

Teaching Human-Computer-Interaction with Shakespeare Sonnets: a case study in interdisciplinary project-based learning

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Abstract: This paper presents a case study illustrating a novel collaborative approach for designing and implementing interdisciplinary projects for undergraduate Human Computer Interaction courses. The starting point is to involve an academic client in the project development cycle, a client that comes from a different discipline than computer science and engineering. While industrial client-driven project specifications are rather commonplace in software engineering undergraduate curricula, the novelty of our approach consists in attributing the client-team a center-stage role in the project-related teaching process. The client team becomes thus a partner in teaching. The theme of the project deals with professional e-reading techniques, which represents a major paradigm change in Humanities Computing. The paper reports on the choice of the project theme, the structure and organization of the project, its final outcomes, and discusses the learning value of the project.

Introduction

The field of Human Computer Interaction (HCI) is inherently interdisciplinary. Knowledge from social sciences, psychology, and business is required as personal computing technologies and a large variety of software applications play an ever increasing role in everyday life. However, in most undergraduate human-computer interaction courses, interdisciplinary content is covered only in a purely theoretical way.

This problem is not limited to HCI courses. Jaccheri & Sindre have found that very few undergraduate software engineering projects have interdisciplinary content. They conclude that “*adding interdisciplinary challenges on top of an already ambitious team project may be too much in terms of student workload and pedagogical risk.*”

Ertas et al emphasize another challenge related to interdisciplinary content in course projects. They point out that ‘disciplines inevitably develop into self-contained hard shells’ which encompass discipline-specific tools, methodologies, and jargon. They argue that the highly-specialized intra-disciplinary jargon limits significantly the efficiency of inter-disciplinary approaches to problem solving.

The notion of interdisciplinarity is closely related to the design of complex systems and information management. Herb Simon, in the chapter *Holism and Reductionism* of his book *The Sciences of the Artificial*, identifies interdisciplinary collaboration as a core element in large scale systems development problems. In the *Science of Design* Chapter of the same book, he writes “*The proper study of mankind is the science of design, not only as the professional component of a technical education but as a core discipline for every liberally educated person.*”

Capitalizing on the findings in the related work cited above, our hypothesis is that assigning interdisciplinary course projects in software engineering courses such as Human Computer Interaction represents an effective way to let the students experience the challenges of handling complex interactions of various disciplines during the design process. To avoid coursework overload, project objectives need to be carefully formulated and planned in

accordance to the theoretical content of the course. This close link between theory and practice should allow for maintaining a reasonable workload while maximizing the learning outcomes of the course.

This paper presents a case study illustrating a novel collaborative approach for designing and implementing interdisciplinary projects for undergraduate Human Computer Interaction courses. The starting point is to involve an academic client in the project development cycle, a client that comes from a different discipline than computer science and engineering, so that it provides a perfect example for Nielsen's fundamental law of user interface design "*The user is not you!*".

One may note that project specifications from industrial clients are rather commonplace in software engineering undergraduate curricula. The novelty of our approach consists in attributing the client-team a center-stage role in project-related teaching. The client team must be able to guide students through the labyrinth of new ways of thinking and interacting with the computer that are specific to the unfamiliar discipline. Therefore, the client becomes an essential partner in the teaching process. Our hypothesis is that a client with an academic background possesses more skills in knowledge elicitation (Wood, 1998) and more specifically, in minimizing the amount of tacit knowledge (Ericsson & Simon, 1993) than clients coming from an industrial background.

Our case study reports upon an interdisciplinary course project whose main objective was the development of a user interface to support professional e-reading strategies; a detailed explanation of such strategies is provided in the following section. The project design and implementation was done in collaboration with an academic client from the Department of English (Humanities Computing). The remainder of the paper is structured as follows. The following section outlines the methodology behind the project design and implementation process. Next, we provide a discussion on project-related learning outcomes and show some samples of project work. Finally, we draw conclusions and describe future work directions.

Methodology

The interdisciplinary project which is the object of this case study was assigned in the Human Computer Interaction course (SENG 310) at the University of Victoria in summer 2007. SENG310 is a third year undergraduate course in Computer Science and Software Engineering Programs at our university. The enrollment for this course consisted in 15 students, which formed 4 teams for project work. All teams received the same project description and were asked to not communicate with other teams during the design process in the perspective of an inter-team competition that was organized during the final oral presentations.

The remainder of the section provides first contextual information about professional (e)-reading, which represents the theme of the project in our case study. Next, the content and structure of the project are described.

Professional (e)-reading

Domains such as literary studies, health care and law require an intensive documentation phase prior to any decision-making process (in health care and law) or writing exercise (literary studies). This documentation process is based upon professional reading techniques. Professional reading is closely related to the issue of information management from multiple sources and at multiple levels of context. A simplified multi-layered model of information management used in professional reading is shown in Fig. 1. The concepts in Fig. 1 are explained below in the specific context of literary studies.

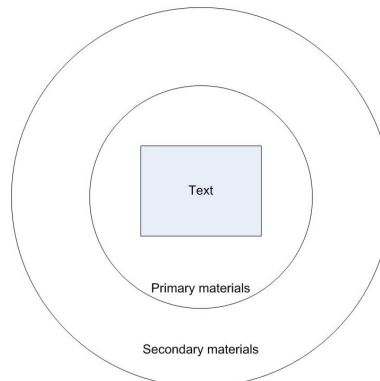


Figure 1. Information structure for professional reading

The (main) *text* is the primary object of study. *Primary materials* are the first level of context; they represent information that the original reader (contemporary with the text) had access to. In other words, primary materials represent everything else that has been written during the same time period (i.e. Renaissance) about the same topic as in the main text (i.e. procreation). Primary materials enable the professional reader to find out what the readers contemporary with the main text understood from it.

Secondary materials are represented by articles, books, journals in direct relationship with the main text at the centre. Secondary materials are important for studying all interpretations and outcomes of the previous text analysis processes. The professional reader must have a deep understanding of secondary materials in order to prove that he brings a fresh insight and a novel interpretation of the studied text.

While paper-based professional reading is at the core of humanities, medical and law sciences, the information age that we live in demands an accelerated transition towards professional e-reading. In literary studies, we see the emergence of a new field, namely *Humanities Computing* or *Digital Humanities*. This field can be defined as the confluence of computational methods with humanities concerns. The project under study belongs to the area of Humanities Computing. Recent progress in this field is listed below:

- e-catalogues are widely used by professional readers; this on-line version of the traditional library catalogue is far more efficient for search activities than its original counterpart.
- on-line Facsimiles (collection of pictures of the original work) emerged as a natural transition from paper-based facsimiles
- e-publishing is the process of making scholarly articles available on internet before they are printed on paper. While e-publishing is mainstream in fields such as applied sciences and engineering, it is still under development in literary studies.

To summarize, the state of the art in humanities computing consists in digitized information. All main texts, primary, and secondary materials are now available in digitized form. The open question, however, is how to efficiently manage all this information in order to support e-professional reading techniques. This question stems from the transition from text to hyper-text. As Fontanini (2004) writes, "Processing hypertexts requires the integration of characteristics which are inherent to the reader's nature (e.g. cognitive abilities, strategies and expertise in the domain), as well as to aspects provided by the machine, such as navigation tools, information structures, accessibility for location of text windows among others. All these factors may influence, and directly affect, reading processing, and thus, comprehension."

Project specification

The project consisted in the design of a user interface for the professional e-reading of Shakespeare sonnets. The students had to choose ten different sonnets from the collection available on the provided data CD. The interface must enable the user to choose one of these sonnets as *main text*, and to use the remaining nine as *primary materials*.

The *secondary materials* consist of sonnet-specific comments extracted from Steven Booth's edition of Shakespeare's sonnets (Booth, 2000). These comments were available in txt files and were stored in the same folder as the sonnet of interest.

The main professional e-reading-related tasks that the interface should support are:

- the simultaneous display of original version(image file) and interactive version(txt file) of the sonnet;
- interactive information search;
- text analysis and annotation based on prior user and task analysis applied to professional readers. For example, professional paper-based reading involves taking notes while reading. The students were asked to find efficient ways to implement annotation within the designed interface.

Project milestones

The project started with an in-class guest lecture held by the client team about user requirements for the development of the e-reading interface. This session also provided background information about professional e-reading techniques in literary studies.

The first project deliverable consisted in the description of a persona and scenario related to professional e-reading strategies; this deliverable forced the students to adopt a user-centric approach to interface design. The interface design process followed an iterative model; each iteration involved prototype testing with the client, whose feedback was used for further development. The final deliverable consisted in a functional demo of the user

interface, along with a project report and an oral presentation. The focus was on interface affordances and navigational models, rather than on the complete functional implementation of the software for professional e-reading.

Discussion

We evaluate the learning value of the interdisciplinary project assignment from three different perspectives. First, we analyze the role of interdisciplinary information in learning how to apply the user-centric design paradigm to a specific HCI problem. Next, we discuss the interaction paradigms and metaphors that were identified in the final project outcomes. Finally, we provide an overview of the student feedback that we collected using post-project questionnaires. One should note that our discussion focuses more on qualitative rather than quantitative aspects of the interdisciplinary project-based learning experience.

User-centric design

One of the main learning objectives in a Human-Computer Interaction course concerns the understanding and application of the user-centric design paradigm. We found that this paradigm was instantiated in all projects in various ways. Perhaps the most direct expression of the user-centric perspective is reflected in the quality of the personas and scenarios that the students were asked to create. The project excerpt below shows that discipline-specific concepts about professional reading were well-assimilated. These concepts were successfully integrated into a fictional professional reader and into a scenario that reflects well the limits of professional paper-based reading.

“Stuart Williamson is working on his final year of a Master’s degree in American English at the University of Victoria. He is currently working on his dissertation on the topic of how Poe’s depression affected his later writings. Stuart grew up in a household that had an average degree of computer literacy. By age 12, there was a family computer in the house, and by the time he went to university, there was a computer in his dorm room. As a result, Stuart is literate in computer technology. He has a typing speed of 65 WPM, and takes advantage of the more obvious features in the office applications he uses (i.e. alignment, font size/colour, tables). He is by no means a “power user” though, and generally takes a long time to learn new features of programs he is using on his own. Like many students his age, he has grown familiar with computers as an aid for doing research, but still prefers to make his notes by hand. He notes that while his typing speed is much faster than his writing speed, when he needs to annotate specific sections of the books he is reading, he finds that adding sticky-notes to pages, and then writing in the margins the most time effective method. The alternative of typing the note into a document and then writing down the page number and book it refers to is “Kind of a hassle.”

Stuart has completed all of his requirements for the masters of American English except for his thesis, which he expects to have finished in approximately 12 months. Since it is by far the most researched-focused part of his program, he is spending a lot of his time with three or more books and a FireFox window open at once. ‘It requires a lot of desk space and page flipping, but it’s the way I’ve been doing it since I started my undergraduate degree and in the end, it’s effective.’ remarks Stuart. Generally, one of the books he has open will be one of Poe’s works, and then he will have other books referencing that part of the text, and often some biographical books. When queried about what problems he was facing when researching his thesis he highlighted the volume of information he was working with as a problem. ‘It’s an organizational challenge, managing all of these different facts and references. Sometimes I think I spend half my time looking for the passage that I’ve noted correlates to the others. I try to keep it all organized, leaving page numbers for important references on my sticky notes, but it gets confusing once there are ten references to a single passage.’ He also mentioned that marking up books was a problem. ‘I buy some of the books that I’m doing research with, but a lot of the time, I’m in the library. Also, whenever I am looking up online resources, I have to write down the link to them, or else print them off and keep the documents in a pile to look through later.’ ”

Interaction paradigms and metaphors

The final interfaces displayed a solid sense of how to organize the information and how to facilitate professional interaction with that information through features, and flexibility within those features (targeting search materials, rearrangement and resizing of windows, zoom on original artifact). Below are examples of project work that showcase some of the best ideas that materialized during the design process.

Among the global metaphors created for the professional e-reading interface, the workspace was the most successful one. Affordances associated to this metaphor include the selection of a main text and the creation of user notes (text annotations) and links to primary, secondary, and tertiary materials. Fig. 2 shows two different layouts implementing the same workspace metaphor.

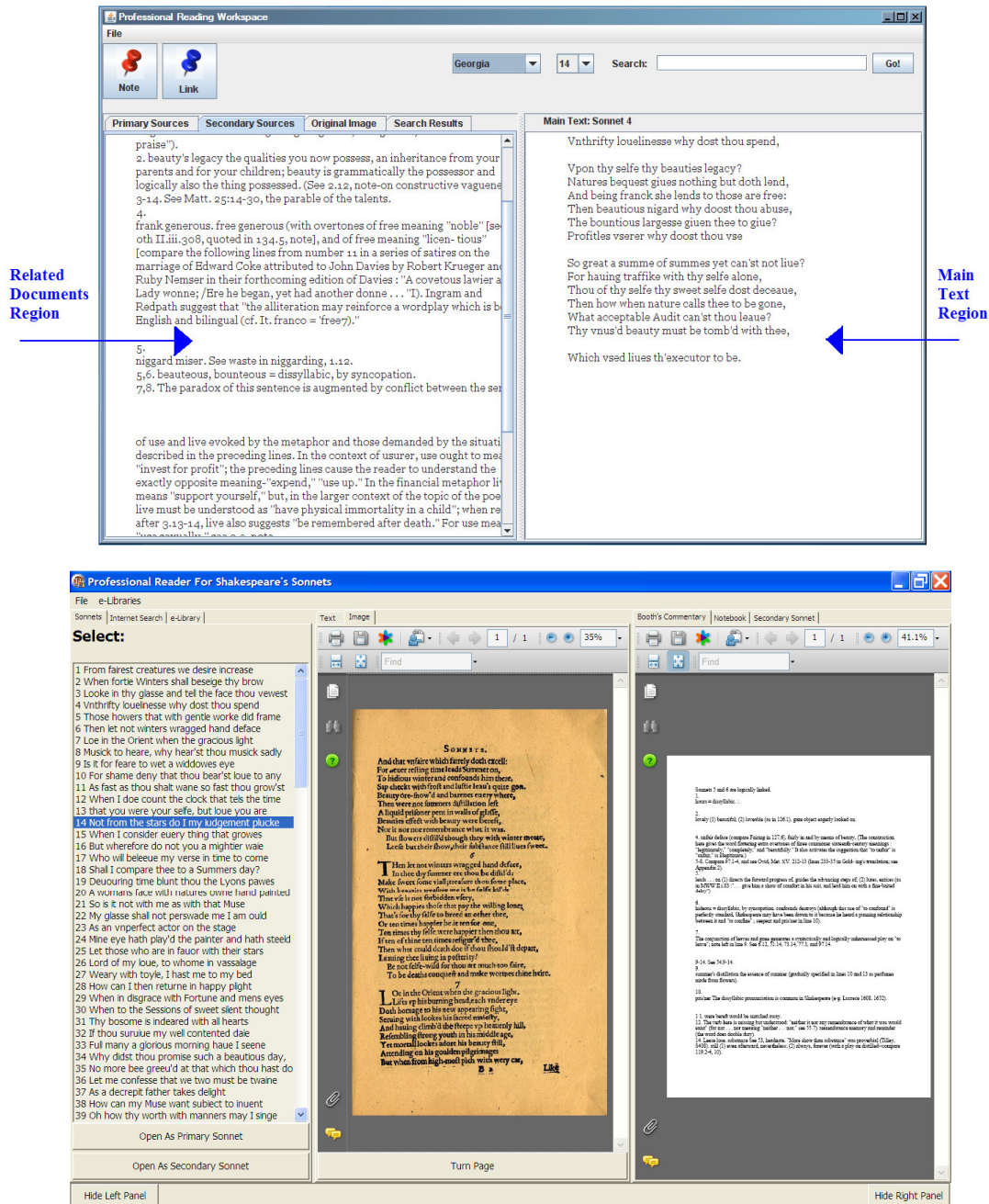


Figure 2. Two layouts of a professional e-reading interface implementing the workspace metaphor

The user is enabled to annotate the main text and to create links between this text and its associated materials via the pushpin metaphor, where the pushpin affords overlaying attachments on top of the text. Two different types of pushpin are used, one for notes, the other for links. Fig. 3 shows the process of creating a link between two documents.

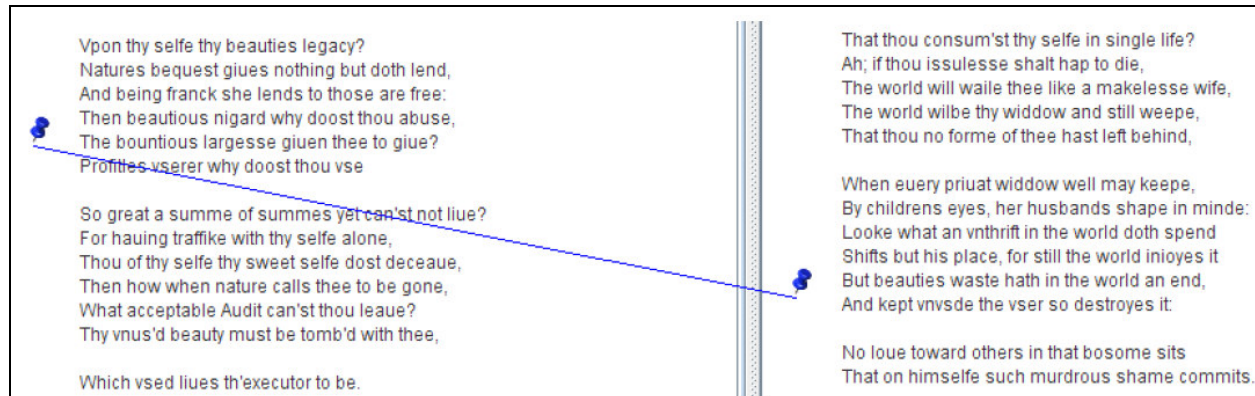


Figure 3. Creation of a link between the main text and an associated material. The user clicks on the link button at the top toolbar (see top layout in figure 2), and the cursor changes into a blue pushpin. The user can click on any line of the document to anchor one side of the link at the selected line. Once the link is anchored at one ending, a line is drawn from that end to wherever the user moves the cursor, until the second ending is selected. In normal operating mode, only the endings of the links are visible as blue push-pins, while the line showing the correspondence between two endings is hidden until the user hovers the mouse over a pushpin.

The notion of data persistence is also central to the workspace metaphor. Saving the current state of the interface is equivalent in a physical workspace to returning to one's books open on a desk exactly as they were left. The data persistence was implemented via an option to save the configuration of files as they stand, like in a computer game, where one saves all aspects of the current environment.

Student feedback

We have collected feedback from students about the perceived learning value of an interdisciplinary project assignment via anonymous questionnaires distributed after the completion of the project. Out of 15 students enrolled in the course, 6 have returned the completed questionnaires. The feedback was very positive overall, with 5 out of 6 students willing to recommend this type of interdisciplinary project to a fellow student. Table 1 shows one of the key questions that provided us with a significant insight in the students' perception of the project value, as well as the complete answers that we received to it.

Q	What did you find most useful about the interdisciplinary information and specific feedback sessions?
A1.	"It was interesting to design a product for a user in a different field. This was the first time I have done a project like this."
A2.	"[It] did not feel like a canned, boring, reused assignment. [It] really was a client-[developer] relationship."
A3.	"Diversity in learning. We engineers spend too much time on trivial applications. It is super useful to have projects that require breadth and depth of understanding."
A4.	"The client feedback. By this I mean specific design/layout choices that have been altered due to these sessions."
A5.	"I felt that the project was meaningful in that we had an actual client to cater to."
A6.	"The importance of user analysis and task analysis in the design process."

Table 1. Sample of student feedback collected via a post-project questionnaire

Conclusion

The presented case study is an example of a successful collaboration between Engineering and English disciplines in the area of teaching Human Computer Interaction. The collaboration was considered successful since the interdisciplinary project assignment helped students gain new insight on user and task analysis, as well as on client–developer interaction via iterative prototype testing.

This case study offers also a strong argument in favor of introducing interdisciplinary teaching in Computer Science and software engineering curricula. Here are some thoughts from our client team illustrating the joys and challenges faced in interdisciplinary teaching: *“The thought-work associated with having to explain the complex goals of our work to a group of bright students, but students in a very different knowledge-domain than our own, provided an opportunity that is increasingly rare in academia: having to explain oneself in non-specialized vocabulary and disciplinary shorthand. The results of this exercise we’ve rolled back into our own understanding of our work, and our conveyance of it to others. In the second instance, the process of interacting with the students as they worked on their projects – which, themselves, took shape in several mutually important ways – provide the opportunity for iterative engagement in the work of others as they saw it relating to the goals of our own work, as we’d articulated them; again, this was a phenomenal opportunity, and a very rewarding one.”*

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