

Using Wikis and Weblogs to Support Reflective Learning in an Introductory Engineering Design Course

Helen L. Chen¹, David Cannon², Jonathan Gabrio, Larry Leifer²,
George Toye², and Tori Bailey²

Stanford Center for Innovations in Learning¹/Center for Design Research²
Stanford University, USA

2005 ASEE Design in Engineering Education Division Best Paper

Abstract

An observation and a pedagogical challenge often found in project-based design courses is that students see what they have produced but they do not see what they have learned. This paper presents preliminary findings from an NSF-sponsored research project which experiments with the use of weblogs and wiki environments, two open source tools, to facilitate student integration and synthesis of learning in *Designing the Human Experience*, an introductory freshman seminar on design engineering at Stanford University. Coupled with *Folio Thinking*, a coached process of creating learning portfolios and supporting reflection, this study explores how the combination of this innovative pedagogy along with these new forms of social software can positively influence students' knowledge, awareness, and skills in design engineering.

Weblogs and Wikis

Social software designed to support group interaction has evolved, since the appearance in the 1960s of multi-user computers and networks, in a variety of forms such as multi-player games, chat rooms, instant messaging, and bulletin boards. More recently, weblogs (or blogs) and wikis (web pages that any user can edit) have captured the imagination of members of both the corporate world and higher education community as valuable knowledge management and group communication tools. Schofield (2003) suggests that the rapid rise of interest in software to support group interaction can be attributed to an emerging web-based platform based on blogs, wikis, and RSS feeds (a format for syndicating news and content), on ease of use, and on the ubiquity of web access.¹ In the professional and personal worlds, social interactions increasingly occur and move fluidly between virtual and face-to-face environments. This is particularly true for today's college students who have been described by Prensky (2001) as "digital natives" of the world and languages of computers, video games and the Internet.² Higher education is only now beginning to explore the potential educational value of blogs and wikis as a means to promote deeper learning and integration of learning experiences from inside and outside the classroom (Williams & Jacobs, 2004).³

Folio Thinking and Reflection

Folio Thinking is an instructional method grounded in the process of students creating learning portfolios. Learning portfolios are purposeful collections of artifacts that represent the learning experiences of the portfolio owner, who might be an individual or a group of individuals—students, project teams, faculty, an academic program, or an institution. The Folio

Thinking pedagogical approach is designed to enhance self-awareness by enabling students to make their knowledge explicit and visible for themselves as well as for others. Folio Thinking also deepens learning by enabling students to make meaningful connections—for example, connections among discrete bits of knowledge and between their learning experiences and a more comprehensive model of (the real work of) engineering.

Written reflection is often considered to be a required component of a learning portfolio and is what distinguishes a learning portfolio from a scrapbook, photo album, or web page. These reflections may be associated with individual artifacts and with groups of artifacts. The set of artifacts contained in a portfolio, together with reflections and annotations, tell a unique story about some aspect of the owner's "learning" by helping the owner make visible and explicit her knowledge, experience, and growth. For example, Professor Leifer's graduate course, "Team Based Design Development with Corporate Partners," has maintained a web based course portfolio for ten years (Leifer, 1998).⁴ These artifacts may have been created by the portfolio owner in the context of the experience being represented—such as a design brief, measurements, diagram, or a drawing. Or, the artifacts may not have been created by the owner but still serve as a representation of the owner's learning experience —such as a client's business card or a photograph of a prototype.

The product alone is not all that makes the portfolio a powerful educational tool. The very process of creating the portfolio is an important learning experience (Cambridge, 2001a; Hutchings, 1998; Lyons, 1998; Shulman, 1998; Porter et al., 1995; Belanoff et al. 1991).^{5,6,7,8,9,10} By linking the process of design to the process of creating a learning portfolio, students have a concrete context in which they can openly and consciously engage in reflection. Creating a portfolio also prompts students to physically juxtapose learning experiences that are otherwise separated by time and space and make meaningful connections among those experiences that can lead to powerful new insights about themselves and their learning career. For students who are contemplating deeply their experiences and the relationships among those experiences, the artifacts may serve as objects to facilitate thinking and remembering (Brereton, 1998; Pea, 1993).^{11,12}

We purposefully chose to couple the implementation of wikis and weblogs (the technology) with Folio Thinking (the pedagogy). It is our working hypothesis that the combination of Folio Thinking practices with the wiki and blog technology will increase: 1) **awareness** of what is learned and 2) **articulation** of connections between learning and the design process. Folio Thinking will enhance the interactive nature of wikis and blogs by encouraging students to make their knowledge explicit and visible not only for themselves but also for course instructors, team coaches, and their peers.

Weblog and Wiki Requirements

Our primary research interest focuses on how to encourage and facilitate reflective thinking about the design process. However, technology was a necessary foundation for our efforts. We chose web-based software to enable the students to gather, organize, and share their writing, photos, videos, presentations, and other digital creations. More specifically, we used a software package of a variety often called 'social software' or 'community building' software,

called Tikiwiki which supports both wiki pages and weblog functionalities. (Tikiwiki is based on the very popular Apache, MySQL, PHP combination of open-source software packages.)

The necessary features underlying our choices of weblogs and wikis are as follows:

Weblogs

1. Distinct, dated entries usually made up of text containing news, commentary, notes, and personal reflections, with links to other artifacts such as websites, photos, or other media
2. Reverse chronological arrangement of entries such that the latest entry appears at the top of the web page
3. Easy upload and editing of entries and artifacts through a web browser
4. Outside commenting on entries from peers, coaches, teaching team, and others at a distance
5. Informal environment with easy and low barriers to posting due to student familiarity with social blogs such as the commercial Xanga, LiveJournal, and Blogger communities

Wikis

1. A group of interlinked pages, each with a unique name
2. Can support both individual and team work
3. Each page editable by a number of people, often a team or the whole community,
4. Use of a simple set of markup punctuation and other non-alphabet character patterns that can be translated into common web page elements
5. Easily edited through a web browser, with previous versions of a page saved and retrievable in the event of mistakes

ME013N: Designing the Human Experience

Designing the Human Experience is a project-based course that guides students with scaffolding through the design process. The course, most recently given in Winter 2004 and Fall 2004, is motivated by the realization that we live and work in a human-built environment. From a design-philosophy perspective, it is imperative that engineers take responsibility for and help guide the ethics and other ramifications of these design processes. The objectives for the course are to: (1) enable students to begin thinking and acting like design engineers without committing to being one; (2) make students aware of what it means and how it feels to think and act like a design engineer; and (3) allow faculty, advisors, and potential employers to see individuals mature from having relatively undifferentiated intelligence into professional minds with documented skills and experience, some becoming design engineers, but all understanding where design thinking fits into our everyday lives. Thus, the course emphasizes direct experience, practical design thinking, and the building of real product prototypes. No prior design experience or fabrication skills are required. The ideas developed in the course are grounded in the students' collective background life experiences and observations of "human needs."

Designing the Human Experience activities and discussions revolve around two design projects. Four to five students work together as teams on project assignments that build on the knowledge, skills, and experience that students gained in the previous assignment, getting closer and closer to full scale, externally sponsored design challenges with real world complexity. In

Winter 2004, the teams worked on the design of an interactive kiosk for an exhibit on revolutionary crowds at the campus museum. In Fall 2004, the project assignments included the building of a “precious” object with specific technical parameters, and the design of a collaborative workspace for computer science students. For each project assignment, the course required both individual and team documentation describing the design process, goals, methods, results, conclusions and broad takeaways or lessons learned. Much of this documentation was completed in the course wiki pages and ‘idea logs’ (weblogs). Capturing learning experiences through the creation of design documentation *as the design project takes place* is an important first step in creating a learning portfolio. As a result, students are faced with the challenge of articulating the knowledge they are acquiring and the relationship of this knowledge to their evolving model of design engineering.

At key times during the course, students shared their portfolios in conversations with the instructor, design team coaches, and peers. Feedback from the instructor was largely given to the students during these discussions rather than in written form. Students were also encouraged to read and comment on each other’s idea logs in the course website.

Student Population

All of the students were first year undergraduates in the first or second quarter. One third of the students were female. Several of the students did have prior design experience from high school but for many, this course was their first exposure to the work of design engineering and the challenges of working in a diverse design team.

Preliminary Findings

In Winter 2004 and Spring 2004, students in *Designing the Human Experience* used these tools to build electronic portfolio collections both as individuals and as teams, thereby creating tangible evidence of how they formulated and addressed various design challenges. Both quantitative and qualitative data were collected from surveys, interviews, classroom observations, and curricula materials. All of the students were interviewed at the end of both ten-week quarters about their experiences in the class. Although analyses are ongoing, we provide some selected examples and preliminary findings demonstrating how students have become more aware of their developing knowledge and skills, and the explicit connections that are made among aptitudes, knowledge, and skills and the real work of engineering.

One of our research interests was aimed at increasing student awareness of what they were learning about design. **Table 1** gives some sense of student perceptions about what they learned about design more generally, beyond the scope of their specific projects. The slight differences between the two courses may be attributed to different class project assignments. **Table 2** represents students’ reports on the impact of the course on their confidence in their abilities to do design work as well as their continuing interest in design as a result of taking this course. At least two-thirds of the students in both classes viewed the experience as a positive one resulting in greater motivation, self-confidence, and interest.

Table 1

Percentage of Students Reporting “Moderate Progress” or “A Great Deal of Progress” Resulting from Taking ME013N: Designing the Human Experience

Progress made, because of this course, in your:	Winter 04 (N=14)	Fall 04 (N=21)
Understanding of what designers do in industry or as faculty members.	71%	71%
Understanding of design as a field that often involves non-technical considerations (e.g., economic, political, ethical, and/or social issues).	75%	61%
Knowledge and understanding of the language of design in engineering.	57%	71%
Knowledge and understanding of the process of design in engineering.	85%	75%
Ability to do design.	71%	62%

Table 2

Percentage of Students Reporting Increases in Design-related Confidence, Motivation, and Interest Resulting from Taking ME013N: Designing the Human Experience (‘...’ indicates ‘moderately improved’ or ‘greatly improved’)

The course was offered as an "experience" in design-thinking. As a result of your experiences in and through the course:	Winter 04 (N=14)	Fall 04 (N=21)
Your confidence that majoring in a design-related field is the right choice for you	65%	60%
Your confidence in your ability to become a designer has ...	78%	66%
Your motivation to become a designer has ...	64%	75%
Your sense of responsibility for your own learning has ...	71%	72%
The likelihood you will continue to take design-related classes has ...	71%	76%
The likelihood you will pursue a design-related career has ...	56%	71%

The relationship between the course and one’s sense of responsibility for one’s own learning is notable, particularly in Fall 2004 where there was a greater emphasis on the wikis and idea logs due to the resolution of prior technology glitches, a quicker roll out of the software, and the development of better scaffolding materials. Of the various course elements such as the course Tikiwiki site and both the individual and team idea logs/wiki pages, over 72% of the students indicated that the Broad Takeaway assignments were the most “important” or “crucial” to their understanding of design thinking. The ‘Broad Takeaways’ were extended reflections founded upon the earlier reflective notes and artifacts captured during the class; in these, students were expected to review and cite previous posts and course materials where appropriate. The following examples from student ‘ePortfolios’ may provide some additional insight into the relationship between the Broad Takeaways and increased student responsibility for learning.

Three Examples of Artifacts and Reflections from Student ePortfolios: Evidence of Learning?

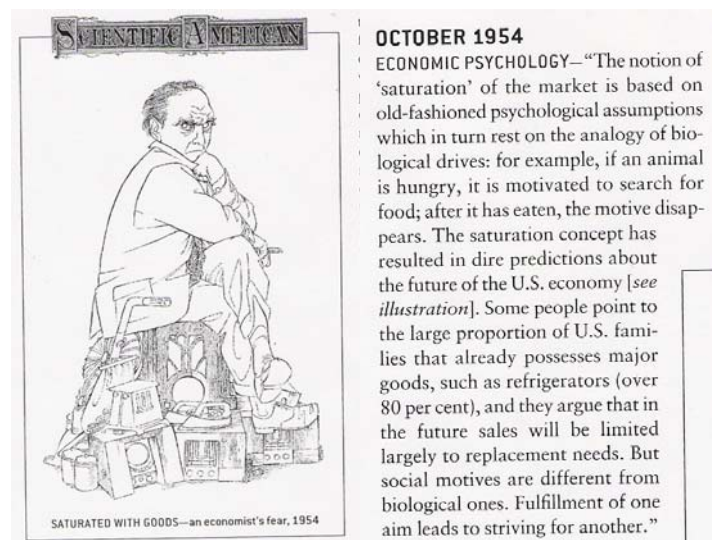
Example 1 illustrates how students began to use the wikis and weblogs as a place to integrate design-related thoughts, resources, and experiences from outside of class into their current work. This article was scanned in by the student and included in a post along with accompanying reflections. From the perspective of the teaching team, this was a rich opportunity to gain some insights into how students, outside the class in activities that would normally be considered unrelated to the class assignments, were interpreting and applying the design principles presented in class.

Example 1: Late Night Revelation

1954 Article about the Economic Notion of Saturation of Market

As I was cleaning my room I chanced upon an article which I discovered a few weeks ago and wanted to comment on. I realized that it had a lot to do with design and our current class disposition to design.

the article is as follows:



The question is after reading this article... does it follow that a majority of designers are designing for "replacement needs"? I think so. Since, designers are constantly trying to make what exists better so that someone wants to buy a better version of what they already have. It is rare that we see a whole new market open up to provide "new" products to people. Yes, technology creates new niches but there is always a huge market for "redesign" Hence, I believe the biggest challenge that designers will face in the future is being wholly original in their concepts and ideas... at some point every idea is "tainted" by the influence of design in the world around us.

I would reflect more... but I'm dead... really really tired... so good night/good morning computer!

BYE

Example 2: This student artifact illustrates how skilled some of these “digital natives” are with their familiarity with Photoshop and digital video editing programs. In our final end-of-the-quarter presentations, all of the student teams used some kind of digital video as an illustrative example of observations or their prototype.

Example 2: People-based design



I have to admit that I am ridiculously proud of my team name idea. I think that “Humanitechie” and “Habitat for Humanitechie” very neatly capture the conundrums contained in our project. We had to design technology-containing environments for people, but for people who were used to their familiar, inflexible technology in the first place. The difficulty in trying to balance new technology with old habits cropped up frequently in our arguments.

Having “people” be the defining point of our designs, rather than “preciousness,” was both more and less vague. It was less vague in the sense that we all know what people are; we are people. Whereas we do not have a firm hold on what preciousness “is,” we do know who people are. That was evident in our ease of identifying problems with our project; we have a sense of how people will respond to our design, and although we often couldn’t define the basis of that response exactly, we still know that there will be one.

Of course, “People” is more vague in regards to what exactly “people” is. Stanford’s much-touted diversity is still just a tiny bit of the full range that exists. Everyone is different, as we’ve been told for as long as we can remember, and I’m unsure as to how that can fit with a project for such a specific demographic. Humanitechie tried to take into account people’s differences in its design, but we still had to categorize to a certain extent in order to get anywhere. Though this sounds exclusivist, I don’t think that we had a narrow-enough focus.

In the end, our name became exactly what we avoided. We couldn’t categorize all computer science and graphic design people as “Humanitechies.” We thought that building around a predetermined person with predetermined habits would only lead to a rearrangement of existing space and surfaces, so we went far off in the other direction. We came up with “cool” technology that could enhance teamwork, but I don’t think that our ends justified our means. “People-centered design,” the term I used in Humanitechie’s executive summary, is an ideal that we didn’t quite reach.

Example 3: This last artifact is a couple of paragraphs from a representative capstone reflection on the course as a whole. The impact of reflection on this student's learning lies primarily in how the student views the reflective activities that were integrated into the curriculum throughout the academic quarter. Evidence of how reflective thinking has influenced this student's learning is most clearly illustrated in these two paragraphs:

Example 3: Broad Takeaway

Another change in thinking I took from this class is not really design related, but from the wiki posting and reflection. I've never had a class that encourages so much reflection, and while it is tedious, I'm realizing how helpful it is. I'm understanding more and more the importance of taking responsibility for my own learning; this is something I am definitely going to keep doing for the rest of my college education, and even life. Knowledge is power, but if you're not aware of what you know, how can you use that power?

Also, I'm planning to use the takeaway of reflective thinking intensely for my college years, and beyond. While I've been aware of my education before, I think it's truly the mark of a higher education that the student takes responsibility for what they are learning, and is fully aware of the value of their time.

Conclusions and Next Steps

This paper presents preliminary findings and examples of several artifacts and reflections from student ePortfolios developed for an introductory freshman seminar on design engineering. We have only begun to analyze the large amount of data that we were able to collect. Our findings thus far suggest several provisional conclusions, and avenues for future work:

Keys to initiating and maintaining the students' engagement in written and illustrated reflection in the wiki and weblog online environment include:

- *Expressed reflection as a core expectation:* establishing the use of the environment as a central part of the course from the first day;
- *Concreteness:* giving regular, clear, small assignments for reflection about specific class-related experiences, along with examples of good reflective writing, photography, drawing, excerpting from things encountered, seen, or read, etc.;
- *Feedback:* regularly engaging the students in conversations about what they are experiencing, how to generalize from the artifacts in their personal ePortfolios, giving feedback to the whole class and to individual students, and encouraging the students to browse, learn from, and respond to what other students were creating;
- *Robustness:* keeping the software and hardware consistently reliable so that students could rely on not losing any of their hard-thought-out work.

This kind of reflective activity enhanced the students' experience beyond the often ephemeral details of each project, enriching this experience with a more general and overarching, personally-constructed viewpoint on design processes and how we experience and create the designed world. In future iterations of the course, we hope to examine other factors which may contribute to and influence students' learning in these classes. Some of our research questions include:

- *Gender differences*: what effect might gender differences have on self-confidence, awareness, and interest in continuing to take design courses that incorporate Folio Thinking pedagogy, idea logs, and team wikis?
- *Self-selection*: given the way that the courses were described in the introductory seminar catalog, are the students who are interested in these kinds of courses more amenable to reflective expression and learning?
- *Long-term effects*: if we were able to interview these students in their junior or senior year, would these students be any different in their thinking about design, their undergraduate education, learning styles, and choice of major, from students who had expressed interest in the course but did not actually take it?
- *Textual analysis of reflection*: Can we develop a rubric or other assessment tool to objectively evaluate the kinds and depth of reflection engaged in by the students, using proxy measurements such as coding and analysis of the text they wrote in their ePortfolios?

Finally, there were a number of areas in the way that we applied the Folio Thinking approach in *Designing the Human Experience* that we will seek opportunities to improve upon and test. These include:

- *How to provide more feedback to students*: We continue to be challenged by the quantity of material produced by the students, as we try to respond with feedback that does justice to the thoughtfulness and insight in their work. We plan to explore ways to increase peer feedback and the building of a class community. As any instructor who has read and graded reports knows, adequate written feedback is difficult if not impossible due to limitations in time, but feedback via conversation may be more feasible;
- *How to best allocate in-class time*: We allocated some time in-class for the students to write and create entries in their ePortfolios; should we increase time for student reflection in class? Certainly some class time for reflection can help students step into the habit of writing, but how much is enough, especially when opportunities for in-person teacher-student engagement are often scarce?
- *Wiki and weblog software implementation*: TikiWiki proved to be reasonably usable but we found that a number of relatively simple adjustments would have improved the usability of the environment for the students and enabled better reflective work. What aspects of this software in particular, and wikis and weblogs in general, facilitate or impede students' reflective work?
- *Physical classroom environment*: This course was taught in a classroom instrumented with wireless laptops and large Smart Panel screens. How significant was the learning space in enabling the students to push forward their design projects, work in collaborative teams, and reflect in their ePortfolios?

We believe that like email, wikis and weblogs will be increasingly included in the repertoire of familiar modes of interaction that students can be expected to use in their learning processes. These channels seem particularly suited to supporting the process of coached reflection, and we anticipate they will play a greater role in students' reflective learning experiences in engineering design and more broadly in higher education.

Acknowledgements

This research is based on work supported by the National Science Foundation under Grant No. DUE-0341143. We are also grateful to the Wallenberg Global Learning Network and the William and Flora Hewlett Foundation which supported earlier research that was essential to creating the pedagogical methods used in these courses.

Bibliographic Information

- [1] Schofield, J. (May 6, 2003). "Social Climbers." The Guardian. Retrieved March 6, 2004 from <http://www.guardian.co.uk/online/story/0,3605,950918,00.html>
- [2] Prensky, M. (2001). "Digital Natives, Digital Immigrants." <http://www.marcprensky.com/writing/Prensky%20-%20Digital%20Natives,%20Digital%20Immigrants%20-%20Part1.pdf>
- [3] Williams, J.B. & Jacobs, J. (2004). "Exploring the use of blogs as learning spaces in the higher education sector," 20(2), 232-247.
- [4] Leifer, L.J. (1998). Design team performance: Metrics and the impact of technology. In S.M. Brown & C. Seidner (Eds.), *Evaluating Organizational Training*. New York: Kluwer Academic Publishers.
- [5] Cambridge, B.L. (2001). Electronic portfolios as knowledge builders. In B.L. Cambridge (Ed.), *Electronic portfolios: Emerging practices in student, faculty, and institutional learning*. Washington, D.C.: American Association for Higher Education.
- [6] Hutchings, P. (1998). *The course portfolio: How faculty can examine their teaching to advance practice and improve student learning*. Washington, D.C.: American Association for Higher Education.
- [7] Lyons, N. (Ed.). (1998). *With portfolio in hand: Validating the new teacher professionalism*. New York City, NY: Teachers College, Columbia University.
- [8] Shulman, L. (1998). Teacher Portfolios: A theoretical activity. In N. Lyons (Ed.), *With portfolio in hand: Validating the new teacher professionalism*. New York City, NY: Teachers College, Columbia University.
- [9] Porter, C. & Cleland, J. (1995). *The portfolio as a learning strategy*. Portsmouth, NH: Boynton/Cook Publishers, Inc.
- [10] Belanoff, P. & Dickson, M. (Eds.). (1991). *Portfolios: Process and product*. Portsmouth, NH: Boynton/Cook Publishers, Inc.
- [11] Brereton, M.F., Cannon, D.M., Mabogunje, A., & Leifer, L. (1996), Characteristics of collaboration in engineering design teams: Mediating design progress through social interaction. In K. Dorst, H. Christiaans, & N. Cross (Eds.), *Analyzing design activity*. Chichester, UK: Wiley.
- [12] Pea, R. D. (1993). Practices of distributed intelligence and designs for education. In G. Salomon (Ed.), *Distributed cognitions: Psychological and educational considerations*. New York: Cambridge University Press.