uFolio: A conceptual design framework for a learning platform and assessment system

.Ku, David T
Department of Educational Technology
Tamkang University
New Taipei City, Taiwan

Chang, Wen-Chih
Department of Information Management
Chung Hua University
HsinChu, Taiwan

Abstract- In recent years, using e-portfolios to assess student learning has become more popular. From the perspective of education, portfolios should encourage students to collect, reflect on, and present their own works to enhance learning. Yet, currently available e-portfolios seem to function mainly as repositories of artifacts without connecting to the real learning process. As a result, although e-portfolios create a much more convenient environment through their technology, they are still unable to fulfill the initial purpose of portfolios.

This paper presents a conceptual framework for the design of *uFolio*, an idea for an all-purpose portfolio system that has never been introduced previously. Based on the core value of portfolio and the technologies of a visual object-oriented platform and ubiquitous communications system, the design framework lays out an innovative system that establishes three major components—*MyFolio*, *MyClass* and *MyLog*—and an instant awareness notification tool, *uAware*, to integrate an e-portfolio, a learning management system (LMS) and a multidimensional assessment system into one. This paper presents the design steps taken so far and indicates the development tasks and related studies that still need to be carried out.

I. INTRODUCTION

Recently, electronic portfolios (e-portfolios) for student learning have become very popular at all academic levels. Using advanced technologies, e-portfolios have overtaken traditional paper-based formats and provide better ways to deposit, access, renew and present evidence of student learning [1]. However, despite storing the digitized information, materials and database, currently available e-portfolios exhibit no major difference from traditional paper formats. In fact, most e-portfolios on the market serve only as a simple HTML editor to provide the functions of the "showcase" without focusing on the real purpose of assessment.

As a sub-project of *COMETUS*—the COnstruction of a Multi-dimensional E-learning Testbed for U-School project, this paper attempts to redefine the meaning of e-portfolio. Based on the developing technologies of *a visual object-oriented LMS*, *a ubiquitous and adaptive communications system* and *a multidimensional assessment system* conceived by the COMETUS research team, this study builds a design framework for *uFolio*, a revolutionary ubiquitous learning portfolio, for better support of learning and assessment of ubiquitous learning.

II. LITERATURE REVIEW

A. Portfolio

Evaluating the effectiveness and achievement of student learning has been a very critical issue for educational researchers. According to Barrett, the concept of portfolio has been introduced more than 25 years ago. Considering the various learning contents, environments, and individual differences, the traditional paper-'n'-pencil tests could not satisfy the need for fair and comprehensive assessment [2]. Arter and Spandel stipulated that the portfolio should be a purposeful collection of student works and provide evidence that enables the instructors to understand the process of learning, efforts, achievement, and reflections of students [3]. Butler also pointed out that "a portfolio is a collection of evidence that is gathered together to show a person's learning journey over time and to demonstrate their abilities" [4]. In other words, student learning portfolios allow students to track and recognize their own learning conditions, help them focus on their thinking, translate theory into practice and enhance their ability to learn [4][5[6]. For instructors, student learning portfolios should go beyond the test scores and finished products to provide a view of the development of students' learning and the evidence of that development.

Abrami and Barrett [7] and Mason, Pegler and Weller [8] have described three very similar types of portfolios:

- Process (developmental) portfolio: Process portfolio collects the steps of the learning process and uses them to present the learning patterns of the learners. It focuses more on their reflection and adjustment.
- Showcase (presentation) portfolio: Showcase portfolio collects the finished products, grades and comments of the learners during their learning. It stresses the effects, evidence and achievements of the learners.
- Assessment portfolio: Assessment portfolio collects the data and materials for the purpose of assessment. Instructors should be able to set the criteria for collection to meet the appropriate needs.

Smith and Tillema also pointed out four types of portfolios: dossier portfolio, training portfolio, reflective portfolio and personal development portfolio [9]. Their studies all clearly

pointed out where the learning took place and emphasized the functions to meet various needs [10][11]. In fact, even though they used different terminologies, basically, they were talking about the same things. In this paper, the classification of Abarmi and Barrett is adapted [7].

B. E-portfolio

As mentioned previously, the traditional paper-based portfolios collect numerous types of artifacts such as assignments, pictures, research projects, reports, grades, comments of instructors and a log of student reflection. The collection process is time-consuming, and preservation and arrangement are very difficult. E-portfolios can not only present the information and materials in various new ways, but also make preservation, assessment and updating materials much easier [1][12]. In recent years, e-portfolios have replaced the traditional paper-based portfolios and become mainstream in education [13].

Theoretically, e-portfolios must retain the original purposes of the traditional portfolios. Barrett and Knezek indicated that the basic concepts of purpose, pedagogy and assessment should be the same for both paper-based and electronic portfolios [14]. There is a good reason why e-portfolios should provide students with the basic functions of collecting, selecting and updating. For both students and instructors, e-portfolios should also be able to assess the learning process and achievements. As a result, mobile communications technology not only allows e-portfolios to provide much more effective and efficient ways to access and receive information, but it also enables students to interact with instructors and their peers immediately [15].

Many studies discuss the types of portfolios and how advanced technologies can improve the usage of e-portfolios; yet, there have been few efforts to create a design to integrate the various purposes. This study attempts to design a multidimensional system that encompasses the three functions suggested by Abarmi and Barrett: that is, tracking the learning process and reflection for students (process portfolio), assigning projects and assessing learning for instructors (assessment portfolio) and collecting artifacts and editing the showcase (showcase portfolio) [7]. In this system, all three types of portfolios are equally important and connected to form a complete portfolio system. This study will present the design concepts and framework designated by the term "uFolio", a multidimensional assessment system.

III. DESIGN FRAMEWORK OF UFOLIO

A. Design concept of uFolio

Butler argued that seven questions must be asked before building a portfolio [4]:
- What is the purpose of the portfolio?
- Who decides what should be included in the portfolio?
- How should the pieces of evidence in the portfolio be organized?
- What kinds of artifacts are acceptable as pieces of evidence?
- What kind of input should tutors, lecturers, and peers have throughout the process of constructing the portfolio?
- How should the portfolio be assessed?
- What should happen to the portfolio after it is finished?

Using the seven questions as the index of needs assessment, the concept of uFolio will meet the needs of a common e-portfolio, integrate the fundamental goals of a portfolio, and use cutting-edge technologies to make a revolutionary change. Even through uFolio introduces an innovative structure to redesign e-portfolio, the original purposes of a portfolio, such as to collect response, reflection, presentation, assessment, and self-enhancement, would become even more distinct through the new design concept and technology. Thus, based on the core value of portfolio and Bulter's seven questions [4], uFolio meets the following three major objectives:
- an all-purpose portfolio
- a ubiquitous learning environment
- a multidimensional assessment system for students and instructors

The aforesaid three major objectives are related and applied to the basic components and functions of the framework that defines uFolio. Fig. 1 presents the design framework of the uFolio system, which based on the fulfillment of the conceptually complete e-portfolio system. Along with Figure 1, the following sections describe how this framework is obtained and how the three major objectives are integrated into the uFolio framework design.

B. Framework of an all-purpose portfolio

To establish an all-purpose portfolio, uFolio demands a system that incorporates three components: *MyFolio*, *MyClass*, and *MyLog*. From the perspective of system design, the three components provide different functions for different purposes, but all the information and data collected share the same repository and can be retrieved from each component. In the uFolio system, the three components are designed to fulfill the functions of all three types of portfolios—process portfolio, showcase portfolio and assessment portfolio, and uFolio also serves as a multifunctional learning environment for students and instructors.

MyFolio works mainly as a showcase (presentation) portfolio and fulfills the basic function of portfolio/e-portfolio products. Barrett proposed that e-portfolio, especially, should provide a setting for students to collect their works, select the best works to be presented, reflect learning via the process of the works, set goals for future works and celebrate achievements throughout the experience [2]. To satisfy the specific needs of a portfolio, *MyFolio* allows students to collect all the artifacts, edit the collected information and present them in the most appropriate ways. The artifacts could be gathered from *MyClass* (learning process, completed projects, finished products, grades, peer review, etc.) and *MyLog* (reflection log, peer reflection, comments of
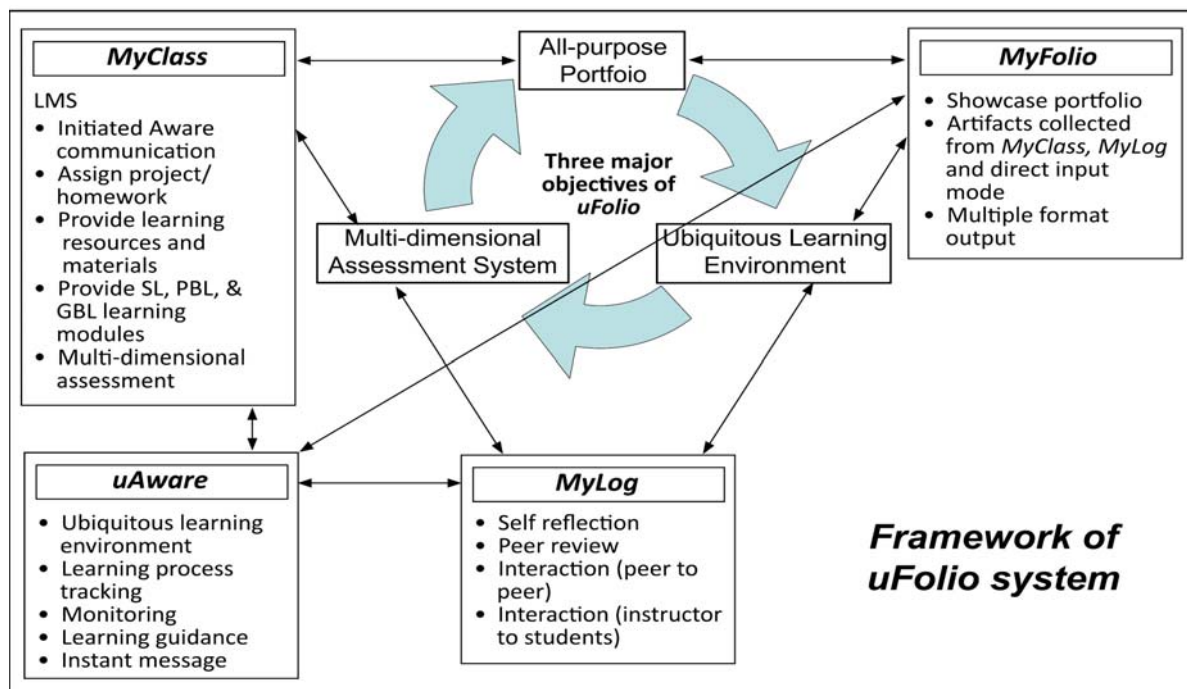
Fig. 1. The uFolio design framework based on the fulfillment of three major objectives as a complete e-portfolio system.

instructors, etc.) or directly input via remote devices. *MyFolio* is able to showcase the process of learning as a multimedia interactive Web site on a computer, on a handheld device, or as a printed copy.

Moreover, with the aim of creating an all-purpose portfolio as a complete learning assessment package, *uFolio* also integrates *MyClass* and *MyLog* to enhance and extend the functions of learning management, critical thinking and reflection. *MyClass* works as an LMS and contains common functions of traditional LMSs such as WebCT or Blackboard. Yet, incorporating learning strategy assessment modules and *MyLog*, *MyClass* gives LMS a whole new meaning and engages the interactions between instructors and students (also among students). It serves as an "assessment" and a "process" portfolio. The detailed description is presented later in the section under Framework of Concepts of the Multidimensional Assessment System in *MyClass*.

MyLog is a personal space for students and an open space for visitors. Integrating the sharing, collaborating, reflecting and social networking concepts of Web 2.0 [16], *MyLog* provides the popular blog features and the mindset of reflection that work as a critical part of a process portfolio. The functions of *MyLog* are the same as the general functions of a regular blog, yet, as a part of *uFolio*, all the functions and parameters of *MyLog* are connected to *MyFolio* and *MyClass*. For instance, students may be assigned to a learning activity called "Project Journal and Reflection" from *MyClass* and have to work on the "Project Journal and Reflection" in *MyLog* to record and reflect on their recent group project. Not only are students able to re-examine their own work and share a particular idea with peers, but instructors can also be immediately aware of students' progress and the level of their learning. Therefore, instructors can provide instant feedback and guidance in *MyLog* and give out the assignment grades in *MyClass*. Eventually, students can use *MyLog* to develop a reviewable learning journey that will provide them with a good indication of their own learning development rather than simply focus on the final grades or end products [17][18][19]. Of course, the various types of reviewable learning journeys will also be collected by *MyFolio*, which is another way to showcase the process of learning. Fig. 2. depicts the system structure of *uFolio* and how different components and functional modules relate to each other.

C. Framework of a ubiquitous learning environment

The concept of ubiquitous learning is a large topic, and numerous related issues have been discussed, yet ubiquitous technology has not been associated with the concept of portfolio until recent years [20]. In general, ubiquitous computing allows users to use wireless technologies and handheld computing devices to receive and send information with no location barrier. From the perspective of learning, in a ubiquitous learning environment, students can use handheld devices, portable computers, or even cellular phones to receive assignments, tests, comments, advice and help and also send out materials, homework, discussions, questions and reactions. In *uFolio*, ubiquitous technologies are used not only as delivery methods; more importantly, they are integrated with teaching strategies and learning assessments.

In addition, to form a complete ubiquitous learning environment, the concept of context awareness is applied in *uFolio*.
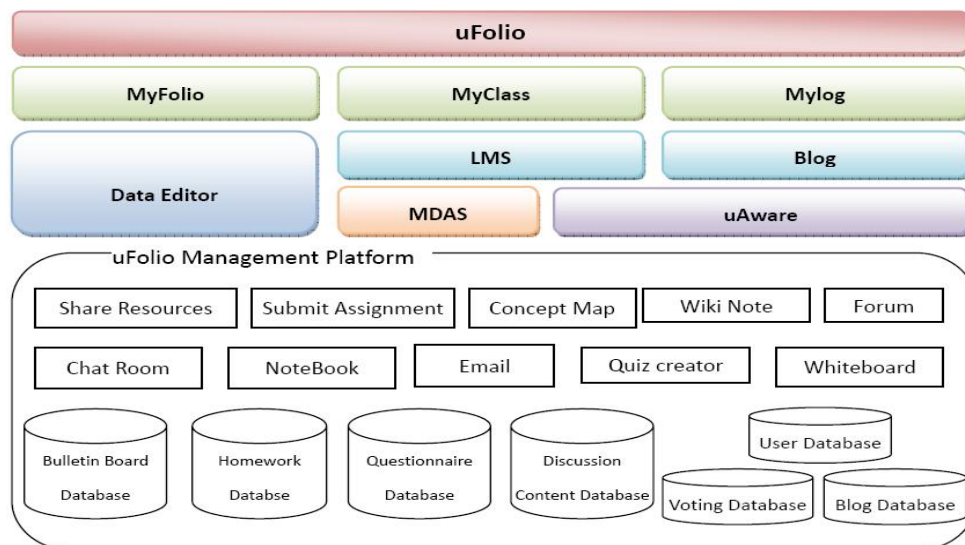
Fig. 2. uFolio management system platform function property.

Context awareness means that the relevant physical environment or circumstances may lead to a certain behaviour or understanding [21][22]. One of the major types of context awareness in the information system is the social nature of information [23]. From the perspective of education, context awareness is not just "awareness", but context information can also be transferred from one context to another. Especially in problem-solving situations, awareness could be an understanding of the activities of others, which supplies the context in which the learner's own activity forms the learning situation [24]. Therefore, in a remote environment, a well-designed system of awareness notification should be able to provide students with information from teammates or even instructors that relates to the learning objectives. Carroll et al. also suggested that the awareness notification could deliver information to the context of objectives and social role [25]. More importantly, the instant reminder and timely advice will enhance the motivation and achievement of learners [26].

uAware is the notification system of uFolio. As a Yahoo! Widget Engine®, uAware can be installed on the desktop of computers and handheld devices. Without a login, uAware provides instant information about the learning activities in uFolio. uAware connects to MyFolio, MyClass and MyLog and reflects projects and learning activities assigned by instructors. It allows users (individuals and team members) to monitor the conditions of activities and progress. On uAware, users are able to track the activity information, which is presented under different learning activities such as news, stage, e-mail, discuss and chat.

D.   Framework of concepts of the multidimensional assessment system in MyClass

It is widely agreed that assessment has a significant influence on student learning [27][28][29][30][31]. In fact, the original purpose of portfolio was to enable a fair and broader learning assessment and to achieve a higher level of learning

and teaching. Therefore, instead of integrating the characteristics of portfolio, uFolio attempts to incorporate a multidimensional assessment system to supplement other assessment results and provide a global description of what students know [32]. To fulfill the purpose of "multidimensional" assessment, MyClass, the main LMS of uFolio, has been designed to reach beyond the ordinary LMS by providing two major features, Multiple Learning Strategy Assessment Modules and Stage Percentage Weight Setting Process, which make this multidimensional assessment system of uFolio unique.

Multiple learning strategy assessment modules

MyClass incorporates three types of assessment under Multiple Learning Strategy Assessment Modules in the system for instructors to manipulate: traditional test, learning strategies evaluation and peer evaluation. The traditional test provides the common test methods used in regular LMSs and everyday classrooms, such as true/false, multiple choice, short essay, etc. Even though evaluating mainly mnemonic knowledge is always criticized, recall and recognition of specific facts are very important in the cognitive domain of learning. Therefore, the functions of traditional tests are included as the first dimension of assessment.

The most critical design element of MyClass in uFolio is based on alternative learning strategies to create matched assessment methods as the second dimension of the assessment system. Obviously, assessment is more than test scores and summative results [31]. Therefore, MyClass includes three learning strategy assessment modules—situated learning (SL), problem-based learning (PBL) and game-based learning (GBL)—so that instructors may create sequential learning activities for particular learning strategies and set up formative evaluation simultaneously.

Using the PBL module as an example, beyond knowledge recall and recognition, PBL emphasizes learning by doing, problem solving and creativity skills at the personal or group level [33]. Frank and Barzilai pointed out that traditional assessment strategies are not suitable for measuring PBL [18]. Final products and test scores are not the only evidence of achievement by students; the process of interaction and problem solving is a more-important indicator for students and instructors in understanding the result of learning. *MyClass* proposes a problem-solving model: (1) clarify the problem, (2) look for solutions, (3) try them out and (4) monitor the effectiveness of the solution. This provides a guideline for instructors in selecting the appropriate learning activities at each stage and in using the visualized object-oriented interface to set up the sequence of learning activities (project/assignment) for students [34].

Peer review is beneficial for collaborative learning and reflection [35][36][37]. It also creates positive peer pressure and establishes a positive attitude among team members. However, peer review has not been included as an assessment tool in currently available e-portfolios and LMSs. Therefore, it is incorporated in *MyClass* as the third dimension of the assessment system. *MyClass* has two types of review: between-group peer review and within-group peer review. Between-group peer review provides good suggestions from other groups and receives comments from different perspectives. Within-group peer review evaluates real working ability and attitude. *MyClass* peer review provides critical information beyond grades and products because evaluating learning is also evaluating real-life situations [38]. Fig. 7. shows an overview of the relationship among students, instructor, and peers in *MyClass.* In integrating traditional tests, learning strategy assessments and peer review, *MyClass* provides a multidimensional assessment environment.

Stage percentage weight setting process
Percentage weight setting has commonly been used in existing LMSs. However, *uFolio* emphasizes the process of learning, not final grades. The percentage weight setting of this system helps instructors to adjust the percentage weight in different assessment dimensions (traditional tests, learning strategy assessments and peer review) and at every single stage of the learning activities, since one of the key concepts of *MyClass* is to integrate assessment from the very beginning of instruction design. During the process of creating learning activities, instructors should first establish the percentage weight among the dimensions of the assessments, for example, traditional tests, 25%; learning strategy assessments, 50% and peer review, 25%. Then, under the traditional tests (25%), instructors may establish the sub-percentage weight, such as true/false, 40%; multiple choice, 60% and short essay, 0%. More importantly, the stage percentage weight setting can help instructors to evaluate every step in the learning process. From the instructor screen, instructors may monitor every step that students take. In the meantime, instructors can recognize the percentage of completion, provide proper instructions to students and monitor the interaction among the teammates. Students can understand the clear work order, steps and sequences from the student screen. In addition, for both instructors and students, *uAware* provides instant updating simultaneously and helps them keep track of the stage and process of learning.

IV. CONCLUSION AND FUTURE DIRECTIONS

Because of the shortcomings of current e-portfolios and the importance of assessment for learning, this study attempted to redefine portfolio and e-portfolio and introduced the innovative concept of *uFolio*. By incorporating three major components—*MyFolio*, *MyClass* and *MyLog*—in one system, *uFolio* not only improves the common functions of e-portfolios for various needs, more importantly, an accurate learning environment and assessment are integrated into the design.

Moreover, experimental studies will be conducted after the system is completed.
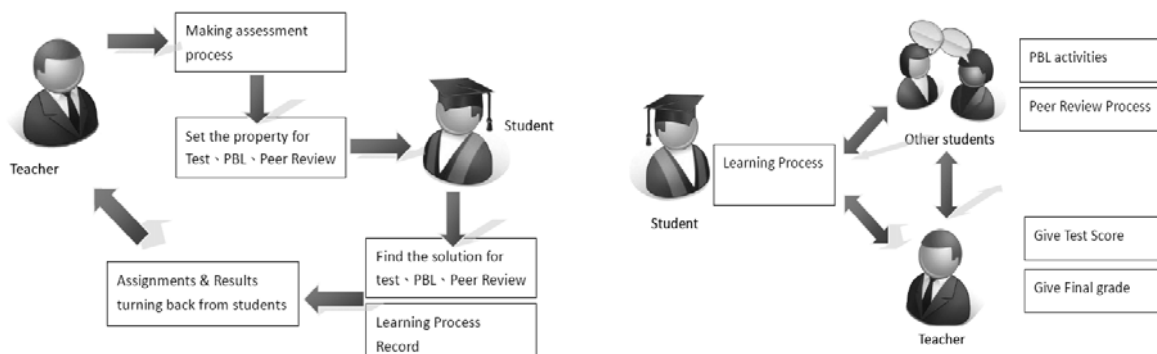

Fig. 7. The overview relationship between students and instructor, and peers in the MyClass

Various aspects and variables will be investigated, such as how different learning strategies affect learning. Can the concept of *uAware* prompt students' learning? Can multidimensional assessment help instructors to better understand students' learning situations and provide more-objective assessment? *uFolio* is a revolutionary approach incorporating advanced technologies and assessment methods. Hopefully, this innovative approach will be well executed and provide an enhanced learning environment and a better assessment system for future teaching and learning.

REFERENCES

[1] K. Song, M. Scordias, C. Huang, and C. Hoagland, C. "Implementing e-portfolios in a university: An enterprise solution." *Paper presented at the SITE conference*, Atlanta, GA. Retrieved March 20, 2008, from http://www.aace.org/dl/files/site2004/peper_3014_7985.pdf.

[2] H. Barrett, The research on portfolios in education. Retrieved January 31, 2008, from http://www.electronicportfolios.com/ali/research.html.

[3]…J.A. Arter, and V. Spandel, "Using portfolios of student work in instruction and assessment," *Educational Measurement: Issues and Practices*, 1992, pp. 36-43.

[4] P. Butler, "A review of the literature on portfolios and electronic portfolios,"Massey University College of Education, 2006. Retrieved May 20, 2008, from http://eduforge.org/docman/?group_id=176.

[5] T.E. Hauge, "Portfolios and ICT as means of professional learning in teacher education," *Studies in Educational Evaluation,*2006, vol. 3(1), pp. 23-36.

[6] R.C. Wade, and D.B. Yarbrough, "Portfolios: A tool for reflective thinking in teacher education?" *Teaching and Teacher Education,* 1996, vol. 15(3), pp. 261-273.

[7] P.C. Abrami, and H. Barrett, "Directions for research and development on electronic portfolios," *Canadian Journal of Learning and Technology,* 2005, vol. 31(3), online version.

[8] R. Mason, C. Pegler, and M. Weller, "E-portfolios: An assessment tool for online courses," BJET, 2004, vol. 35(6), pp. 717-727.

[9] K. Smith, and H. Tillema, "Clarifying different types of portfolio use," *Assessment and Evaluation in Higher Education,* 2003, vol. 28(6), pp. 625-648.

[10] D. Challis, "Commentary: Assessing the current status of electronic portfolios," *Canadian Journal of Learning and Technology,* 2005, vol. 31(3), online version.

[11] H. Barrett," The research on portfolios in education," 2003, Retrieved January 31, 2008, from http://www.electronicportfolios.com/ali/research.html.

[12] S. Lambert, and L. Corrin, "Moving towards a university-wide implementation of an ePortfolio tool," *Proceedings of the 23rd Annual ASCILLITE Conference,* 441-450, University of Sydney, 2006.

[13] L. Avraamidou, and C. Zembal-Saul, "Exploring the influence of web-based portfolio development on learning to teach elementary science.," *AACE Journal,* 2006, vol. 14(2), pp. 178-205.

[14] H. Barrett, and D. Knezek, "E-portfolios: Issues in assessment, accountability and preservice teacher preparation.," *Paper presented at the American Educational Research Association Conference,* Chicago, IL, 2003.

[15] D. DiBiase, "Using e-portfolios at Penn State to enhance student learning," 2002, Retrieved March 15, 2008, from http://www.e-education.psu.edu/portfolios/e-port_report.doc.

[16] C. Safran, D. Helic, and C. Gutl, "E-learning practice and web 2.0," *Proceedings of Conference ICL2007,* Villach, Austria, Sep. 26-28.

[17] Y. Gulbahar, and H. Tinmaz, "Implementing project-based learning and e-portfolio assessment in an undergraduate course," *Journal of Research on Technology in Education,* 2006, vol. 38(3), pp. 309-327.

[18] M. Frank, and A. Barzilai, "Integrating alternative assessment in a project-based learning course for preservice science and technology teachers," *Assessment & Evaluation in Higher Education,* 2004, vol. 29(1), pp. 41-61.

[19] A. Garthwait, and J. Verill, "E-portfolios: Documenting student progress," *Science and Children,* 2003, vol. 40(8), pp. 22-27.

[20] K. Matsuura, K. Niki, M. Katayama, and Y. Yano, "Development of the Digital Portfolio Environment for both PC and PDA," *Proceedings of the 2005 IEEE International Workshop on Wireless and Mobile Technologies in Education* (WMTE '05).

[21] J. Laffey, "A context awareness system for online learning: Design based research," Manuscript submitted for publication.

[22].. Y. Zhang, and Y. Yano, "A framework of context-awareness support for peer recommendation in e-learning context," *BJET,* 2007, vol. 38(2), pp. 197-210.

[23] J. Brown, and P. Duguid, *The Social Life of Information.* Boston, MA: Harvard Business School Press, 2002

[24] P. Dourish, and V. Bellotti, "Awareness and coordination in shared workspaces," *Proceedings of Conference on Computer-Supported Cooperative Work*, 1992.

[25] J.M. Carroll, D.C. Neal, P.L. Isenhour, M.B. Rosson, and D.S. McCrickard, D. S, "Notification and awareness: Synchronizing task-oriented collaborative activity,"*International Journal of Human-Computer Studies,* 2003a, vol. 58, pp. 605-632.

[26] Y. Zhang, H. Ogata, and Y. Yano, "Using knowledge awareness to support learning services in collaborative e-learning environment," *Proceedings of International Conference of Web Intelligence '04,* Beijing, China, Sep. 20-24 pp. 694-698.

[27] M. Price, B. O'Donovan, and C. Rust, "Putting a social-constructivist assessment process model into practice: Building the feedback loop into the assessment process through peer review," *Innovation in Education and Teaching International,* 2007, vol. 44(2), pp. 143-152.

[28] P.T. Knight, "Summative assessment in higher education: Practices in disarray.," *Studies in Higher Education,* 2002, vol. 27(3), pp. 275-286.

[29] G. Brown, J. Bull, and M. Pendlebury, *Assessing Student Learning in Higher Education.* London: Routledge, 1997.

[30].. D. Boud, *Enhancing Learning through Self Assessment.* NY: Routledge, 1995.

[31] J. B. Garfield, "Beyond testing and grading: Using assessment to improve student learning," *Journal of Statistics Education,* 1994, *vol. 2*(1). Retrieved March 20, 2008, from http://www.amstat.org/publications/jse/jse_archive.html#1994.

[32] N. Webb, and T. Romberg, Implications of the NCTM standards for mathematics assessment. In T. Romberg (ed.), *Mathematics Assessment and Evaluation: Imperatives for Mathematics.* Albany: State University of New York Press, 1992.

[33] N. Ozdener, and T. Ozcoban, "A project based learning model's effectiveness on computer courses and multiple intelligence theory," *Educational Sciences: Theory & Practice,* 2004, vol. 4(1), pp. 164-170.

[34] D. H. Jonassen, *Learning to Solve Problems: An Instructional Design Guide.* San Francisco, CA: Pfeiffer, 2004.

[35] K.R. Lai, and C.H. Lan, "Modeling peer assessment as agent negotiation in a computer supported collaborative learninge environment," *Educational Technology & Society,* 2006, vol. 9(3), pp. 16-26.

[36] P. Davies, "Using agent reflective self-assessment for awarding degree classifications.," *Innovations in Education and Teaching International,* 2002, vol. 39(4), pp. 307-319.

[37] R.C.W. Kwok, and J. Ma, "Use of a group support system for collaborative assessment.," *Computers and Education,* 1999, vol. 32(2), pp. 109-125.

[38].. R.B. Heckendorn, "Building a Beowulf: Leveraging research and department needs for student enrichment via project based learning," *Computer Science Education,* 2002, vol. 12(4), pp. 255-273.