hypertextually linked set of electronic texts that have been created for and placed on the World Wide Web" (Watkins, 1996, p. 219). The World Wide Web acts like a global, distributed hypermedia system. It provides a standard for structuring applications as hypertext documents that can be "published" on the Internet (Boyle, 1997). The literature suggests that the Web-based forum has more to offer in addition to the benefits of other types of electronic portfolios.

The Web, as both a technology and an interface, enables the prospective teachers' ultimate control in assembling or reorganizing, as well as the ability to integrate narrative captions among the learning evidence to emphasize the interrelated nature of learning (Watkins, 1996). In addition, the Web forum has added advantages related with organization issues. According to Pierson and Rapp (2001) the Web is the most promising primary storage format for portfolios due to its flexibility, accessibility, and compatibility. As Morris and Buckland (2000) noticed, Web-based portfolios are easy to edit, permitting a continuity of documentation of growth with the control of distribution in the hands of the prospective teacher.

Furthermore, Web-based portfolio development provides the opportunity for revisions. Substantial revisions involve reflection on course content encompassing processes like reordering and reevaluating, resulting in new insights (Yates, Newsome, & Creighton, 1999).

Another aspect of the Web-based forum is its public nature since it makes the portfolio available to a variety of audiences. As Pierson and Kumari (2000) illustrated, the Web environment permits prospective teachers the flexibility to maintain their portfolios in a Web-space that can be remotely accessed from anywhere at any time, by the prospective teacher, faculty, peers, and potential employers. Moreover, the Web-based portfolio has the potential of being viewed by a greater number of people. Thus, greater effort and pride is taken to create a public document (Aschermann, 1999).

In addition, the public nature of the Web-based portfolios provides the opportunity for prospective teachers to give and receive feedback from peers or professors instantly. They are easier to share, making it possible for prospective teachers to see a variety of exemplars, view other perspectives of teaching and learning, and challenge their own practices and beliefs (Morris & Buckland, 2000).

Previous Studies on Web-based Portfolios

Research in the area of Web-based portfolio development is limited. However, the few findings are consistent and suggest that the Web-based portfolio development is a constructivist process that facilitates connections between concepts and practices (e.g., Avraamidou, 2001; Avraamidou & Zembal-Saul, 2001; Avraamidou & Zembal-Saul, 2002, Milman, 1999; Morris & Buckland, 2000; Watkins, 1996, Zembal-Saul, 2001).

A study by Milman (1999), for example, suggested that engaging prospective teachers in Web-based portfolio development results in engaging them in reflective activities while connecting coursework and field experience. In this study, Milman (1999) documented the use of the World Wide Web to create electronic teaching portfolios in a pilot prospective teacher education course as a tool for reflection. The objectives of the course were for prospective teachers to create electronic teaching portfolios, to reflect upon their coursework and teaching experiences, and to become more proficient with the technology. The purpose of this study was to investigate how prospective teachers created their portfolios, what they learned as a result of creating their portfolios and what they saw as the advantages and disadvantages associated with using the World Wide Web. The class was taught in a multimedia laboratory and the software program utilized to create portfolios was Claris Home Page. Interviews with the participants, analysis of their journals, and observations in their classes revealed that the process was constructivist, demanding, and multifaceted. The prospective teachers reported that the process of creating electronic teaching portfolios was very positive, resulting in reflection about themselves as teachers. Through the process of analytic induction of the participants' journals, interviews, and observations, the following assertion was made: "Creating electronic teaching portfolios is a constructivist process that promotes an examination of prospective teachers' beliefs, philosophies, objectives, and purposes for teaching" (Milman, 1999, p. 3).

Web-based Portfolios in Support of Learning to Teach

A large number of studies have looked at the effect of portfolio development on supporting learning to teach. Other studies have investigated the use of hypermedia in teacher education. However, the role of hypermedia authoring and portfolio development combined in support of learning is largely unexplored. The two innovations of portfolios development and hypermedia authoring combined has the potential to provide a powerful learning tool for prospective teachers. Given the strong evidence that portfolio development supports reflection and knowledge construction, the large contribution of hypermedia authoring to conceptual development, and the advantages of the Web, why not combine the Web-based forum and portfolio development? If our goals, as teacher educators, are to help prospective teachers become independent and lifelong learners, develop their own teaching philosophies, construct knowledge, and be self-reflective and able to present information in a variety of ways, then we must provide them with the appropriate tools. Web-based portfolio development seems to be a promising approach due to its potential to support reflection and understanding of what it means

to be a teacher. Particularly in this paper, we propose the use of Web-based portfolios in service of supporting reflective thinking and learning to teach at the elementary school.

We argue that Web-based portfolios can be used to assist prospective teachers in developing meaningful understandings about teaching and learning. Using the Web-based forum to develop portfolios is intended to provide prospective teachers with opportunities to connect their personal theories of teaching and learning with their field experiences. In addition, the Web-based forum has the potential to facilitate the development of dynamic and complex interconnections among claims made by prospective teachers and multimedia evidence used to support those claims.

Particularly, we propose a model of Web-based portfolios which includes two main components: (a) three versions of a personal, evidence-based philosophy about teaching and learning developed and revised over a semester, and (b) a collection of evidence consisted of course assignments. Examples of the main page of the portfolios and a piece of evidence are presented in Figures 1 and 2.

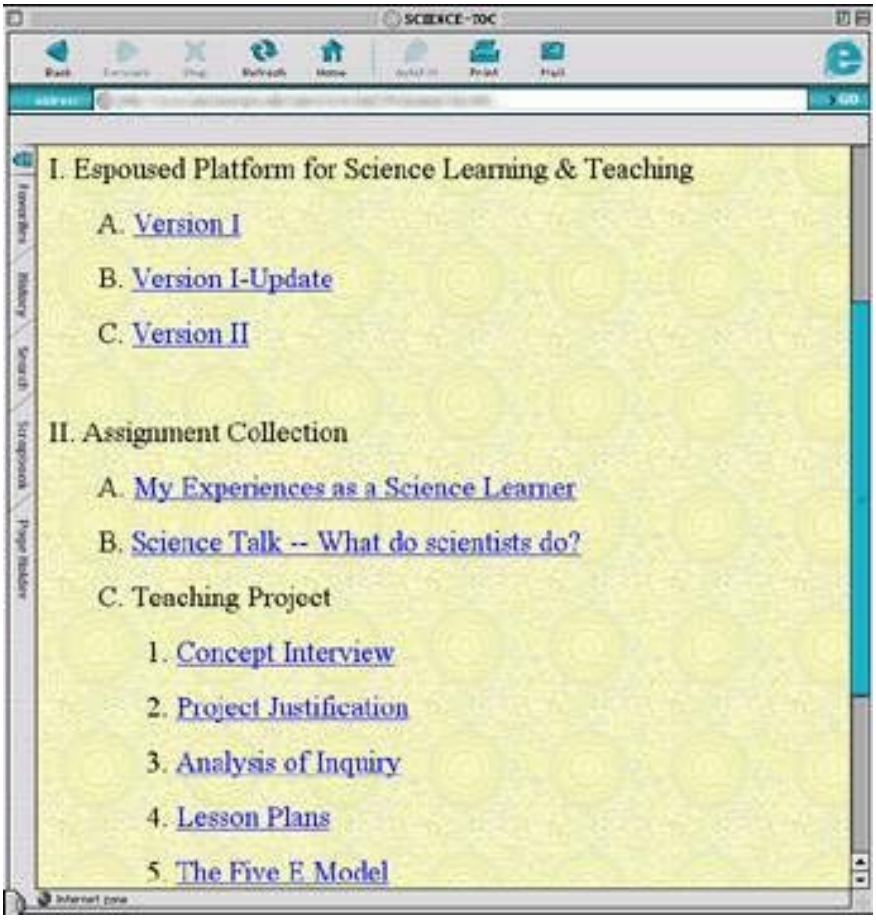

Figure 1. **Sample of the main page of Web-based portfolios.**

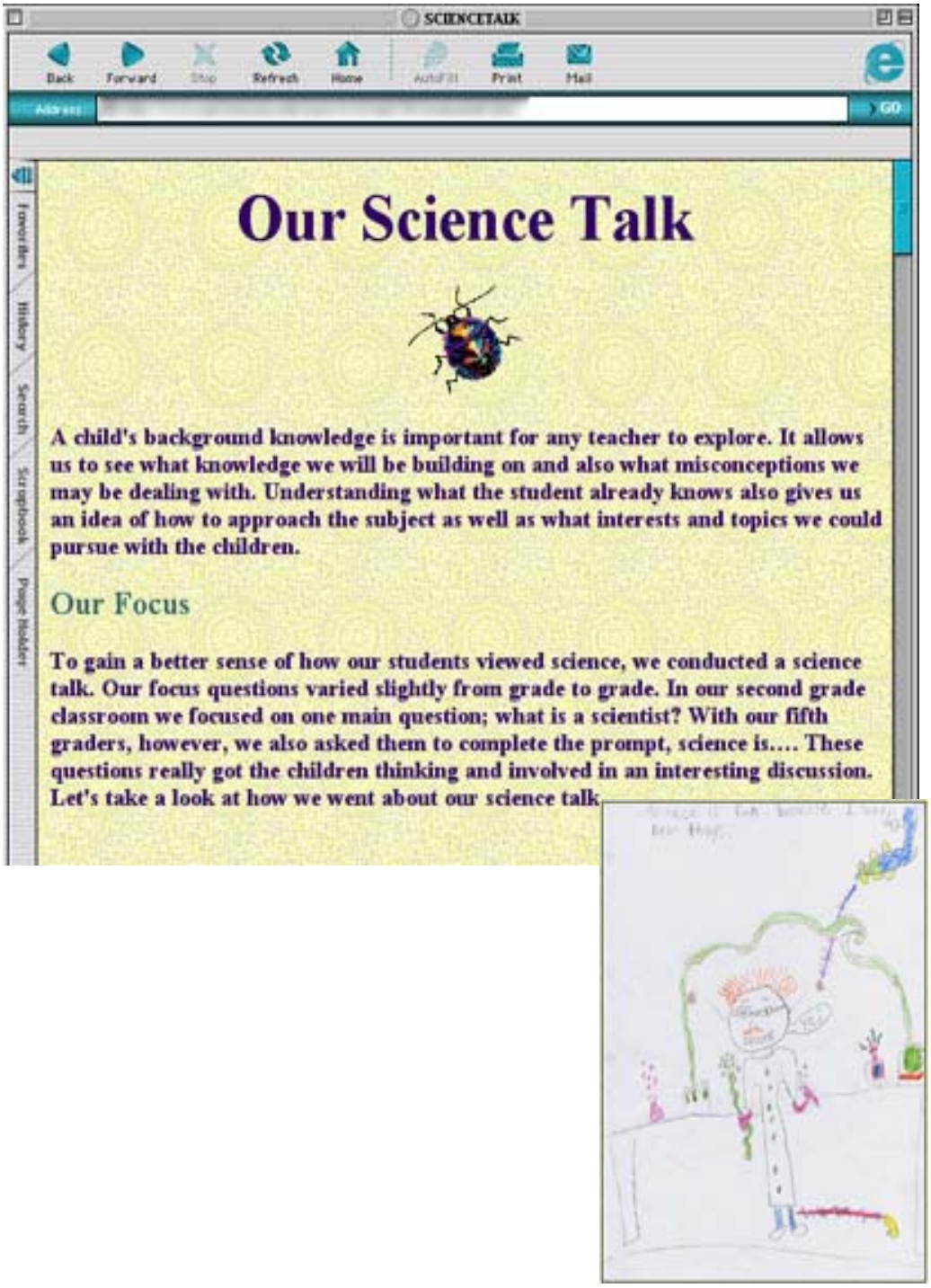

Figure 2. **Sample of evidence used to support claims.**

Web-based portfolios are to be used by prospective elementary teachers as tools for (a) developing personal theories about teaching and learning explicitly and publicly, (b) promoting reflection on personal theories in light of new experiences and learning, and (c) facilitating the development of connections among theory and practice.

Developing Personal Theories

This model of Web-based portfolios can support prospective teachers in articulating their personal theories about teaching and learning, externalizing their thinking, and also can provide us (as researchers and as teacher educators) with an insight into their thinking, their prior knowledge, and beliefs about teaching and learning.

Many researchers have argued that by the time prospective teachers get to college they hold well-established beliefs and practices related to being a teacher (Pajares, 1992). These beliefs include ideas about what it takes to be an effective teacher and how students ought to behave. Although usually unarticulated and simplified, these ideas are brought into teacher preparation programs (Clark, 1988; Nespor, 1987). Not surprisingly, these views of teaching and learning have been shown to influence classroom teaching practice (Pajares, 1992). Therefore, targeting prospective teachers' views about teaching and learning is essential to supporting their professional growth. It is important to make prospective teachers' views on learning and teaching explicit, to discuss and analyze these views critically, and to encourage prospective teachers to reflect on these views and their implications for science instruction (Aguirre & Haggerty, 1995).

Studies have suggested that people learn when they are prompted to articulate the steps taken during their thinking processes and to reflect on their own learning (e.g., Collins, 1990; Collins & Brown, 1988). Web-based portfolios provide a place where prospective teachers can articulate their science teaching philosophies and present them in a hypermedia format. In particular, Web-based portfolios make prospective teachers' thinking visible and document their growth. As Loughran and Corrigan (1995) noted, "A major focus of the process of developing a portfolio and the product is to help prospective teachers begin to articulate their understanding of what they think it means to be a teacher" (p. 574).

An emerging characteristic of a teacher as a professional is this ability to articulate, evaluate, engage in, and respond to criticism about teaching, their own practice, and student learning (Lyons, 1998b). As Shulman (1998a) stated, portfolios institutionalize norms of collaboration, reflection and discussion. Perhaps the most striking consequence of a portfolio process for new teacher professionalism is the creation of new norms for teachers, that is, making public discussion and debate about what constitutes good teaching (Lyons, 1998b). Shulman (1998b) noted the importance of communicating ideas:

> Having to take our teaching from the private to the public sphere, having to think about how we are going to engage in it, but also how we will come to understand what we are doing as teachers in ways that will permit us to organize what we do, display and communicate and converse about it to our own community, will have an improvement effect on teaching. (p. 12)

Through the Web-based portfolio development, prospective teachers are required to clearly articulate their views of teaching and learning and support them with evidence from their learning experience. Thus, they communicate their personal views and philosophies to the public sphere where they can serve as targets of discussion and change.

Promoting Reflection and Metacognition

We believe that the model of Web-based portfolios that we propose can serve as a vehicle for prospective teachers to reconsider and reevaluate their views of teaching and learning in light of new learning experiences. The development of the Web-based portfolio is a constructivist process that requires prospective elementary teachers to reflect and critically examine their own beliefs and ideas about teaching and learning. As Perkins (1986) stated, central to the vision of constructivism is the notion of organism as active: engaging, grappling, and seeking to make sense of things.

The development of a personal teaching philosophy requires prospective teachers to think about their knowledge, understandings, ideas, and beliefs about learning and teaching. Web-based portfolio development provides the vehicle through which prospective teachers can explore their understandings of learning to teach, through the development of different versions of their teaching philosophies. According to Hoban (1997), prospective teachers should be encouraged to be metacognitive and become more aware of how they learn in teacher education courses with the intention of informing their decision-making as they construct their personal pedagogies.

The Web-based forum supports the engagement of prospective teachers in meaningful reflection since it allows them to keep multiple versions of their philosophies. Thus, prospective teachers can look back to prior versions of their philosophies, build on their initial ideas, revise their views about teaching and learning and easily reorganize their philosophies. Prospective teachers are able to view how their philosophies change over time, which supports a continuous engagement in metacognition, self-evaluation and self-reflection.

Providing a Dynamic Representation of Knowledge

The multimedia possibilities of Web-based portfolios allow prospective elementary teachers to make nonlinear, dynamic representations of their teaching philosophies. Another aspect of the Web-based forum is the use of multimedia. Multimedia refers to communication from multiple media sources such as text, audio, graphics, animated graphics, and full motion video (Sharp, 1999). When developing their Web-based portfolios, prospective teachers can use a variety of multimedia artifacts to present information from their coursework and their field experiences. Specifically, they can use text-based descriptions of activities, reflective statements on activities, pictures of themselves and their peers participating in activities, pictures of their students participating in activities, samples of their students' work, and samples of worksheets.

According to Morris and Buckland (2000), by compiling the portfolios in a Web-based environment, prospective teachers are able to use the hyperlinking capabilities to organize the presentation in such a way that demonstrates their unique understanding of their own learning. The hypermedia component fosters connections between coursework, concepts, and applications because it allows the individual to designate links between ideas and themes (Morris & Buckland, 2000). Through the hyperlinking process, prospective teachers can make connections between their coursework and field experiences, between their claims, evidence, and justification statements which results in an interconnected presentation of their learning experiences.

Conclusions

As illustrated in the literature (e.g., Avraamidou, 2001; Avraamidou & Zembal-Saul, 2001; Avraamidou & Zembal-Saul, 2002; Milman, 1999, Morris & Buckland, 2000, Zembal-Saul, 2001) Web-based portfolios can make a powerful tool for supporting learning to teach. This is based on the potential of Web-based portfolios to engage prospective elementary teachers in meaningful reflection, which influences their ideas about learning and teaching. A study by Avraamidou and Zembal-Saul (2002) exploring the influence of Web-based portfolio development in support of learning to teach elementary science revealed a shift in the participants' understandings about science teaching and learning. Specifically, the participants became more sensitive to children's thinking, placed more emphasis on teaching science as inquiry, and became attentive to what teachers can do to support children's science learning throughout the semester.

Many studies have concluded that it is very difficult to influence prospective teachers' prior ideas about learning and teaching (Aguirre & Haggerty, 1995; Calderhead, 1989; Gustafson & Rowell, 1995; Hollingsworth, 1989). Calderhead (1989) questioned whether teacher education courses really do encourage prospective teachers to reflect and supported his inquiry with the observation that prospective teachers' prior ideas are "highly influential in shaping what prospective teachers extract from their preservice training, how they think about teaching, and the kind of teacher they become within the classroom" (p. 47).

Web-based portfolios provide a dynamic and powerful pedagogical tool since they combine the potential of hypermedia to support making thinking visible and enhance learning and the potential of portfolio development to support reflection and metacognition. If a central aspiration of the portfolio process is to make teachers reflective of their own learning, to recognize that learning is a lifelong process, then that learning is beginning to accrue to their students as well (Lyons, 1998b). As Wolf (1998) argued, "Creating a portfolio culture for students and teachers demands new skills, new visions of being a professional, and the commitment of each school community to its students and teachers—it is a necessary challenge holding great possibilities" (p. 50).

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