

Support of Case-based Authentic Learning Activities: A Collaborative Case Commenting Tool and A Collaborative Case Builder

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Abstract

Cases are widely used in professional education to engage learners with examples of real world practices. Collaboration in case-based learning can add to the authenticity of the experience by encouraging learners to synthesize multiple perspectives. In this paper, we present some of our experiences in collaborative case-based learning in the context of a usability engineering (UE) course. The work reported here is part of an ongoing project designing UE cases and learning activities that use them; more recently we have begun to explore the role of collaborative activities and tools in case-based learning. We describe the activities that were developed and fielded in two different UE courses, and two collaborative tools created to support these activities – a collaborative case browser and a collaborative case builder. Students were positive about both types of collaborative activities and offered suggestions for how to enhance effectiveness in the future.

1. Introduction

Cognitivism views learning as a matter of construction, acquisition, and outcomes. Knowledge is seen as a property and possession of an individual's mind. Learning is a process of transferring knowledge and applying it in new situations (e.g., [1][6]). Conversely, constructivism views learning as a process that happens when individual interacts with his/her environment (social,

physical, etc.) It emphasizes the importance of the socio-contextual situation where the learning process is embedded. Knowledge is one aspect of participation in cultural practices [2][15][19]. Constructivists assume that learning occurs when "knowledge is constructed by learners as they attempt to make sense of their experiences. Learners therefore are not empty vessels waiting to be filled, but rather active organisms seeking meaning" ([10], p 360). Constructivists contend that students learn best when they engage in real activities [8]. Brown, Duguid, and Collins [2] state that "Activity, concept, and culture are interdependent. No one can be totally understood without the other two. Learning must involve all three." The concept of authentic learning harmonizes with this understanding by suggesting an approach of engaging students to work in groups on real-world problems that are relevant to the practice and by scaffolding the learning process with guidance [9]. The key elements in authentic learning are authentic tasks, teachers' scaffolding, exploration and inquiry activities, opportunities for social discourse, and the accessible resources to students for solving the real problems. By working in groups on real-world problems, students should realize that their learning is meaningful. They learn to explore, discover, discuss, as well as meaningfully construct concepts and relationships in actual contexts.

Cases are stories about specific activities of real world practice with a purpose to educate.

By providing detailed information about an authentic problem situation and how experts approach the problem, a case can help novices to appreciate the complexities of the real world and can evoke critical thinking and integrative reasoning about real world practices [11]. Because cases can be presented at many levels of detail, and in many forms, they lend themselves to many styles of teaching and learning (e.g., debates, group discussion, tradeoff analysis, summarization, critical analysis; [4]). Although case-based learning has been most common in the medical, legal and business professions (e.g., [18][28]), case methods have become widely recognized as an important teaching strategy [21][22]. The advent of the World Wide Web and of digital library infrastructures has made it possible to develop and disseminate large repositories of case studies structured as either narratives or as hypermedia documents (see e.g., the National Center for Case Study teaching in Science, <http://ublib.buffalo.edu/libraries/projects/cases>).

We have been exploring the development and use of authentic design cases as part of our own teaching of usability engineering (UE) courses [3][4]. One aspect of this work has been to develop and refine several UE cases, and to develop learning activities that lead students to engage with the material in a variety of ways. The current repository of UE cases is available on the Web (see <http://ucs.ist.psu.edu>), as is a set of learning activities developed and used in undergraduate UE courses (<http://cscl.ist.psu.edu/public/projects/cases/activityIndex>).

In the work reported here, we are beginning to investigate the role of collaborative activities in the context of case-based learning. Collaborative learning emphasizes a learner-centered approach, in contrast to the teacher-centered approach of traditional teaching practices. In collaborative

learning activities, students are viewed as active participants in a learning process where they interact with peers and experts. This has the potential to produce a richer experience than the individual students learning on their own. Research on collaborative learning has shown that students working together on a common task outperform individuals working alone and produce higher levels of achievement and greater productivity [14][23]. In collaborative learning activities, the cognitive processes include explanation, internalization, conflict, appropriation, shared cognitive load, mutual regulation and social grounding [12].

In this paper, we first describe a collaborative case commenting tool that enables student groups to browse as well as comment on any UCS case document collaboratively both in real-time and asynchronously. We then discuss three collaborative case commenting activities conducted with the tool in the UE class of spring 2006. The lessons learned from these activities led to the development of a case builder tool to enable students to collaboratively build their own UCS case. We then discuss these new functions and report on the feedback from other students who used it to collaborate and build a new UCS case for their group design project in the Fall 2006 UE class. We conclude with the lessons we learned from these activities and explore possible future research directions.

2. A Collaborative Case Commenting Tool

The goal of the authentic learning model is not just helping students learn the content knowledge of the subject, but also helping them interpret, process, and apply them. Because students have their own understanding of the complex social phenomena, they may individually hold different views when studying the same case.

When students share their understandings with other students it helps them understand the real world development process from different perspectives instead of a single view. The collaborative case commenting tool enables students to document their understandings while studying the case and to share their opinions with others. Studies have shown that a structured discussion increases the total amount of information (albeit, mostly shared) discussed when compared with information shared in an unstructured discussion [17][25]. With these findings in mind, we designed our tool to be case specific, and document-based. To use the tool effectively, students first choose a case to study. The system then displays the structure of the case and provides a comment space for each case document. Additionally, each case document and its comments are presented in one window to provide a one-to-one association in an integrated presentation.

Figure 1 shows a screen shot of the structure of the tool and how one student in the course used it for reviewing and commenting on the UCS PhoneWriter case. There are three screen regions. The left panel presents the tree view of the case documents in a conventional hierarchical model drawn from the structuring framework of scenario-based design process [20]. The leaves of the tree are the titles of the documents of the specified case. Each time the student clicks on a leaf of the tree, its corresponding case document is retrieved from the UCS library and displayed on the upper right data panel, and the comments associated with the document are displayed in the lower right comments panel. The case document in the upper right data panel is in HTML format and may include both text and images. If there is a hyperlink to a word or PDF file in the document, the student can open the linked document by clicking on the hyperlink. The data panel does not allow students to edit the original UCS case documents. The comments

panel in the lower right corner of the screen provides a free-form text editor for the students to write their comments about the displayed case material. The text editor supports asynchronous collaborative editing so that the student can leave his/her own comments in the space as well as edit the comments made earlier by others. There is also support for synchronous editing, so that two or more students studying a case at the same time can simultaneously write their comments about the case material in this space and be able to see each other's real time comments.

2.1. Attention-Centric Notification Mechanism

Notification systems are interfaces specifically designed to support user access to additional digital information from sources that are secondary to the user's current activities [5]. McCrickard and Chewar [16] refer to notification systems as attention-centric when they adapt to the information presentation and delivery in a way that avoids overloading the user and recommends content that may be of interest. We implemented a notification scheme in the directory tree to draw users' attention to the change of the content in the comments space to support awareness of group members' comments. The tree structure is initially populated with default icons for each document that a case could have. The default icon indicates that there is no content in the comments space of the document. We added two additional icons, one with a red plus sign and another one that depicts an envelope. The red plus icon indicates that there is new content in the document's comments space that has not been read. The envelope icon indicates that there are content in the document's comments space and the student has visited the space. A document will normally begin with a default icon associated with it. When a student leaves

a comment or changes other students' comments, the tool notifies others of this behavior by showing a red plus icon next to the document's title in the tree view. As a

student clicks on the title, the red plus icon becomes an envelope icon indicating that the student has visited the comments space. The notification mechanism works both for the

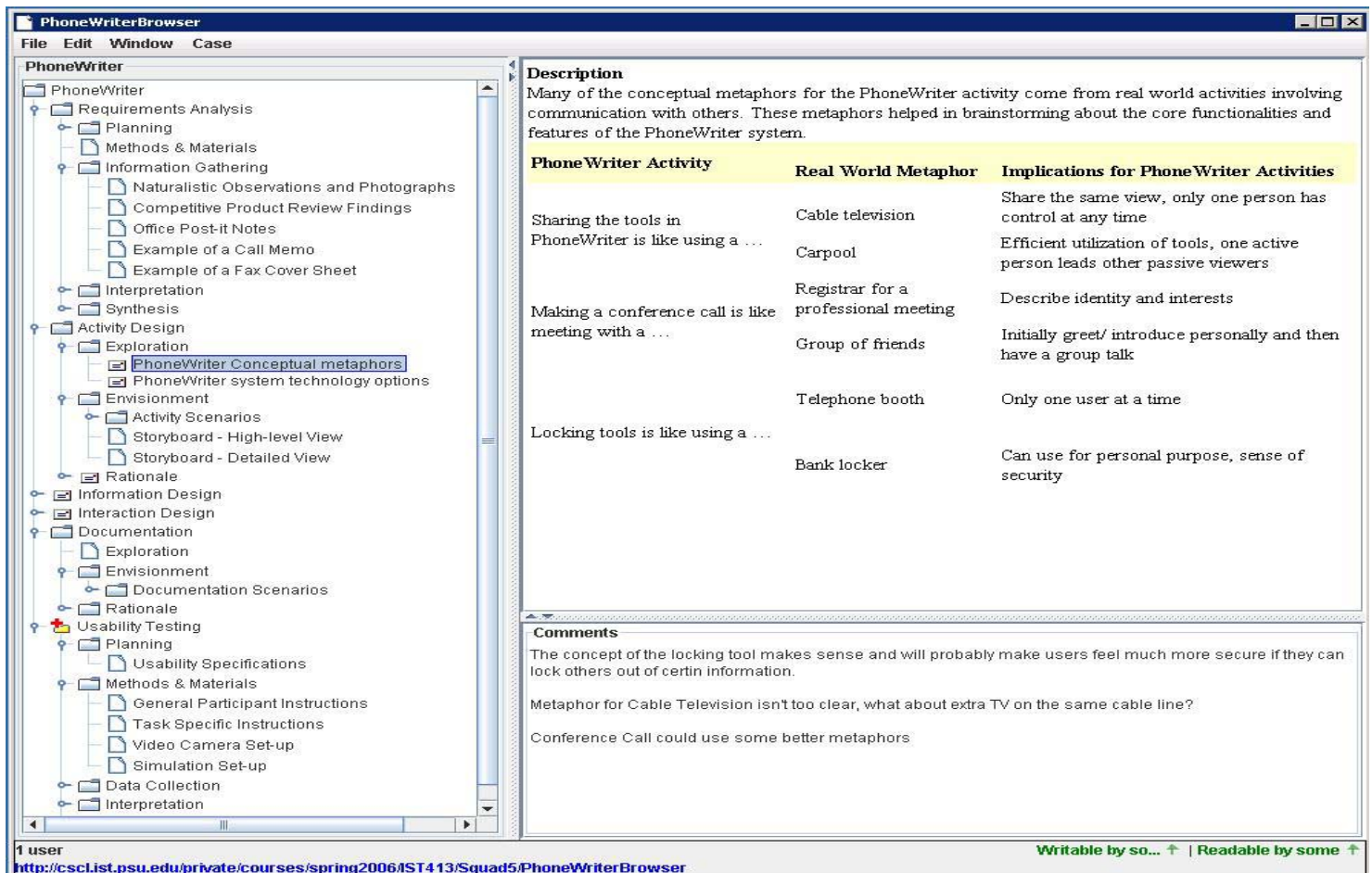


Figure 1. A screenshot of the collaborative case commenting tool used by a student group when studying the PhoneWriter case in Spring 2006's UE course

students who are present in the tool when the new content is added, and for the students who are not. Also, the notification propagates from the leaf nodes to the internal nodes when the tree is not expanded.

3. Collaborative Case Commenting Activities

Students in a spring 2006 UE class were assigned to groups for semester long projects to redesign a Web site. To prepare the students for this, we implemented three in-

class activities in the class that involved their working with case materials from actual projects. In each activity, students were given one week to review one or two case studies and comment on the case documents individually using the case commenting tool. They then worked in groups to review the comments in class. Each student group was given a collaborative case commenting tool. Access to the case commenting tool was partitioned by group so that a student could only share his/her comments within the group.

3.1. Activity I: Authentic Example as a

Demonstration of the Practice

In authentic learning, students are encouraged to speak the language of the practice and to use the tools the experts use. In the first activity we asked students to review the UCS PhoneWriter case and focus on the professionals' approaches to planning and developing the user interface design. Because the PhoneWriter case deals with design and development of a telephony hardware product, it serves as an authentic example. The case shows how experts worked on a UE project, what tools they used, what procedures they followed, and what analyses they conducted.

3.2. Activity II: Knowledge Resources for Assembling and Flexible Use

One key principle in constructivism is that learners should be given the opportunity of "assembling" knowledge from diverse sources that are appropriate to the problem at hand. This is so that they can create their own innovative and situation-specific understandings. In other words, knowledge use in an authentic learning environment should be oriented toward the problem situation that the students are given, and it should be flexible to allow the integration of multiple resources. The design of our second in class activity follows this principle. Here, students reviewed two cases reflecting different approaches to usability testing. Students were asked to assume certain roles during their review of the case materials (e.g. (e.g., two team members each played an advocate of a particular cases, and one team member conducted the case critique). After review and reflection they were asked to compare and contrast the approaches

3.3. Activity III: Information Repository for Understanding from Different Perspective

Constructivism maintains that learners should be able to visit the same knowledge source from different perspectives. Divergent thinking with an existing knowledge space should be supported [24]. To facilitate divergent thinking in a group activity, we designed our third case commenting activity so that each group member would choose a role from a given list (e.g., product manager, designer, and customer). Then each member would study and comment on the case materials from the perspective of the role they selected. Students worked on these activities at different stages of the group project. Case materials that the students reviewed and commented on were chosen for their relevance to each stage of the project they were working on. Some of the student feedback about the learning experience with the collaborative case commenting activities was quite positive. One student said, "the PhoneWriter [case] reminded us of the needs of the user and not just content management". Another student from the same group commented, "some interaction [of discussion of the reviews] helped with the navigation of the web site [we will design]". When asked to reflect on the groups' activities and to give an instance of how the teammates' comments changed one's understanding of the case or design in general, one student said, "my teammate mentioned that a left-side panel takes up valuable screen space."

4. A Collaborative Case Builder

Although the case commenting activities had positive impact on students learning experience, the Spring 2006 students found difficulty in relating the authentic design cases with their own design project. To address this issue we required the students in the fall 2006 UE class build a design case collaboratively for their own design project, and use the same format as a UCS case. The rationale behind this was that students would be able to

compare their project with UCS cases and gain a better understanding of the UE project process. We hoped that they would be able to

better articulate their UE projects when they followed the UCS case format.

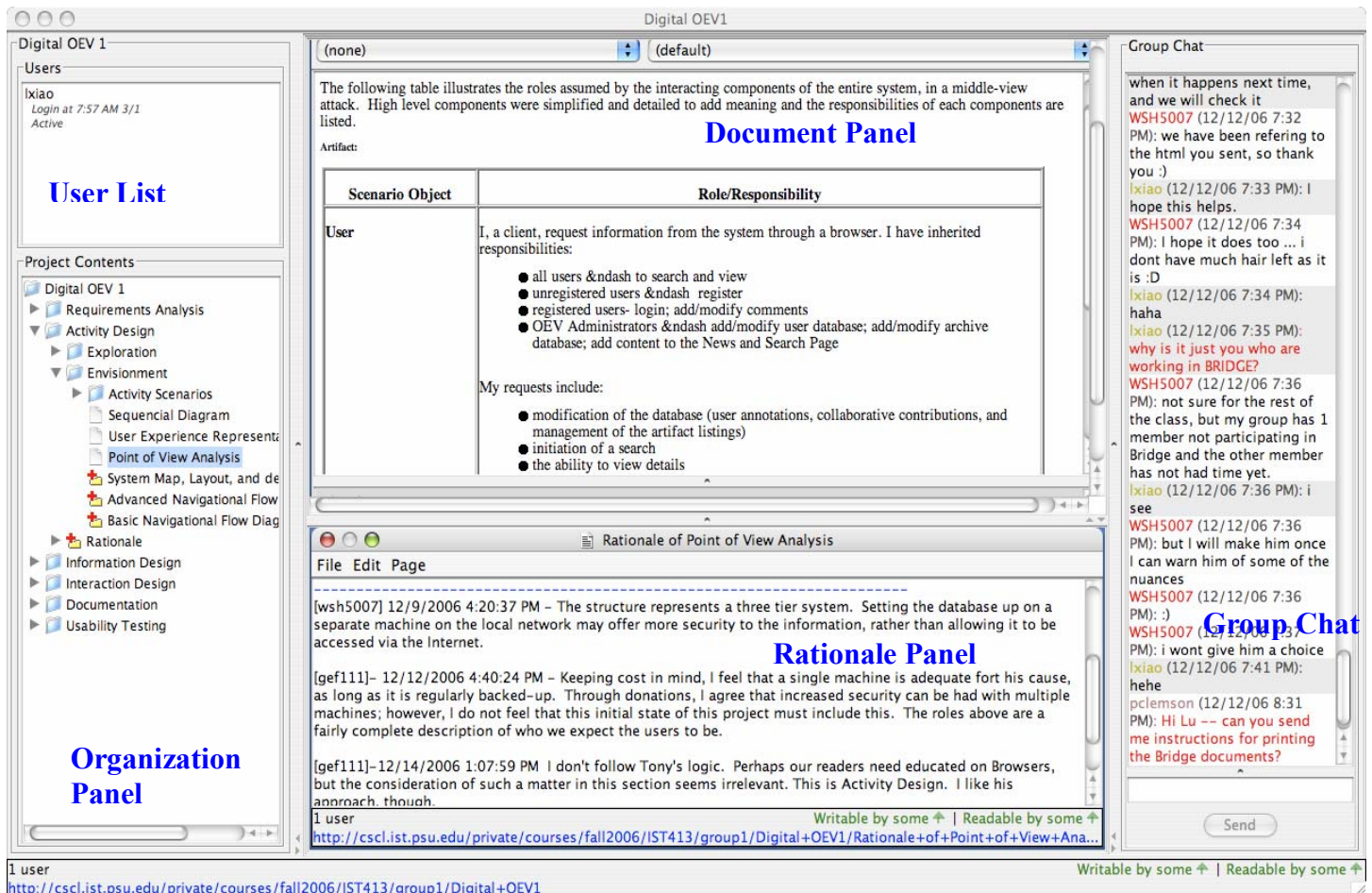


Figure 2. A screen shot of the case builder tool used by a students group for the design project of usability engineering course in fall 2006

To support this collaborative activity, we developed a case builder tool that could provide a shared virtual workspace. Here students could work together on the design project and organize their project documents in the same format provided in the UCS case workspace. Figure 2 contains a screen shot of the case builder prototype used by a student group in the class. The interface of the software has five areas:

- User panel: This area displays the list of usernames who are currently logged into the workspace.

- Organization panel: This panel presents a tree view of the project documents. As shown in the figure, the students’ project was to design a Web site for Old Economy Village (a historic site in Pennsylvania). According to a UCS case format, there are five phases for a design project (Requirements Analysis, Activity Design, Information Design, Interaction Design, Documentation, and Usability Testing), and there are different activities at each phase (e.g., there are five activities in the phase of Requirements Analysis: Planning, Methods & Materials,

Information Gathering, Interpretation, and Synthesis).

- Document panel: This panel displays documents that are currently open.
- Rationale panel: This panel provides a free-form collaborative text editor for the student to write down any comments related to the open document and share their comments with others.
- Group chat panel: This panel provides a group chat that automatically saves and displays all the chat messages exchanged within the group, i.e., a persistent group chat.

5. Collaborative Case Building Activities

In the fall 2006 class, the students worked in groups on a term project to get hands-on experience on the techniques and tools discussed in the class and to better understand the design process following the scenario-based framework. The project involved the development of prototypes for a proposed Web-based finding aid for digitized facsimiles of the 18th and 19th Century documents in the archives at Old Economy Village. Students worked with one of the museum curators who provided digital images of actual documents. The students worked with the documents to get a sense for the work involved in their digitization and classification. They were encouraged to develop a methodology for allowing Old Economy Village to grant secure access to researchers outside of the organization so that they could add descriptors and other metadata to the database. The students also took several field trips to the site and had conversations its representative. After collecting the requirements from the organization, the students worked on web interface design. The instructor invited the representative to the class to evaluate the interface. Based on her evaluative feedback, students revised their interface design. The students then developed usability testing scripts to test the searching functionalities of

the web for different types of web users of the organization. At the end of the project each student group gave a presentation on what they accomplished. to the representative, their instructor and students in the class.

During the last two weeks of the project, the instructor required the students to reflect on their project process and document their group project into a design case with the UCS case format using the collaborative case builder prototype. During this activity, the students read the UCS cases and documented their project mimicking a UCS case. For example, in the UCS Garden-com case, photos of designers' early design notes were provided in the Planning activity of Requirement Analysis phase (Garden-com case is freely available at <http://ucs.ist.psu.edu>). One student group took photos during their project process and put the photos taken during their brainstorming meetings into the case.

The focus on design process helped the students realize that early design concepts are important artifacts in a design project. A UCS case structure is articulated at a fine level of technical detail. The largest case incorporates 82 design documents at the terminal category level (this count excludes 26 intermediate branching nodes in the hypertext and 82 container objects for the primary design artifacts). Analogous to a UCS case, each student group created a sufficient number of documents to describe its respective design project in detail. We consider this exercise a good way to follow the evolution of the product and reflect on the group project process. One group created six documents under the Envisionment activity of the Activity Design phase (see Figure 3). The largest student group case incorporated 39 design documents.

The students gained authentic learning experience during the group project from many perspectives including: working on a real life problem; and interacting with customers. In this activity students also dealt

with changes in the project scope and direction a couple of times due to real life issues. There were also several points during the term when students' work provided critical information to the project managers.

There were three student groups in this class. Two groups had three members each and one had four members. Nine out of the ten students filled out a questionnaire regarding the group project at the end of the semester. The questionnaire consisted of thirteen essay questions and five 5-Likert scale items.

The questions asked about the students' learning experience of the group project. They all liked the authenticity of the project, and some even expressed their sympathy on the future of the project for the organization. Listed below are some answers from the students to the question: "How do you like or dislike this project that includes field trips to customer's organization, direct communication with customers, and evaluation from customers for different prototypes during the design?"

"I enjoyed going to the customer's organization. It gave me a chance to see what we were working for. Having a chance to make a system that would give easy access to OEVs archive was great. I hope that OEV gets the funding they need to continue with this project."

"I think it is a good idea to interact with "real world" users during the class. It helps to prepare for dealing with different types of people in your career."

"I liked it. It gave us practice and experience in working with a customer to fulfill their needs and wants."

Students were asked to provide feedback on the experience of collaborating online with the case builder tool. Students liked the real time collaboration and the file organization that the tool provides. Below are the responses from the students (Note that the students refer to the case builder tool as BRIDGE which is the collaborative environment the case builder tool uses).

"The thing that I liked most about using BRIDGE was the feature for real time collaboration. Being able to

interact with my group mate while making changes and comments"

"I liked the group chat and being able to see changes that other team members are making in real time."

"I liked that it was real time display of what was being placed into bridge. Another key feature is that you could speak with your group members that were signed on directly in bridge instead in a separate application such as IM"

"I enjoyed the connectivity features because it allowed for communication at long distances"

"I like the organization and how it kept all our project information in order and viewable by all members."

"I like that it is a unified place where team members can go to build a case study. Everyone can work on it at the same time and it updates in real-time."

The students generally liked the feature of having a shared place for rationale in the workspace. Five out of nine students said that they read other students' rationale. In answering the question "do you think you have learnt things from their rationale? If so, please give one or two examples here. Please be specific about what you have learnt (e.g., design idea, the way of approaching the problem)", four of the five students acknowledged some level of learning. One student said, "I learned how other people react to what a person says also how design ideas differ from team to team and the way they see how the project should be."

The results of the five 5-Likert scale items -- ranging from "Strongly Disagree" to "Strongly Agree" -- are listed below with students' responses to each measure. Because there were only three groups and nine participants, we consider these numbers only indicators of the users' preference in this context instead of being statistically meaningful:

It was easy to find where my classmates had left rationale with the tool
(Disagree 2 Neutral 2 Agree 5)

I liked the fact that the rationale I leave are related to the document/material I refer to directly
(Neutral: 2 Agree: 6 Strongly Agree: 1)

I like the fact when my classmate made a rationale for a material I could notice it while I was still using the tool
(Neutral: 1 Agree: 4 Strongly Agree: 4)

The feature of relating a rationale with a document helped me better understand my teammates' points in the rationale
(Disagree 2 Neutral 4 Agree 3)

I liked the fact that the rationale about one document/material by our group are there in one place and everyone can put their arguments there
(Agree: 6 Strongly Agree: 3)

We also noted some student dissatisfaction with the introduction of the collaborative tool in a senior-level course. Some felt that this tool should be introduced in earlier courses so that students have more opportunities to learn how to operate the tool and practice its use.

The customer representatives from Old Economy Village also learned about the design process through working with this class. The customer met with the class at the beginning of the term to help them define the scope of the problem, and then returned several times throughout the term for status meetings and to see the work in progress. At the end of the term the customer participated in the usability testing.

The customer representatives also learned a great deal about the different ways the interface could be designed. They were able to choose the best ideas from the design features they were shown. This was also their first experience with usability testing and they were quite impressed with how much they learned about the usability of a feature before the system was actually implemented. Some ideas that were good in theory did not work in practice. Other ideas that were not exciting on paper proved quite exciting in action. However, most ideas that were good in theory and prototype were validated by the tests.

The collaborative case-building tool facilitated efficient documentation of the project in progress and captured some of the details during the design project. Students showed their own creativity by including cell

phone camera shots of whiteboard Notes made during their brainstorming sessions. The experience was considered a success for the students, instructor and customer. Students and the customer derived mutual benefit from the activity. The customer plans to implement the interface as soon as resources are available.

6. Conclusion

As the newest of nine core areas in the computer curriculum [7][27], Human-computer interaction (HCI) has been developing its methods for undergraduate HCI education for over a decade. The HCI community acknowledges that real examples are the best way to introduce undergraduates to HCI. Real examples instruct students about the social and psychological concepts that guide the design and evaluation process [13][26]. Cases are such real examples. Cases are stories about specific activities of a real world practice with a purpose to educate. We have been researching the best way of applying the case-based learning model and authentic learning principles to UE courses. Our results show that using authentic design cases engages students and facilitates their learning UE concepts and techniques. Additionally, students enrich their learning experiences through collaborative study authentic cases and build a case. Our study is rather exploratory at this stage, as we have only experimented in two courses with a limited number of students. Based on the lessons we learned from these courses, we are working on the design of new class activities and development of new tools for the UE course of Spring 2008. Our future research directions include designing and supporting case-based authentic learning activities in the UE courses at different universities to grow a global UE learning community.

7. References

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