

Designing ePortfolio 2.0: Integrating and Coordinating Web 2.0 Services with ePortfolio Systems for enhancing Users' Learning

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ABSTRACT

An educational ePortfolio usually contains work that a student has collected, reflected, designed, and published to demonstrate personal learning and growth over time. However, previous studies have shown that traditional ePortfolio systems lack flexibility, peer review, and group collaboration. Without these features, ePortfolios do not have the benefits of social learning or Communities of Practice. In this paper, we propose a new design that integrates and coordinates emerging Web 2.0 services into ePortfolio systems to enable community-wide annotation, interaction, and collaboration, with the goal of enhancing the learning experience for individuals as well as the community. We review relevant literatures, theories, and development of traditional ePortfolio systems. We conduct a preliminary survey study to explore users' perceived values in ePortfolio and Web 2.0 services. The survey results show opportunities to design a new generation of ePortfolio systems enabled with Web 2.0. We illustrate and discuss an ePortfolio 2.0 conceptual model, and a system prototype.

Keywords: ePortfolio, Web 2.0, System Design

1. INTRODUCTION

Electronic portfolios (ePortfolios) may support social learning if enhanced with Web 2.0 services. Currently, ePortfolios are "a collection of electronic artifacts or evidence demonstrating what one knows and can do" (Wikipedia, 2007a). They are used in academia for various purposes, such as for assessment, for career planning, and for documenting and demonstrating personal learning and growth over time. A successful ePortfolio system must include ease of use, advanced features, a robust integrated technology architecture, lifelong support, standards, and transportability (Jafari, 2004). And a "true" learning portfolio should contain three fundamental components: documentation (a structured record of the student's work over a period of time), reflection (on the contents of the students' learning experiences), and collaboration (with teachers, student mentors, and an entire learning community the student elects to participate in) (Zubizarreta, 2004). However, traditional ePortfolio systems are usually limited by the existing infrastructure of a particular course or an educational organization, and its compatible technologies. Because of these limitations, the influence of ePortfolio systems in supporting effective, collaborative learning cannot be fully realized.

In this paper, we develop a design for an ePortfolio system with Web 2.0 features and demonstrate how such a design has the potential to enhance student learning. "Learning is the process of direct and indirect experience and observation", where knowledge is an internalized result of learning through individual efforts and social interactions" (Pollard, 2006). Human beings learn in different ways: concrete experience, observation and reflection, abstract conceptualization, and active experimentation (Kolb, 1984). The most basic way of learning includes observation (i.e., seeing or hearing). For example, students gain knowledge through lectures; reading books and newspapers; watching television; surfing the Web; and observing behaviors of and conversing with their teachers, parents and peers. When computer science students write programs, they test whether they can apply their knowledge from lectures (e.g., syntax and logic) in an effective and efficient way. The students generate reflections and personal insights during practice, and they explore and develop a chain of logic.

Berger and Luckmann (1967) state that one's knowledge of everyday life is structured in terms of relevance, is socially distributed, and "is possessed differently by different individuals and types of individuals" (pp. 46). Thus, the social distribution of knowledge of

certain elements of everyday reality can become highly complex and even confusing to outsiders (pp. 45-46). Constructivist learning theories (Bruner, 1966; Piaget, 1950; Vygotsky, 1978; Wood, 1998) also support that learning is an active, social process. For example, students learn through interacting with people in school, at home, in public and online. They exchange information they know, and sometimes work on a project together.

Lave and Wenger (1991) first introduced the term "Communities of Practice" (CoP) to refer to "the process of social learning that occurs when people who have a common interest in some subject or problem collaborate over a period of time to share ideas, find solutions, and build innovations" (Wikipedia, 2007c). Wenger (1998) further extended the work of CoP to organizational and educational learning. His "Social Theory of Learning" model integrates the following components necessary to characterize social participation as a process of learning and of knowing: "Meaning (learning as experience); Practice (learning as doing); Community (learning as belonging); and Identity (learning as becoming)" (pp. 5). Wenger suggests that learning should be primarily a practice of identity formation and modes of belonging, and not just accumulating skills and information.

While ePortfolios are widely used in today's educational institutions to foster learning and teaching (McGrath, 2005), the idea of learning as community and identity is not instantiated in the design and development of current ePortfolio systems. In the following sections, we review the development of general ePortfolio systems in recent years, analyze their strengths and limitations, and discuss the usage of Web 2.0 services in educational settings. Based on the aforementioned literature and theories, we ask two research questions: 1) Will ePortfolio users experience a better learning effect using collaborative ePortfolio systems than those using traditional ePortfolio systems? 2) How can Web 2.0 services be effectively integrated and coordinated with the design of ePortfolio systems to support collaborative activities?

Students in any discipline, including Information Systems, can use an ePortfolio system. As such, this paper is not unique to IS education. Yet, it clearly fits the topic because it demonstrates how IS educators can devise solutions for their own students as well as those from other disciplines. IS educators have knowledge about applications design and development that can be generalized for the benefit of all students and faculty.

2. DEVELOPMENT OF EPORTFOLIO SYSTEMS

2.1 Form-driven and Flow-fixed ePortfolio Systems

As Internet usage continuous to increase, many educational institutions have either purchased commercial ePortfolio systems or built their own from scratch. These systems use common web-based forms and presentation features (McGrath, 2005). These web-based ePortfolio systems employ built-in forms and pre-determined workflow to facilitate student and faculty creation of online portfolios for their credentials and academic work. Although these ePortfolio systems offer robustness and ease of control for IT staff, the underlying design model is rather limited and rigid due to the inflexibility in how to manage the flows and appearance of the contents (e.g., text, multimedia, and web

links) (Jafari, 2004). In addition, these ePortfolio systems are not applied to a full range of uses such as peer review and group collaboration (McGrath, 2005). As a result, such systems have not realized the benefits of a web-based virtual learning environment that fosters electronic interaction and discussion within a community of learners and provides access to a wide range of resources on the Internet (Piccoli and Ahmad, 2001).

2.2 Flexible and Portable ePortfolio Systems

During recent years, a new generation of web-based ePortfolio systems has emerged offering both users and administrators more flexibility and portability (e.g., KEEP toolkit and Open-Source Portfolio (OSP)), also showing practical interests of integrating with current Learning or Course Management Systems (L/CMS) and learning environments. OSP is an open source project that has recently been integrated into the Sakai collaborative learning environment (CLE) to provide ePortfolio tools and services. OSP was developed with six priorities (Open-source Portfolio, 2006): "1) Usability and Customization; 2) Assessment and Accreditation; 3) Integration Interfaces; 4) Scholarship of Teaching and Learning; 5) Templates; and 6) Portability". The open source nature of this Java-based web application makes it easy to collaborate, test, and share new features and functions desired by educational practitioners. From a design perspective, in addition to the form-based and wizard-based portfolio building scheme, OSP also allows users to customize portfolio templates by utilizing web standards, such as using XSLT stylesheets for the user input forms, CSS stylesheets for the presentation view facilities, and XHTML stylesheets for customized templates. In the most recent Sakai version 2.3, OSP tool was enhanced with comments and a WYSIWYG editor. However, several limitations exist in OSP. Like discussion forums, chat rooms, blogger, wiki (discussed in Section 3) and many other Sakai tools, OSP is only accessible through a course or project site, thus interactions and collaboration with peers outside the classroom are restricted. Furthermore, there are not many connections between the contents of each tool except that users can make internal links to the files stored in "resources" (i.e., the shared file repository in a Sakai course or project site). In addition, users need skills and knowledge of XHTML, XSLT, and CSS stylesheets, or must rely on a system administrator or instructional technologist in order to create customized portfolio templates.

KEEP toolkit is a Carnegie funded ePortfolio project developed by the Knowledge Media Laboratory (KML). To use KEEP, users can either register at the KEEP web site (with over 16,000 registered users), or download the source code and install on a server. Distinctive features of KEEP include a user-friendly snapshot in which users can edit, add, delete, or move content blocks of the portfolio, and a dashboard (Figure 1) that supports portfolio management, e.g., stitching multiple pages together to make a portfolio web site.

Furthermore, KEEP allows users to attach evidence to portfolio blocks in various formats (e.g., WORD, PDF, GIF, and JPEG). KEEP also allows users to publish their portfolios to a publicly accessible URL, but does not allow annotation. KML hosts an online forum for stimulating discussions in the community of KEEP users and

developers. In a discussion thread called "Groups and Sharing" in the KEEP forum list "Desired Functions", many users have requested group feedback / comments, and easier ways of sharing portfolios with others.

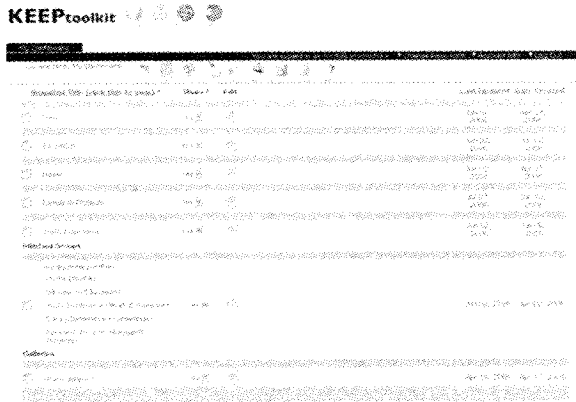


Figure 1: KEEP toolkit Version 1.8.4 Dashboard

KEEP also integrates with other educational systems and web applications. For example, the project team developed a plug-in for Sakai CLE as a one-stop authentication for the KEEP Toolkit. It authenticates a Sakai user into KEEP and displays the Toolkit's Dashboard as a Sakai tool. The team also developed a digital repository integration where content generated using KEEP is imported/exported as a standard package to/from other repositories (e.g., DSpace and FEDORA). KEEP also demonstrates collaborative vision. The most recent release (version 1.9.8) allows users to apply tags or keywords to snapshots, stitched groups, and galleries. The team is currently working on launching a searchable public archive that will consist of work by the tens of thousands of KEEP users and enable world-wide knowledge and experience sharing. With the open source nature and collaborative vision of the KEEP toolkit, we believe that it could be a suitable platform to implement, test and evaluate the integration and coordination between Web 2.0 services and ePortfolio systems to promote community-wide reflection and learning.

2.3 Opportunities with Future ePortfolio Systems

The increasing popularity of student community web sites (e.g., MSN Groups "PhD students," Phinished.org, and Eurodoc.net) is also evidence that the aforementioned services are in high demand. For example, we subscribed to the MSN Groups "PhD students" newsletters for six months and observed that about 10 new members join the online group each week. According to the site statistic reports of Phinished.org (Phinished.org, 2007), an average of 200,000 pages are requested from the web site per month and 30 messages are posted on the discussion forum per day. Many members of these web sites have requested and/or offered academic advice, knowledge sharing, collaboration, and even emotional support. However, since both the aforementioned web sites provide only traditional community services such as forums and chats, space is limited where members can organize and demonstrate

detailed processes, plans, academic or research work. Members who wish to obtain further peer assessment, support, or collaboration have to rely on other communication channels such as email or meetings, which may not be feasible or sufficient.

Meanwhile, faculty and students want more attractive technology options to be built into formal course experience, including multimedia (e.g., audio and video) and collaborative tools like Flickr, Facebook, MySpace, de.lic.ious, and wikis. Poorly implemented synchronous communication tools (e.g., whiteboard, chat, group surfing) were often mentioned as the reality of L/CMS and were not used by students (Jafari, A., McGee, P. & Carmean, C., 2006). Recent innovations in both commercial (e.g., WebCT, Blackboard) and open source (e.g., Sakai, Moodle) L/CMS have responded to the faculty and students' requests by implementing discussion forums, blogs and wikis to support collaborative activities. However, access to these tools is usually limited to the students, instructor and teaching assistants within the class. Most importantly, these tools are usually distributed to the course site with little connection to each other. For example, there is no direct way for users to link certain blog entries or wiki pages to an assignment or a portfolio page. The most common way to connect is to link the files from repository or archive to blog entries or wiki pages. As a result, students may have to generate repetitive knowledge and information in different tools, and instructors may have to increase their workload to review them. Rather than providing multiple stand-alone tools or applications and expecting users to figure out how to make the best use of them, we explore in this paper whether there is a better way to integrate and coordinate these collaborative tools with ePortfolio systems so that collaborative contents can connect to existing course materials (e.g., portfolios) more effectively and efficiently.

3. WEB 2.0 SERVICES AND EDUCATION

Instead of providing simple static information or downloads, today's World Wide Web has become a platform that offers dynamic services and applications that emphasize online collaboration and sharing among users. These philosophies of the programmable Web are referred to as Web 2.0 in the industry (Wikipedia, 2007b). MySpace, Friendster and Facebook are examples of rapidly expanding collaborative social networking communities. Furthermore, Web-based social software allows people to meet in virtual spaces and share common interests (Wenger, 1998), significantly enhances knowledge accessibility, sharing and creation, and increases the productivity and flexibility of collaborative work (Raman, Olfman & Ryan, 2005; Richardson, 2006). Wikipedia, Digg.com, de.lic.ious and Salesforce.com are some well-known examples.

Today's students are "digital natives" who have grown up immersed in the uses and etiquette of computers, digital cameras, cell phones, text messaging, weblogs (blogs), and the like (Prensky, 2001). On the other hand, teachers are generally less facile with these tools. Richardson (2006) demonstrates how Web 2.0 tools can make classroom technology easily accessible to classroom research, writing, and learning. He states that Web 2.0 tools can help strengthening students' critical thinking, writing, and

reflection; and engage students in a new world of information sharing and social learning. For example, students use blogs to voice their opinions, wikis to collaborate, social bookmarks to share Internet resources, and podcasts to review their class lectures. Barrett (2005) noted that technology tools such as “blogs, reflective journals, online discussions, self-report surveys, and digital storytelling” can engage learners in reflection, support learning, and create portfolios. Tosh and Werdmuller (2004) discussed the possibility of merging weblog technology with ePortfolios to integrate portfolio contents with users’ learning experiences. They explored how XML-based content management, searching through weblogs, and weblog feed auto-discovery can be accomplished using web services and search engine mechanisms, as well as how these technologies can be applied to syndicating and searching through ePortfolios.

Table 1 provides an overview of several mainstream Web 2.0 tools and their potential usage in ePortfolio systems.

4. EPORTFOLIO 2.0 USER READINESS SURVEY

We conducted a preliminary survey studies to explore: 1) How often students use Web 2.0 services in learning, professional development and personal goals; 2) Whether they perceive Web 2.0 services as critical features in ePortfolio Systems; and 3) What barriers they perceive in using general ePortfolio systems. The survey was designed and published using an open source survey software “PHP Easy Survey Package” (PHPESP). PHPESP was chosen because it creates dynamically generated online questionnaires with automatic capture and tabulation of results in real-time. A snowball sampling method was used. Survey invitations were sent via email to randomly selected students at Claremont Graduate University, who were also asked to send the survey to their classmates and friends. Survey invitations were also posted on the discussion forums of Phinished.org and MSN Group “PhD students”. The survey questionnaire (Appendix A) consists of twelve questions in three sections: Biographical Information, Usage of Technologies, and Perceptions of ePortfolio systems. The questions were designed in different formats including multiple choice, five-point Likert scale, and an essay text box. A combination of submission time and the participant’s IP address were examined to prevent “voting” more than once (ballot stuffing). A total of 44 valid and completed surveys were received. The surveys were analyzed using SPSS; the statistics are shown in Appendix B. Most participants were 26-30 years old (47.7%), doctoral students (68.2%), going to school full-time (77.3%), and majoring in IS or Computer Science (75%). 27.3% of the participants had used an ePortfolio system; another 18.2% only heard or read about ePortfolio systems. Since the survey was used as a preliminary study to explore users’ perceptions of using Web 2.0 and general ePortfolio systems, validity and reliability were not the focus of the study.

Although web browsing, email, and Microsoft Office were reported as the most used technologies, participants also reported noticeable usage of Web 2.0 services including: wikis or other collaborative writing tools (79.5%), blogs or online spaces (70.5%), social

bookmarking (70.5%), and podcasting or RSS (50%). Multimedia sharing sites (e.g., Flickr and YouTube) were especially popular (88.6%), which shows potential interests in using such services in an ePortfolio system for sharing knowledge with others. Most participants rated the following critical ePortfolio services and features as somewhat to very important: “Collaborate with professors, colleagues, and friends in your portfolio development” (86.4%), “Be able to customize your ePortfolio” (77.3%), “Design your ePortfolio easily” (79.5%), and “Reflect on your learning achievements, strengths, and gaps” (75%).

However, most participants noted that the following issues were somewhat or definitely barriers to use ePortfolio system: lack of connection (i.e., extra work, little connection to coursework and other external contents) (68.2%), time consuming (65.9%), and not being able to find appropriate software or applications (56.8%).

Table 2 shows that participants who are IS or Computer Science students tend to use blogs and wikis for learning, professional development, and personal goals more often than those participants who are majoring in other fields. Also, the more ePortfolio experience the participants had, the more often they used wikis and social bookmarking, and the higher they rated the importance of having Web 2.0 services in ePortfolio systems.

Several participants offered suggestions and comments related to using Web 2.0 in ePortfolio systems.

- “Ability to add friends and create a social network. Forwarding email alias so interested parties could contact me.” (Participant 5)
- “It would be nice to be able to attach files from repository to support contents of portfolio sections.” (Participant 7)
- “I like the idea linking portfolio pages to my blogs so people can get to know more about the project that I am describing in the portfolio.” (Participant 8)
- “Maybe a comparison as to how others in same academic program are progressing.... updates on important conferences and journals.” (Participant 42)
- “Using tags and RSS feeds will make ePortfolio easy to search, syndicate and podcast, like the one at <http://www.flickr.com/photos/tags/>.” (Participant 43)

Overall, the survey results present opportunities to design a new generation of ePortfolio systems enabled with Web 2.0.

5. A PROPOSED EPORTFOLIO 2.0 SYSTEM

Figure 2 shows a conceptual model for a new generation of collaborative ePortfolio systems, which we refer to as “ePortfolio 2.0” systems. In addition to traditional ePortfolio activities (i.e., collecting, reflecting, designing, and publishing), the model suggests engaging students, peers, faculty and institutions into learning as community, in which they share and exchange knowledge and reflection (“annotate”), interact and collaborate on projects that they are mutually interested. The characteristics of an ePortfolio 2.0 system are: 1) Ease of use and flexibility; 2) Knowledge sharing; 3) Community-wide reflection and interaction; and 4) Knowledge collaboration. To demonstrate the implementation of the proposed ePortfolio 2.0 model, we

Tools	Descriptions	Potential Usage in ePortfolio Systems
Blogs and Blog Connections	A blog, also known as Weblog, is an online personal journal that is frequently updated and shared with the general public. A blog site typically contains reflections (blog entries), comments, hyperlinks (e.g., blogroll) and multimedia contents. Blogging has increased in its popularity from education (e.g., edugadget.com), to politics (e.g., blogforamerican.com) to corporations (e.g., Microsoft community blog).	Learning blogs facilitate students, peers, faculty and institutions to record and share knowledge, learning, and research experience. Connecting to existing learning blogs not only helps portfolio owners keep track of their project progress and acquire feedback from readers, but also helps readers get a detailed picture of the project development, which may result in more valuable feedback.
Wikis	A wiki is "a freely expandable collection of interlinked Web Pages, a hypertext system for storing and modifying information- a database where each page is easily editable by any user with a forms-capable Web browser client" (Cunningham & Leuf, 2001, pp. 14). Many academic institutions and enterprises have adopted wiki technology as their collaborative software (Raman, Olfman & Ryan, 2005).	The ability of transforming portfolio pages to/from wiki pages can facilitate collaborative activities such as project communication, publication modification, and knowledge construction for a group of ePortfolio users. The wiki idea can also be borrowed to design a group collaborative portfolio writing module within ePortfolio systems.
RSS and Atom Syndication	RSS is an abbreviation for "Really Simple Syndication". Both RSS and Atom are specified in XML and used for Web syndication by providing web content or summaries of web content together with links to the full versions of the content, and other metadata. In addition, RSS and Atom allow a website's readers to track updates on the site using an aggregator.	With RSS or Atom feeds, readers can configure their aggregator to receive automatic updates of the portfolio site as the contents change. Portfolio owners can also get automatic updates when readers post comments to their portfolio sites. This is particular valuable for learning portfolios that are constantly updated or involve collaboration.
Podcast	Podcast refers to "audio contents available on the Internet that can be automatically delivered to user's computer or MP3 players" (Geoghegan & Klass, 2005, pp. 5). However, a podcast can also represent any type of file (e.g., a Word document or a PowerPoint presentation) as long as it is defined in XML formats for the same purpose.	With podcast service, subscribed ePortfolio users can download and retrieve an updated multimedia portfolio, such as a recent conference presentation, automatically. The podcast feature may also assist enhancing learning at a lower transaction and search cost.
Social Bookmark	Social bookmarks allow users to share internet resources via tagged web addresses. Popular social bookmark sites such as del.icio.us allow searchable tagged bookmarks that entail a community knowledgebase that extends beyond an individual resource. Users can subscribe to RSS to automatically retrieve up-to-date bookmarks.	With a social bookmark tool, ePortfolio users can easily accumulate and share Internet resources, which may enhance the efficiency of learning and researching.

Table 1: Web 2.0 Tools and ePortfolio Systems

		A	B	C	D	E	F	G	H	I
Major 1 = IS major 2 = Non-IS	Pearson Correlation	-.309*	-.324*	.010	-.023	-.053	-.186	-.173	-.242	-.067
	Sig. (2-tailed)	.041	.032	.950	.882	.732	.226	.261	.114	.667
	N	44	44	44	44	44	44	44	44	44
ePortfolio Experience 1 = None 2 = Heard/Read 3 = Used	Pearson Correlation	.121	.517**	.372*	.202	.232	.132	.373*	.455**	.454**
	Sig. (2-tailed)	0.435	0.000	0.013	0.188	0.130	0.393	0.013	0.002	0.002
	N	44	44	44	44	44	44	44	44	44
A = Use of Blogs; B = Use of Wikis; C = Use of Social Book Marking; D = Use of Podcast; E = Use of Multimedia; F = Critical Blogs; G = Critical Comments; H = Critical Collaboration; I = Critical Communities of Practice.										
**. Correlation is significant at the 0.01 level (2-tailed). *. Correlation is significant at the 0.05 level (2-tailed).										

Table 2: Correlations

developed a system prototype that focuses on four collaborative activities supported by Web 2.0 technologies: Annotation, Blog Connection, Collaborative Writing, and Site Syndication. The prototype was developed based on the KEEP toolkit because of its ease of use, portability and open source nature.

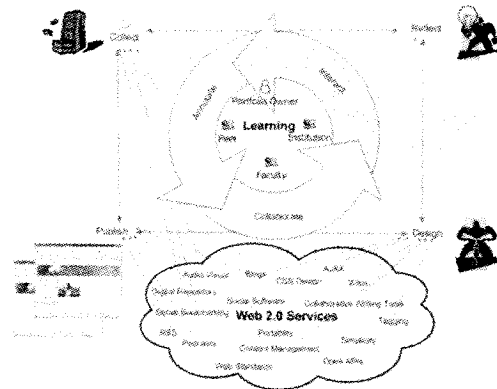


Figure 2: A conceptual model of ePortfolio 2.0 systems

Figure 3 shows a Web 2.0 enhanced dashboard interface that allows portfolio owners to manage not only portfolio pages and other digital resources, but also various collaborative activities which original dashboard (Figure 1) doesn't support. Portfolio owners have a personal digital repository called "Gallery", which they use to collect and organize any digital items (e.g., papers, presentations, audio, and video) they choose. Once items are stored in the digital repository, the portfolio owner may access, organize, select, and attach them to any portfolio page within the system. The Portfolio owner can decide whether to make a digital item private or sharable with public. The portfolio owner can design a portfolio as either a single web page, or multiple pages (i.e., a stitched portfolio group); each page incorporates a design that presents knowledge objects selected and organized for a particular purpose. The portfolio owner can reuse any page or a template to build new portfolio pages by simply copying and editing. On the dashboard, the portfolio owner can also manage whether to share a portfolio ("Share?" column on Figure 3), let others comment on it ("Comments?" column), connect it to external blog sites ("Blog?" column), allow collaborative portfolio writing ("Wiki?" column), or enable RSS feeds ("RSS?" column). Innovative Web 2.0 services such as open APIs and content management - as well as web standards, simplicity, and portability - make these features and tools possible and convenient to develop.

Figure 4 shows the editing interface for a portfolio page named "My Research Projects". Each content box is a building block of the entire portfolio page. Within a box, the portfolio owner can edit, delete, move (in four directions) the box, or add a new box. The portfolio

owner can edit content in a WYSIWYG editor, or cut and paste content from other applications into the editor. He/She can edit or add internal or external hyperlinks with the click of a mouse and without HTML skills. The portfolio owner can also attach supporting evidence to the portfolio by selecting an item/file from the digital repository. The portfolio owner can preview a snapshot of the portfolio page on the browser at any time.

Students learn through constant reflection on their experiences. As weblogs become popular in today's classroom practice and everyday life of "digital native" students, we propose that instead of simply providing an external link of the blog site, an ePortfolio system can connect to existing learning blogs through one-time configuration so students can record and share their learning experiences and reflections that are relevant to portfolio contents such as a class project, a book, or a seminar. Such reflection can serve as the contents of a portfolio and can be utilized as instruments to enhance the portfolio owner's learning processes. To connect to an external blog site, the portfolio owner needs to set up with certain information (e.g., API Endpoint of the external blog site, login information) depending on the type(s) of his/her existing blog site(s) (e.g., Blogger.com, WordPress, or TypePad blog) to the ePortfolio system. With blog connection, two activities can be supported:

Blog-this: Portfolio owners can blog about any portfolio page within the ePortfolio system (using a web-based form) without having to login to the blog site. A snapshot and a hyperlink of the portfolio are also automatically posted to the blog site when the portfolio owner submits the form. This blog connection feature has emerged in popular social networking Web sites recently, including flickr.com, where people can share and blog about a picture they took; and Diigo.com, where people can share and annotate about a Web site they found.

Relevant blog entries: Based on the tags of the portfolio and the blog entries, the ePortfolio system automatically matches relevant blog entries with specific portfolio contents, extracts and displays them. By linking relevant portfolio contents and blog entries together, portfolio readers are able to learn more about the stories behind the portfolio contents, which typically are an abstract of hard work and learning experiences over a period of time. Readers are also able to exchange their feedback and reflection by annotating on either the portfolio page or the blog entries. On the other hand, the portfolio owner can also view comments and suggestions made by the readers at any time during the design process and improve his/her portfolio based upon such collaborative knowledge. Portfolio owners are able to control whether relevant blog entries are shown on the published portfolio page.

Figure 5 shows an example of the extracted relevant blog entries (tagged with the keyword "Sakai") by the ePortfolio system to match with the "Sakai project" block within the "Research Project" portfolio page.

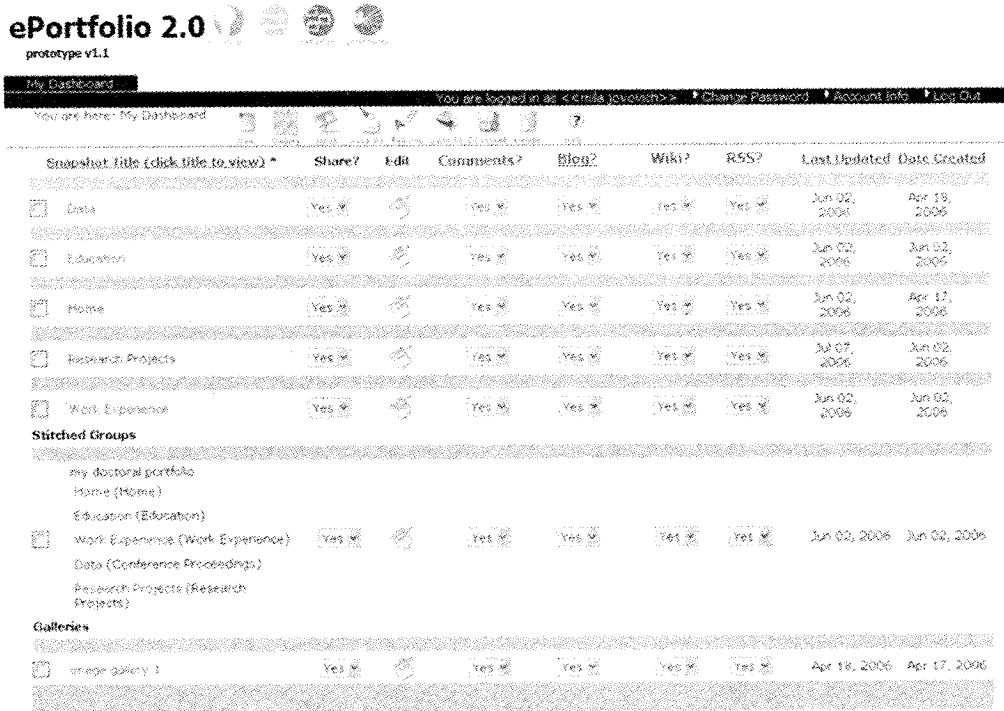


Figure 3: System Prototype – My Dashboard

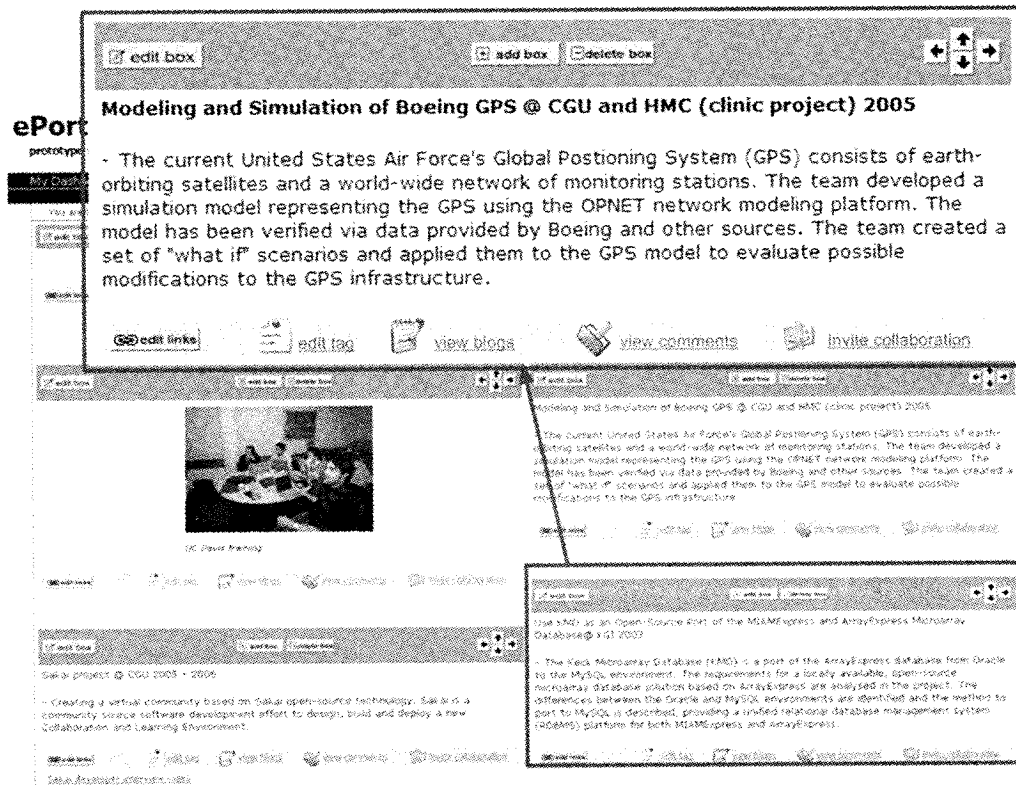


Figure 4: System Prototype – Editing Interface

The portfolio owner can also further interact and collaborate with others by using a built-in wiki or connecting to other online collaborative writing tools. This is not only valuable to community-wide learning but also valuable to classroom experience because many curriculum designs today involve group projects. Group collaboration feature can support these group activities by allowing group members to construct different blocks within their individual portfolio pages that describe and discuss their work, and compile them into a whole project. Figure 6 shows an invitation interface that the portfolio owner can fill out to invite peers or interested scholars to collaborate on the portfolio page. Once submitted, the ePortfolio system generates a wiki page with the original portfolio contents, and grants permissions to the portfolio owner and those invited. The system then sends email invitations with a pass code to those invited and a copy of the message to the portfolio owner. Like many other wiki applications, history of changes (e.g., added/deleted contents, timestamp, author, notes of the author) are saved in the ePortfolio database whenever a group portfolio is updated and viewable by the members of the group at any time.

When the portfolio owner publishes the portfolio and grants access to the public, readers can view the portfolio via a publicly accessible URL. Readers can also view tags and relevant blog entries, add comments, and blog about the portfolio, if the portfolio owner enables these features. To strengthen system security, we recommend login-restricted comments to the portfolio page and registration with human check mechanisms. By requiring users to take an affirmative action such as entering their name and email address to register with the site, and then to enter a username and password whenever they post a comment, the process helps eliminate malicious users. As long as the benefit and value of the membership are clearly communicated and the registration process is kept simple, users should be willing to register with a student's ePortfolio. Visual confirmation can be used as a human check mechanism at registration, which is a common method to prevent

bots from auto signing up and spamming the site. This method requires users to recognize and enter the numbers or letters embedded in a random generated image when registering on the site. Although the method cannot prevent human spam, it should block most of the script-based bots.

For a published portfolio page or site, the portfolio owner can activate RSS feeds to facilitate site syndication (to communicate his/her portfolio contents to other sites and applications) and allow the portfolio's readers to subscribe and automatically track updates on the portfolio site using an aggregator. The portfolio owner can also subscribe via RSS to the comments, thus getting automatic updates whenever a comment is posted to the portfolio site. Activating RSS feeds also allows the portfolio owner to podcast multimedia portfolio contents to readers through automatic downloads. Figure 7 shows a published portfolio page.

6. IMPLICATIONS FOR RESEARCH AND PRACTICE

The authors propose that an ePortfolio should not be a one-time presentation, nor should it only be an assessment tool. Rather, it should be knowledge representation resulting from ongoing learning processes. These learning processes should involve constant resource collection, self-reflections, and re-design; as well as foster community-wide annotations, interactions, and collaborations. Meanwhile, Web 2.0 technologies and applications have provided a variety of educational software and applications that challenge the traditional ways of teaching to meet the learning needs of a new generation of students, and enable cutting edge collaborative learning environments for educational settings. This paper discusses the potential benefits of integrating Web 2.0 services into ePortfolio systems and demonstrates a system prototype to illustrate how designers can bridge the two artifacts to enhance learning experiences for individual users and the community.

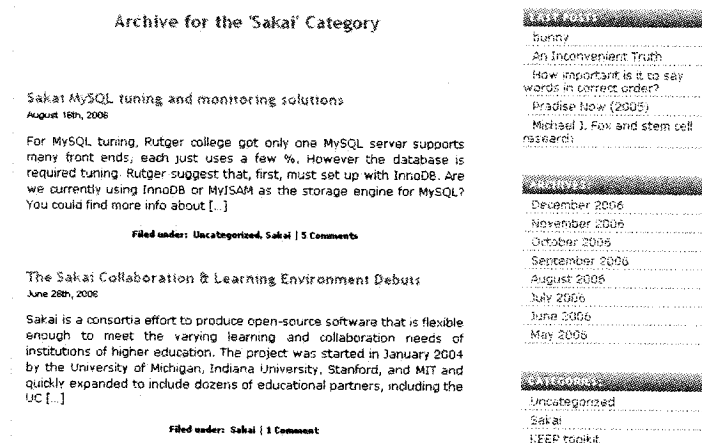


Figure 5: System Prototype – Relevant Blog Entries

Figure 6: System Prototype – Collaboration Invitation

Figure 7: System Prototype – Published Portfolio Page

Both the proposed conceptual model and the system prototype can be applied to designing and developing new ePortfolio systems, new ePortfolio modules or plug-ins for existing L/CMS, virtual learning environments, or online educational communities or networks, with further customizations to support different needs, focus and control. This paper invites IS researchers and educational software practitioners to further explore and discuss how to design the next generation of ePortfolio systems to promote information sharing, knowledge collaboration, and community-wide interaction, and ultimately achieve optimal user learning.

7. CHALLENGES AND FUTURE RESEARCH

One of the challenges of implementing a collaborative ePortfolio system is how faculty and institutions re-engineer their assessment and grading methods to deal with the situations where part of a student's portfolio is

collaborative work by multiple people, and how the freeloader or dominator issue (Tu, 2004) be addressed in collaborative work. A combination of instructor review, peer evaluation, and self-evaluation or other evaluation mechanisms used for team projects may be applied to resolve these problems. In addition, evaluation criteria such as communication, contribution, support, and leadership should also be considered.

Another challenge for fostering community participation and gaining user support in a collaborative system is building mutual trust among users and sustaining such trusting relationships. Trust development is important in encouraging users to open up and contribute to others' portfolio development, including collaboration on research projects. Tu (2004) suggested several effective strategies in establishing trust relationships within online collaborative learning communities that can also be applied in collaborative ePortfolio systems: 1) Avoid anonymity because it

creates feelings of distrust and insecurity; 2) Be patient because it takes time to generate a trusting relationship; 3) Encourage sharing personal life and research experiences – with ePortfolio pages connecting to the user's blog sites, users can easily extend the depth and breadth of experiences in sharing; 4) Moderate and scrutinize portfolio activities, providing students with effective learning strategies, and enabling them to improve learning skills continuously.

In future research, a working collaborative ePortfolio system can be developed and implemented with the assistance of the results of this study. Such a system can be further tested, evaluated, and refined within different academic settings. Relevant IS theories used for measuring system quality and system use such as the IS Success Model (DeLone & McLean, 1992, 2002) can be used as a guide to instantiate new learning paradigms, collaboration techniques, and artifacts; and to reach the goal of enhancing users' learning. Furthermore, the user learning experiences can be measured and compared with those using traditional ePortfolio systems to verify whether this new design is useful and valuable.

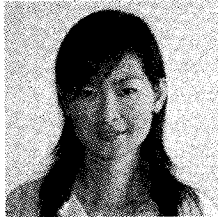
9. REFERENCES

- Barrett, H. C. (2005), "White Paper: Researching Electronic Portfolios and Learner Engagement". Retrieved February 10th, 2007, from: <http://electronicportfolios.org>
- Berger, Peter L. and Thomas Luckmann (1967), *The Social Construction of Reality: A Treatise in the Sociology of Knowledge*. Anchor Publishing.
- Bruner, J. S. (1966), *Toward a Theory of Instruction*. Belknap Press of Harvard University Press, Cambridge, MA.
- Cunningham, Ward and Bo Leuf (2001), *The Wiki Way: Quick Collaboration on the Web*. Addison-Wesley Professional, Boston, MA.
- DeLone, W.H., and E.R.McLean (1992), "Information Systems Success: The Quest for the Dependent Variable", *Information Systems Research* Vol. 3, No. 1, pp. 60-95.
- DeLone, W. H. and E. R. McLean (2002), "Information Systems Success Revisited", *Proceedings of the 35th Annual Hawaii International Conference on Systems Sciences* 2002.
- Geoghegan, M. and Dan Klass (2005), *Podcast Solutions: The Complete Guide to Podcasting*. Friends of ED, Berkeley, CA.
- Jafari, A. (2004), *The "Sticky" ePortfolio System: Tackling Challenges and Identifying Attributes*. *EDUCAUSE Review*, Vol. 39, No. 4, pp. 38 - 49. Retrieved February 10th, 2007, from: <http://www.educause.edu/ir/library/pdf/erm0442.pdf>
- Jafari, A., Patricia McGee, and Colleen Carmean (2006), "Managing Courses, Defining Learning: What Faculty, Students, and Administrators Want", *EDUCAUSE Review*, Vol. 41, No. 4, pp. 50–71. Retrieved February 10th, 2007, from: <http://www.educause.edu/er/erm06/erm0643.asp?bhcp=1>
- Kolb, D.A. (1984), *Experiential Learning: experience as the source of learning and development*. Prentice-Hall, New Jersey.
- Lave, J. and Etienne Wenger (1991), *Situated Learning: Legitimate Peripheral Participation*. Cambridge: Cambridge University Press.
- McGrath, O. G. (2005), "Gauging adoptability: a case study of e-portfolio template development", *Proceedings of the 33rd annual ACM SIGUCCS conference on User services SIGUCCS 2005*
- Raman, M., Terry Ryan, and Lorne Olfman (2005), "Designing knowledge management systems for teaching and learning with wiki technology", *Journal of Information Systems Education*, Vol. 16, No. 3, pp. 311-320.
- Richardson, W. (2006), *Blogs, Wikis, Podcasts, and Other Powerful Web Tools for Classrooms*. Corwin Press, Thousand Oaks, CA.
- Open-source Portfolio (2006), "White paper: Understanding OSP". Retrieved on February 10th, 2007 from http://www.rsmart.com/assets/understandingOSP_Dec2005.pdf
- Phinished.org (2007), *Web Statistics*, Retrieved on February 10th, 2007 from <http://www.phinished.org/stats/>
- Piaget, Jean (1950), *The Psychology of Intelligence*. Routledge, New York.
- Piccoli, G. and R. Ahmad (2001), "Web-based virtual learning environments: A research framework and a preliminary assessment of effectiveness in basic IT skills training", *MIS Quarterly*, Vol. 25, No. 4, pp. 401 - 427
- Pollard, D. (2006), "A Theory of Knowledge, and How It Could Save the World", Retrieved on March 8th, 2007 from <http://blogs.salon.com/0002007/2004/08/30.html>
- Prensky, M. (2001), "Digital natives, digital immigrants". Retrieved February 10th, 2007, from <http://www.marcprensky.com/writing/Prensky%20-%20Digital%20Natives,%20Digital%20Immigrants%20-%20Part1.pdf>
- Tosh, D. and Ben Werdmuller (2004), "ePortfolios and weblogs: one vision for ePortfolio development", Retrieved on March 8th, 2007 from http://elgg.net/bwerdmuller/files/61/178/ePortfolio_Weblog.pdf
- Tu, C. H. (2004), *Online Collaborative Learning Communities: Twenty-One Designs to Building an Online Collaborative Learning Community*. Libraries Unlimited, Westport, CT.
- Wenger, E. (1998), *Communities of Practice: Learning, Meaning, and Identity*. Cambridge University Press, New York, New York.
- Wikipedia (2007a), *ePortfolio*. Retrieved on February 10th, 2007, from <http://en.wikipedia.org/wiki/EPortfolio>
- Wikipedia (2007b) *Web 2.0*. Retrieved on February 10th, 2007 from http://en.wikipedia.org/wiki/Web_2.0.
- Wikipedia (2007c) *Communities of Practice*. Retrieved on March 8th, 2007 from http://en.wikipedia.org/wiki/communities_of_practice.

- Wood, D. (1998), *How Children Think and Learn*. 2nd edition. Blackwell Publishers Ltd., Oxford.
- Vygotsky, L. S. (1978), *Mind and society: The development of higher mental processes*. Harvard University Press, Cambridge, MA.
- Zubizarreta, J. (2004), *The learning portfolio*. Anker Publishing, Bolton, MA.

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APPENDIX A Survey Questionnaire (Note: converted from the actual online questionnaire)

An ePortfolio is a portfolio based on electronic media and services. It consists of a personal digital record containing information such as a collection of artifacts or evidence demonstrating what one knows and can do. This survey is to explore the users' readiness and perceived values in ePortfolio and Web 2.0 services. The findings will help us design and develop new generation of ePortfolio systems that meet true user needs with state-of-art information technologies and services. Questions marked with a * are required.

Section 1: Biographical

- *1. What is your age? 1) Under 20 2) 20 – 25 3) 26 – 30 4) 31 – 35 5) 36 – 40 6) Older than 40
- *2. What is your gender? 1) Female 2) Male
- *3. Which educational level are you in? 1) Undergraduate 2) Graduate 3) Doctoral 4) Post Doc 5) Other
- *4. Are you a ...? 1) Full-time student 2) Part-time student
- *5. What is your major? 1) Information Science, Computer Science, or a related field 2) Others

Section 2: Technology expertise as a user

- 6. How do you rate your expertise as a user of technology? (1 = Novice, 5 = Expert)
 - 1) For my educational work 2) For my research work 3) For my personal work
- 7. How do you learn about technology?
 - 1) Self taught explore or books 2) Computer seminars or classes or job training
 - 3) Friends, family, colleagues 4) IT support staff
- 8. How often do you use the following tools in learning, professional development, and your personal goals? (1 = Never, 5 = Everyday)
 - 1) Web browsing 2) Email
 - 3) Calendar/Day Planner 4) Discussion forums
 - 5) Chats (e.g., MSN Messenger, AIM) 6) Blogs or Online space (e.g., Blogger, mySpace)
 - 7) Wikis or Other collaborative writing tools (e.g., Writely) 8) Podcasting or RSS
 - 9) Social bookmarking (e.g., del.icio.us, digg) 10) Multimedia (e.g., Flickr, Youtube)
 - 11) Word processing/Spreadsheet/Power Point 12) Personal web sites

Section 3: ePortfolio Readiness

- *9. What experience have you had with ePortfolios?
 - 1) Heard or read about it 2) Used an ePortfolio system 3) None
- *10. How important is it to you to have the following services and features available in your ePortfolio system? (1 = Not important, 5 = Very Important)
 - 1) Track your academic plans.
 - 2) Store and organize documents in central repository.
 - 3) Design your ePortfolio easily (e.g., WYSIWYG editor, attach files from repository, bind pages).

- 4) Reflect on your learning achievements, strengths, and gaps.
 - 5) Blog your portfolio development and reflections.
 - 6) Grant access to professors, colleagues, and friends so they can view your portfolio and comment.
 - 7) Collaborate with professors, colleagues, and friends in your portfolio development.
 - 8) Advance your learning experience as a community of practice (e.g., review others' work, collaborate).
 - 9) Manage and organize resume, CV, or job application package.
 - 10) Be able to customize your ePortfolio (e.g., grant access to others, enable or disable comments, blog connections, group collaboration or site syndication).
11. What barriers do you perceive to using ePortfolio? (1 = Not a barrier, 5 = Definitely a barrier)
- 1) Extra work, little connection.
 - 2) Takes too much time.
 - 3) Don't have technical support.
 - 4) Too complicated.
 - 5) Too boring.
 - 6) I don't have the skills.
 - 7) Doesn't work on my computer.
 - 8) I cannot find appropriate software or application.
12. What other services or features would you like to see in an ePortfolio system?

APPENDIX B: Survey Statistics

Variable	Categories	Frequency	Percent	Variable	Categories	Frequency	Percent
Age	20 - 25	8	18.2	Education Level	Doctoral	30	68.2
	26 - 30	21	47.7		Graduate	12	27.3
	31 - 35	9	20.5		Post Doc	1	2.3
	36 - 40	4	9.1		Undergraduate	1	2.3
	Older than 40	2	4.5		Total	44	100.0
	Total	44	100.0		ePortfolio Experience	Heard or read about it	8
Gender	Female	26	59.1	Used one	12	27.3	
	Male	18	40.9	None	24	54.5	
	Total	44	100.0	Total	44	100.0	
Student Type	Full-time student	34	77.3	Major	IS major	33	75.0
	Part-time student	10	22.7		Non-IS major	11	25.0
	Total	44	100.0		Total	44	100.0

Use of Technologies

	1 - Never (%)	2	3	4	5 - Everyday (%)	Total
Valid Use_Web_Browsing	0	2.3	0	4.5	93.2	44
Use_Email	0	0	0	4.5	95.5	44
Calendar/Day planner	20.5	18.2	18.2	11.4	31.8	44
Discussion forums	11.4	18.2	31.8	18.2	20.5	44
Chats (e.g., MSN Messenger, AIM)	36.4	22.7	13.6	15.9	11.4	44
Blogs or Online space (e.g., Blogger, mySpace)	29.5	20.5	18.2	15.9	15.9	44
Wikis or Other collaborative writing tools (e.g., Writely)	20.5	22.7	34.1	22.7	0	44
Podcasting or RSS	50.0	31.8	4.5	9.1	4.5	44
Social bookmarking (e.g., del.icio.us, digg)	29.5	31.8	18.2	6.8	13.6	44
Multimedia (e.g., Flickr, Youtube)	11.4	13.6	27.3	29.5	18.2	44
Word processing/Spreadsheet/Power Point	2.3	0	4.5	25.0	68.2	44
Personal web sites	29.5	31.8	18.2	4.5	15.9	44

Critical ePortfolio Services and Features

	1 - Not Important (%)	2	3	4	5 - Very Important (%)	Total
Valid Track academic plans	22.7	6.8	22.7	22.7	25.0	44
Store and organize documents in central repository	20.5	6.8	2.3	31.8	38.6	44
Design your ePortfolio easily (e.g., WYSIWYG editor, attach files from repository, bind pages).	11.4	9.1	13.6	22.7	43.2	44
Reflect on your learning achievements, strengths, and gaps.	11.4	13.6	27.3	20.5	27.3	44
Grant access to professors, colleagues, and friends so they can view sections of your portfolio and comment.	9.1	20.5	20.5	34.1	15.9	44
Blog portfolio development and reflections.	11.4	22.7	31.8	20.5	13.6	44
Collaborate with professors, colleagues, and friends in your portfolio development.	6.8	6.8	36.4	36.4	13.6	44
Advance your learning experience as a community of practice (e.g., review others' work, collaborate).	11.4	15.9	34.1	25.0	13.6	44
Manage and organize resume, CV, or job application package.	25.0	2.3	25.0	27.3	20.5	44
Be able to customize your ePortfolio (e.g., grant access to others, enable/disable comments, blogs, collaboration).	13.6	9.1	11.4	22.7	43.2	44

Barriers of using ePortfolio

	1 - Not a barrier (%)	2	3	4	5 - Definitely a barrier (%)	Total
Valid Extra work, little connection	20.5	6.8	31.8	25.0	11.4	42
Takes too much time	18.2	11.4	27.3	29.5	9.1	42
Don't have technical support	34.1	18.2	34.1	9.1	0.0	42
Too complicated	31.8	22.7	25.0	15.9	2.3	43
Too boring	36.4	15.9	22.7	13.6	6.8	42
I don't have the skills	50.0	15.9	15.9	6.8	6.8	42
Doesn't work on my computer	59.1	13.6	13.6	6.8	2.3	42
I cannot find appropriate software or application	27.3	11.4	27.3	11.4	18.2	42



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