## Session 2158

# Developing Information Technology Career Path Awareness through Student Online Portfolios

**Ed Crowley, Susan L. Miertschin**

**University of Houston**

Introduction

At the University of Houston, the College of Technology operates a relatively young Information Technology (IT) program that, like other similar programs, continues to develop its identity. Most IT students at UH are developing their own professional identities as well. To foster this development, IT faculty designed a learning focused portfolio project with a primary goal of increasing student awareness of the Information Technology discipline and their potential roles within the discipline. Another goal is to increase the student's understanding of relationships between academic experiences and professional goals. In addition, involved faculty members have found that the portfolio project has the potential to provide an extraordinarily rich means of student assessment.

The portfolio project began as an assignment in a senior level special topics class focused on Internet technologies. Initially, the class focused on open static technologies, such as HTML, but over time, as the technologies changed, the class embraced active technologies, such as DHTML and ASP. The portfolio assignment provided students with an opportunity to demonstrate the skills they acquired in the class. In addition to designing and building dynamic data-base driven web sites in the course, each student also built and secured his or her own web server. They then showcased all the skills they learned in the course by building an on-line portfolio illustrating what they had learned in the course.

The faculty involved immediately saw the potential of the portfolio assignment and developed it as a semester-long senior 'capstone' project with a primary goal of showcasing technical skills students acquired during their undergraduate education. Specifically, it provided students with an opportunity to communicate and demonstrate their Internet, programming, and database skills.

As the portfolio project developed, the class format, content and scope also evolved and faculty began to see a new vision for the course and the project. The course was moved to the junior level and some of the course content was moved to sophomore level courses. Thus, students now enter the course with more technical skills in place, so less class time had to be devoted to technical content. The portfolio project continues to offer students the opportunity to collect and

showcase skills and knowledge, but it also serves as a means to develop student awareness of available career paths.

Furthermore, the class originally utilized a traditional lecture/lab format. Now, the faculty member functions more as a guide that helps "… the student construct meaning through facilitation and coordination of the learning environment."[1] In effect, the class evolved into one with increased emphasis on learning.

This paper relates significant parts of UH's three-year experience with online portfolio projects. First, the paper surveys literature concerning portfolios. Then, it presents the portfolio development process including a discussion of tools and resources. Then ways of assessing student portfolios are presented. Potential future project directions are discussed.

Overview of Portfolio Usage

While a long tradition of using Internet based portfolios does not exist, in certain disciplines such as architecture or fine art, the use of portfolios is traditional. Historically, these portfolios have been collections of work recorded onto a physical media, typically paper, and then carried from one presentation to another. Typically, the expected audience is prospective clients.

Depending on the context, the term portfolio can have several meanings. Web portfolio, digital portfolio, and e-portfolio, are all similar terms with somewhat similar meanings. While many portfolios are decentralized, some portfolios are designed to interface with centralized student information systems. A literature survey produces several different portfolio types and definitions, as shown in Table 1.

**Table 1 Definitions of the Term "Portfolio"**

| Term and Definition | Source |
|---|---|
| A portfolio is a purposeful collection of student work that exhibits the students' efforts, progress and achievements in one or more areas. The collection must include student participation in selecting contents, the criteria for selection: the criteria for judging merit, and evidence of student self-reflection. | Educators in the Pacific Northwest (Northwest Evaluation Association, 1990) developed this portfolio definition. |
| A portfolio is a visual representation of your abilities, skills, capabilities, knowledge, qualities – it represents your potential. | Association of American Geographers (AAG) |
| Essentially, an e-portfolio is an extensive resume that links to an online repository of a student's papers, problem sets, pictures from study-abroad stints and anything else that demonstrates the student's accomplishments and activities. | Chronicle of Higher Education[15] |
| Portfolios are collections of student work representing a selection of performance. | Office of Education Research[2] |
| " a purposeful collection of student work that tells the story of a student's personal self and a student's | Worthington[3] |

| Term and Definition | Source |
|---|---|
| achievement or growth characterized by strong vision of content, skills, and processes addressed…. | |
| … a portfolio is a purposeful, systematic anthology of the student's work over time that includes student participation in selection of content, evidence of student self-reflection, criteria for selection, and criteria for judging merit". | Ury[16] |
| We define a webfolio as a tightly integrated collection of Web-based multimedia documents that includes curricular standards, course assignments, student artifacts in response to assignments, and reviewer feedback to the students work. | Gathercoal[1] |
| … a portfolio is a compendium of materials that document and demonstrate a person's accomplishments and career readiness. | Gathercoal[1] |
| We define learning portfolios as purposeful collections of artifacts that characterize the learning experiences of the portfolio owner. | Chen[17] |
| In the context of contemporary higher education, the term "Student Learning e-portfolio" denotes collections of evidence assembled by students, faculty members, or entire institutions to enhance the effectiveness of teaching and learning, to assess learning effectiveness, and to demonstrate competence to external stakeholders. | Penn State[4] |

Summarizing, a portfolio is a collection of information yet it differs from other collections of information in several important ways.[5] A portfolio has a predefined audience. Additionally, a portfolio has purpose, order, and structure. All information within a portfolio is related. An online portfolio can utilize user-driven non-linear navigation.

Different types of portfolios have different purposes, and sometimes the perceived purpose varies depending on the audience. Breault observed that "Students see portfolios as marketing tools whereas, faculty see portfolios as assessment and formative evaluation tools."[6] Some colleges, such as Kalamazoo College, use portfolios for internal purposes such as reflection, advisement, and goal setting.[7] Other colleges, such as the University of Houston, use portfolios as summative documents meant, in part, to aide students in the transition between undergraduate education and work or graduate school.

Since portfolios are multipurpose and complex, they can be categorized multiple ways. They can be categorized by purpose, by discipline, or by content. Categorization by purpose yields the categories of learning portfolios and professional portfolios (and possibly more). A learning portfolio is an example of a portfolio categorized by purpose. A learning portfolio can be defined as "A representative or selective collection of one's work often amounting to a documentation for a personal résumé."[8] In the case of a student, the work collected is usually drawn from classroom

work. In the case of a professor, "…the purpose…is to provide a body of work that is a representative sample of a professor's better work accumulated over several years."[9] In contrast, a professional portfolio is "is a tool judiciously and carefully crafted to appropriately showcase the work of a professional while providing evidence of career growth."[10]

Portfolios can also be categorized by the discipline within which they developed.[11] Each discipline has a unique context and vocabulary. Three discipline areas represented by portfolio use are traditional, educational, and information technology. Traditionally, fields such as architecture, fine arts, and photography have used portfolios. These portfolios are collections of work collected on a physical media. Typically, audiences for these portfolios are prospective clients. In the Educational field, portfolios are often used for faculty or student, assessment. "… faculty portfolios are typically used for assessment purposes during promotion and tenure processes (with superiors as audience members) or for reflective purposes, to improve courses materials (with colleagues as the intended audience).[12] Many of these portfolios may be developed online. Information technology portfolios are typically developed online.

An online portfolio may also be categorized by its architecture. Some portfolios utilize client/server architectures to interface with campus student information systems. At some future time, these devices may replace or supplement existing transcripts. These portfolios are designed to provide a richer method for assessment than traditional transcripts.

UH Portfolio Projects

Currently the portfolio project at University of Houston is a semester-long project in a junior level course. Course assignments guide the portfolio development process and guide the students to explore their skill sets in the context of career opportunities in information technology. The portfolios produced are professional portfolios crafted to appropriately showcase the work of a student providing evidence of growth in professional information technology related skills. The portfolio project enables each student to demonstrate core IT skills including analysis, communication, problem solving, and project management.

Each student serves as his or her own project consultant. Their role is to design and produce an online portfolio for prospective employers. The portfolio's primary goal is to demonstrate student skills relevant to career goals in information technology. At another level, the goal is to demonstrate to potential employers that the student can use information and information systems technologies for competitive advantage. UH faculty members teaching the course maintain links to student online portfolios from several previous semesters. As current students begin to contemplate and work on their portfolio they can reference these portfolio examples.

The project viewed in its entirety may seem overwhelming to many students. Thus, the portfolio project process utilizes Systems Development Lifecycle (SDLC) methodology. UH IT students all take a systems development course; the concepts learned in this course are reinforced in almost every subsequent course in the major. In the portfolio project course, clear project guidelines and examples developed as a series of structured assignments facilitate specific SDLC phase development. Barrett has noted that "Electronic portfolio development brings together two different processes: multimedia project development and portfolio development."[13] Table Two is

derived from Barrett's work, and incorporates the phases of the SDLC, information that is familiar to and appropriate for IT students.

**Table 2 SDLC Applied to Portfolio and Multimedia Development**

| SDLC | Portfolio Development | Electronic Portfolio Development | Multimedia Development |
|---|---|---|---|
| Preplanning | Purpose & Audience | Define the Portfolio Context, Goals, Audience | Decide Access |
| Analysis | Collect, interject | The Working Portfolio | Design Plan |
| Design | Select, reflect, direct | The Reflective Portfolio | Develop |
| Implement | Inspect, perfect, connect | The Connected Portfolio | Implement Evaluate |
| Support | Respect | The Presentation Portfolio | Present Publish |

Prior to starting work, it is important that each student define their portfolio audience as clearly as possible. The specific audience determines the appropriateness of many portfolio attributes including media design, navigation, content, resolution. Historically, not all UH IT students are ready to define their prospective employers in detail sufficient for the portfolio project. Consequently, faculty members have written specifications for an offline project notebook that students now build prior to beginning their portfolio projects. This structured course element encourages reflections that facilitate student self analysis. Specific self analysis exercises include a "Skills Analysis", a "Knowledge and Learning Style" Analysis, a "Career Objective" Analysis, as well as a "Goal Action Form". These exercises were modeled after and are available online in the University of Waterloo's Self-Assessment Career Development eManual. The student's results are posted to their private offline reflection workbook.

Meaningful reflection often includes dialogue and conversation with a coach, a mentor, an adviser, or a peer. At this stage the professor, or other adviser, often must help students build a solid vision of their future goals. Once the audience and the future goals have been selected the student then must analyze what to include in their portfolios.

Once, the students have completed their preplanning phase, they are ready to begin gathering artifacts that represent their best IT efforts and achievements. An artifact is any object/item that can represent a student's accomplishments and qualities in tangible form.[14] Artifacts should be relevant to the audience and supportive of the portfolio. Artifacts used by students include programming projects, project plans to demonstrate knowledge of project management principles, data base projects, analysis related to case studies from other classes. Artifacts must be converted to digital media. Since students are in their junior year, they are advised to build a portfolio that can be extended to accommodate future projects.

During the preplanning phase, the course defines specific online portfolio development tools, technologies, and resources. Students are required to use W3C standard technologies that work with all browsers and on all platforms. In the UH program, because the students are IT students, they are allowed to use only text editors to create the portfolio files. Notepad is readily available

and some students download and use trial versions of commercial editors such as HomeSite. The portfolio requirements specify that students use standard Web technologies including XHTML, JavaScript, CGI, ASP, XML, and Cascading Style Sheets. Students are not permitted to use WYSIWYG editors such as Microsoft's Front Page or MacroMedia's Dreamweaver for their portfolio pages. They, however, are permitted to link to projects that illustrate their competence with those applications and others or with proprietary technologies such as Macromedia's Flash.

For graphics, students have access to scanners. Many students utilize their own digital cameras. Students are also encouraged to customize and employ program modules obtained from public, open source, web-sites as long as they credit the source.

Once the artifacts have been collected, students place them online. While design is not a class focus, students are expected to implement their own media design. Part of the media design and a key factor to the success of the portfolio is connecting the separate pages through a consistent and transparent navigational system. The navigation system greatly influences the way the portfolio is perceived by its intended audience, and thus, is a significant portfolio component. Young observed that "Hypertext allows for deeper understanding and explanation through links that go from summary statements to complete documents, related items, and reflections. In addition to displaying artifacts efficiently, links can allow the collection of material in a Personal Archive to become broader and more thoughtful."[15]

The course uses a structured set of journal exercises that facilitate effective media design. Each journal is a short informal assignment that involves research, collaboration, and/or reflection. For the first assignment, students research online portfolios. They locate what they consider to be a very good online student portfolio. They document by writing a short journal article, why the portfolio they selected qualifies as a model. Students then collaborate in small groups to choose and present to the class the best model portfolio from those their group has chosen. Class discussion identifies and names traits common to all of the model portfolios. Students are also given a list of design errors to avoid.

While students are not expected to become professional designers, they are, within this structured environment, expected to make decisions concerning media design and navigational methodologies. These decisions have considerable value. As Ury has noted, a portfolio project "Requires a student to think critically about what to include, why include it, and how to draw adequate attention to included items … this attention to organizing, reorganizing, and reacting to included items that produces the educational and self-evaluative process."[16]

With respect to hardware used in the project, UH lab computers have removable interchangeable hard drive cartridges. Thus, each student creates their own working environment on their personal hard drive. Each student installs his or her own operating system. Each student installs his or her own web server. In this environment each student builds and troubleshoots their portfolio drafts. When they are developed sufficiently, the students move the portfolio to an Internet Web Host. Most students choose to use a free web hosting service. Students have used Angelfire, GeoCities, Brinkster, and others. By using these commercially available web hosting sites, student retain access to their online portfolio after they complete the course.

On the last class day, each student presents their portfolio to the rest of the class. All students in the class evaluate their own portfolio and those of their peers according to stated standards.

Assessing Students' Portfolios

The student portfolio development process yields a diverse array of end products. The portfolios are judged on both content and aesthetic criteria. At this point in the evolutionary process, the responsible instructors, realizing that aesthetic appeal has a large subjective component, have developed an assessment process that includes objective and subjective criteria as well as feedback from the students' peers. Students 'turn in' their portfolio project by sending the instructor the URL. The instructor posts the URLs so that all students in the course can view all the portfolios. After all students' portfolios are 'turned in', each student is provided with an Excel workbook that contains a spreadsheet template of the categories and criterion together with a rating scale. There is one worksheet for each student and each student is responsible to evaluate each classmate's portfolio and their own.

Early in the semester, as the portfolio development process begins, students are provided categorized specific criteria upon which their portfolios will be judged. The evaluation categories and criteria are shown in Table 3.

**Table 3 Portfolio Evaluation Categories and Criterion**

| Item | Category | Criteria |
|---|---|---|
| 1.1 | Content | Contains brief biography. (If you have a biography and it is great you get 5 points. If you have a biography and it is meager you may get 2 points.) |
| 1.2 | Content | Contains statement of employment objectives. |
| 1.3 | Content | Contains downloadable printable resume. |
| 1.4 | Content | Contains summary of technical skills. |
| 1.5 | Content | Contains links to projects/pages that demo application of technical skills and explain what technical skill is being demonstrated. |
| 1.6 | Content | Contains summary of non-technical skills/qualifications that might be important to a prospective employer. |
| 1.7 | Content | Contains summaries of educational accomplishments and/or significant volunteer efforts. |
| | | |
| 2.1 | Technical Merit | No spelling or grammar errors anywhere on site. |
| 2.2 | Technical Merit | Language usage/writing style appropriate for a professional site. |
| 2.3 | Technical Merit | Functional e-mail link to yourself. |
| 2.4 | Technical Merit | All hyperlinks and links to graphic elements work properly, even if pages are migrated to another web server. |
| 2.5 | Technical Merit | Projects linked to that demonstrate technical skills contain technology that works without failure. |
| 2.6 | Technical Merit | Technical elements that convey a working knowledge of information technology are included on the site. |
| 2.7 | Technical Merit | Navigation system is efficient, easy to use, and easy to understand. Navigation system allows you to move backward easily as well as forward. |

| Item | Category | Criteria |
|---|---|---|
| 2.8 | Technical Merit | Visual 'theme' from one page to the next. |
| | | |
| 3.1 | Aesthetics | Aesthetic appeal appropriate for audience (audience = prospective IT employers) |
| 3.2 | Aesthetics | Personal information is separate from professional information so user can easily skip personal information. |
| 3.3 | Aesthetics | Effective use of color. |
| 3.4 | Aesthetics | Effective use of graphic elements such as pictures, icons, animated .gifs., etc. |
| 3.5 | Aesthetics | Effective balance among reading, scrolling, clicking. |
| | | |
| 4.1 | Bonus Points | Demonstrate unusual level of innovation with respect to information delivery (such as a unique, effective navigation system). (0 to 3 points) |
| 4.2 | Bonus Points | Demonstrates unusual level of artistic appeal. (0 to 3 points) |
| 4.3 | Bonus Points | Demonstrates unusual level of technical expertise. (0 to 3 points) |
| | | |

For some criterion there is a rating scale from 0 to 4. Higher numbers represent higher scores. For other criteria, a binary scale is utilized. Either the student provided the element or they did not.

Also note that for several criteria, descriptors are not provided for each rating value but the values are valid rating choices for which the descriptors are 'implied'. Descriptors for each rating category are shown in Table 4. Notice that there are no descriptors for criteria 4.1 through 4.3. Only the instructor is allowed to award bonus points.

**Table 4 Rating Scale Descriptors by Criteria**

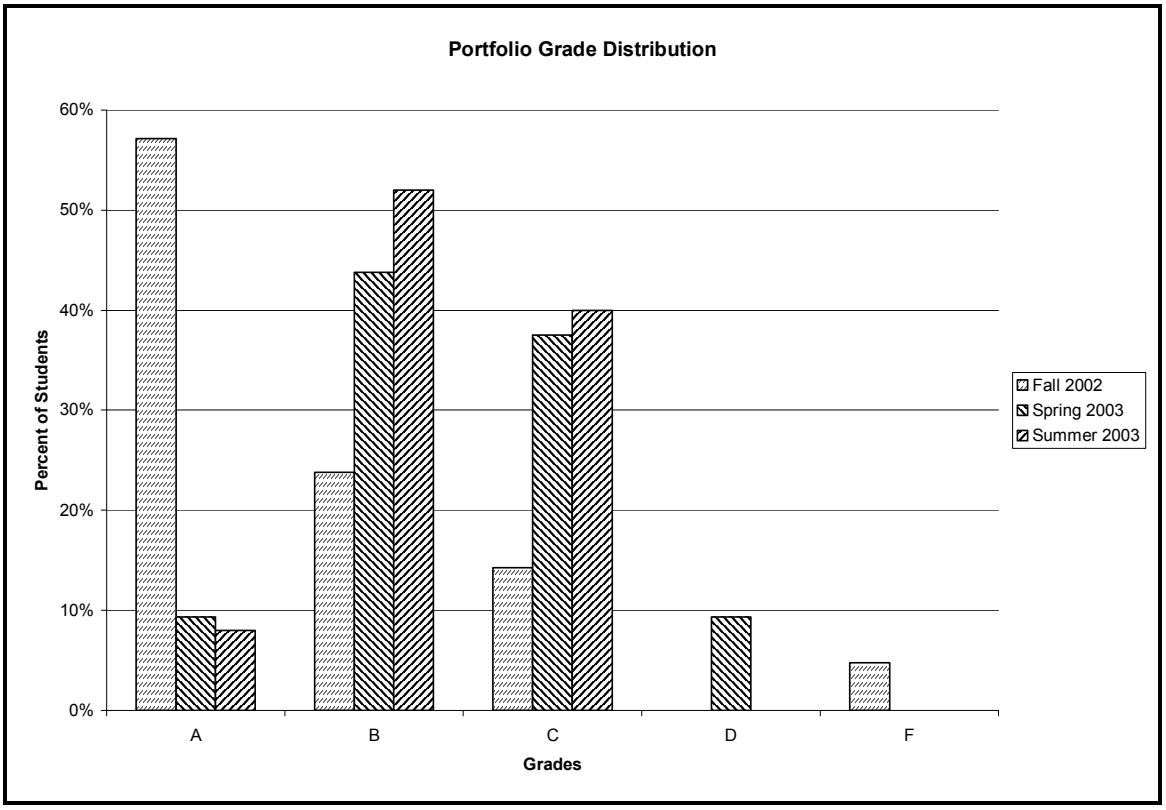
| Criterion No. | 0 Descriptor | 1 Descriptor | 2 Descriptor | 3 Descriptor | 4 Descriptor |
|---|---|---|---|---|---|
| 1.1 through 1.6 | The student did a very poor job or there is none. | There is one but it needs a great deal of improvement. | There is one and it is OK. | There is one and it is better than average. | There is one and it is outstanding. |
| 1.7 | The student did a very poor job or these elements are not part of the online portfolio. | The elements are there but need a great deal of improvement. | There elements are there and they are OK. | The elements are there and the student presented them effectively. | The elements are there and the student did an outstanding job presenting them. |
| 2.1 | There are more than 10 grammar/spelling errors on the site. | | There are about 5 grammar/spelling errors on the site | | There are 0 grammar/spelling errors on the site. |
| 2.2 | Strongly Disagree | Disagree | Neutral opinion | Agree | Strongly Agree |
| 2.3 | There is not one to be found or it does not work. | | | | There is one to be found and it works. |
| 2.4 | Some hyperlinks | | | | All hyperlinks |

| Criterion No. | 0 Descriptor | 1 Descriptor | 2 Descriptor | 3 Descriptor | 4 Descriptor |
|---|---|---|---|---|---|
| | and/or links to graphic elements in the student's online portfolio do not work properly. | | | | and/or links to graphic elements in the student's online portfolio work properly. |
| 2.5 | There is a lot of failed functionality demonstrated through these links or there are no such links. | | There are some failures in functionality demonstrated through the links. | | There are no failures in functionality within the projects linked to. |
| 2.6 through 2.8 and 3.1 through 3.5 | Strongly Disagree | Disagree | Neutral opinion | Agree | Strongly Agree |

Students enter their evaluations of each portfolio into the separate spreadsheets of the workbook template, they rename the workbook to identify themselves as evaluator, and then they email this to the instructor, who compiles the summary information together with his her evaluation into a 100-based grade for each portfolio. The instructor's evaluation is given greater weight than the compiled student evaluations.

A distribution of portfolio grades for three consecutive semesters is shown in Figure 1. The criteria and student input system were instituted in Spring 2003. The result of adding a more formal assessment methodology yielded a distribution of portfolio grades that is closer to a normal distribution that might be expected as a result of a more standard evaluation tool, such as a test.

**Figure 1 Distribution of Portfolio Grades by Semester**




The instructors involved in developing the portfolio course, based on their experience, have several assessment goals. One goal is to refine the criteria by conducting research on scales used to evaluate aesthetics and web sites in general. Another goal is to involve evaluators that represent a different audience, namely potential employers. Third, is to standardize the evaluation tool as a database-driven web-application that is capable of producing feedback and summary reports for each student, course summary reports for the instructor, and longitudinal data for course evaluation purposes.

## Conclusions and Future Directions

Faculty members involved with the portfolio project observe that the process of creating a professional portfolio offers many positive benefits. Other researchers describe the value of the process in providing:

> "… a uniquely valuable context for prompting student self assessment; for engaging in formative assessment with a student attempting to make informed personal and academic decisions that contribute to the development of an intellectual identity; and for supporting students in making meaningful connections between their work and learning across courses and co-curricular activities."[17]

Properly structured, the portfolio development process helps students assess their own learning, skills, and goals. Once they have completed their portfolio they become more keenly award of their own skill sets. They may then make a meaningful comparison to an employers' skill needs. The delta from this comparison can then be used to create goals and learning plans.

As the course evolves, the faculty members contemplate changes that would make the experience even more valuable to students. Logical areas to examine for change include content array, distribution media, purpose, and assessment. Some thought has been given to adding a multimedia (video) component to the portfolio. This would broaden the skill areas that could be documented effectively in the portfolio. Also, the multimedia portfolios could be burned to a miniature CD format to facilitate the physical distribution of the portfolios. An independent student project has demonstrated the feasibility of this concept. In terms of assessment, the faculty would like to incorporate input from IT professionals. Student organizations and the alumni organization have responded enthusiastically to this project. It is hoped that steps can be made in the near future to expand assessment activities to include alumni organizations and other groups that could represent potential employers.

The portfolio project has increased student involvement with course material. It also seems to foster self-discipline by putting students more in charge of their own work. Faculty members also feel the project builds the student's technology self-efficacy. Faculty members are planning research projects to verify some of these findings.

## References


[1] Gathercoal, P., Love, D., Bryde, B., McKean, G. "Web-Based Electronic Portfolios". *Educause Quarterly*. Number 2; 2002.

[2] www.ed.gov/pubs/OR/ConsumerGuides/classuse.html

[3] Worthington, Paul. "Technology Support for Authentic Assessment in the New Milllennia: A Case study on Implementing Digital Portfolios". ACM.

[4] DiBiase, David, et.al. "Using e-Portfolios at Penn State to Enhance Student Learning". *E-Education Institute*. 23 Feb 2002.

[5] Barrett, Helen. Electronic Portfolios, School Reform and Standards

[6] Breault, 2000.

[7] http://www.kzoo.edu/pfolio/

[8] Krumme. http://faculty.washington.edu/~krumme/students/portfolio.html.

[9] Kiper, James; Cross, Valerie; Delisio, Diane; Sobel, Ann; Troy, Douglas. "Perspectives on Assessment Through Teaching Portfolios in Computer Science". ACM.

[10] Lions. http://lions.odu.edu.

[11] Barrett, Helen. The Electronic Portfolio Development Process. 2000.

[12] Treuer, Paul; Jenson, Jill. "Setting Standards for Electronic Portfolios". *Educause Quarterly*. Vol. 26, No.2, 2003.

[13] Barrett, Helen. "Create Your Own Electronic Portfolio:. *Learning & Leading with Technology*. April 2000.

[14] http://www.cdm.uwaterloo.ca/ University of Waterloo Career Development eManual

[15] Young, Jeffrey. "Creating Online Portfolios Can Help Students See 'Big Picture' Colleges Say". *Chronicle of Higher Education.* 21 Feb 02.

[16] Ury, Gary. "Authentic Assessment Through Electronic Portfolios". *JCSC.* March 2001.

[17] Chen, H., Mazow, C. "Electronic Learning Portfolios and Student Affairs" . 28 Oct 2002.

Ed Crowley is Clinical Assistant Professor in the Information Systems Technology program at University of Houston. He earned an Electrical Engineering Technology undergraduate degree and a Master's degree in Information Systems. Professor Crowley is a Certified Information Systems Security Professional (CISSP). After a career in IT, most recently as a Director, Professor Crowley joined the College of Technology in 1997. In addition to the impact of the Internet on curricula, his interests include computer forensics and risk management. He is a member of the Information Systems Security Association (ISSA), the Association of Information Technology Professionals (AITP), and the Association of Computing Machinery SIG-Information Technology Education.

Susan L. Miertschin is an Associate Professor in the Information Systems Technology program at University of Houston. She earned a B.S. degree in Mathematics and a M.Ed. degree in Mathematics Education, both from the University of Houston. Her interest in the integration of computer technology into mathematics education to enhance student's acquisition of mathematical constructs led to an intense study of information technologies and how they can be used to enhance learning and instruction. She is a member of the American Society of Engineering Education (ASEE), active in the Engineering Technology Division, and the Association of Computing Machinery (ACM), active in the Information Technology Education SIG. Professor Miertschin also served as Editor of the *Journal of Engineering Technology* 2001-2003.