HCI for the Masses: Multidisciplinary Design Instruction with LINK-UP

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Abstract: While the discipline of human-computer interaction is beginning to benefit from knowledge capture and reuse methods, lacking are effective tools to provide students with the breadth of knowledge and the importance of multidisciplinary exchanges that are vital to productive scientific disciplines. Our ongoing work on the LINK-UP knowledge management and reuse system provides the basis for multidisciplinary exchanges of knowledge among students by leveraging falsifiable hypotheses called claims. This paper describes three case studies, extracted from different disciplines or environments, in which students extract claims from prior work in an effort to better understand the design decisions made.

Introduction

The field of human-computer interaction (HCI), relatively new within the discipline of computer science, is beginning to benefit from knowledge capture and reuse methods such as patterns, task models, and claims. However, lacking are the interactive educational tools to provide to students the breadth of knowledge and importance of multidisciplinary exchanges that are vital to productive scientific disciplines—threatening to limit practical acceptance and use of these methods. Our ongoing work on the LINK-UP knowledge management and reuse system provides the basis for multidisciplinary exchanges of knowledge among students (Chewar et al., 2004; Lee et al, 2004; McCrickard et al., 2003). This poster paper specifically highlights our efforts to encourage multidisciplinary use of LINK-UP through case studies that illustrate its use.

The work leveraged through the LINK-UP system builds on the work of Carroll and others toward a scientific approach to research and interface development, which arguably can be achieved by making explicit the underlying design rationale of interface artifacts (Carroll, 2000; Carroll & Kellogg, 1989; Rosson & Carroll, 2002; Sutcliffe, 2002). Carroll argues that theory-grounded HCI research can drive innovation by expressing, testing, and reusing "falsifiable" hypotheses (or *claims*) about the psychological effects an artifact has on a user. Using Carroll's approach, HCI professionals and software developers conduct an explicit *claims analysis* in formative and summative usability engineering efforts, continuously striving to balance and validate tradeoffs of use. A claims analysis record for a single system, and the accumulation of records from multiple systems, holds valuable design-related knowledge that, as Carroll has argued, should facilitate component reuse, motivate further empirical research, and inspire high-impact innovative development.

Our LINK-UP work continues where Carroll and his colleagues left off—bringing the claims theories to actual interface engineering processes that can be used synergistically across many disciplines and educational institutions.

Without broader acceptance and widely available tools, the knowledge capture and reuse advances in HCI will not encompass the multidisciplinary research partners in explaining, testing, mitigating, and merging claims from their areas of expertise. The work in this paper highlights one part of the LINK-UP system—claim creation—by tracing its utility in teaching situations that cross disciplines and educational institutions (see Figure 1 for an example of a claim and how it is created within LINK-UP). Our premise is that many disciplines could benefit from a careful examination of existing systems, and claims provide guidance for the students who create them (through claims structures like the feature, rationale, upsides, and downsides) while allowing freedom of expression through the free-form nature of the structures.

Through workshops, meetings, conferences, and similar events, the LINK-UP system has been introduced to researchers in a wide variety of HCI-related disciplines: computer science, computer engineering, industrial and systems engineering, math, architecture, English, and more. This paper focuses on three HCI-related courses in three very different settings: a small course in a mathematical sciences department at a four-year college, a large course in a computer science department at a Research I university, and a mid-sized course in an English department at a Research I university.

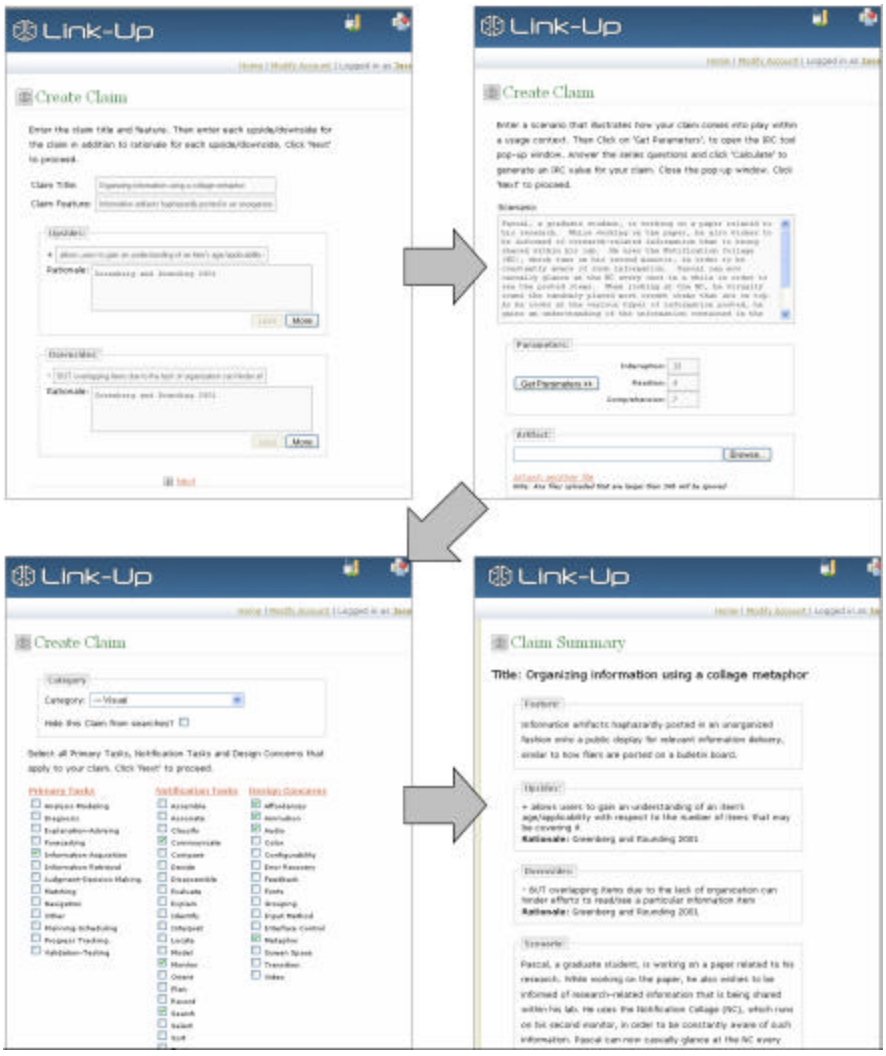

Figure 1: Claims creation within the LINK-UP system. Claims capture important interaction features of design, highlighting effects that a feature might have within a scenario. Claims include both positive and negative impacts of a feature to allow future designers and experimenters the opportunity to learn from hypotheses of others. By extracting claims and storing them in the LINK-UP library, we can enable designers in multiple disciplines to gain from others' unique perspectives and experiences—leading to richer understanding and better design.

Case Studies

This section describes the use of LINK-UP—specifically the claims creation portion of the system—in three classes. First, we examine its use in small group settings, in which students can interact with their instructor to gain significant feedback. Second, we discuss how LINK-UP can be used in larger classes to enforce the claims definition on students. Third, we examine how LINK-UP is used in a non-computing discipline to encourage students to extract design and describe it in a way that could help future designers.

Using LINK-UP to Instruct Small Groups

Initial efforts in using LINK-UP focused on small research groups, albeit at a Research I university where all students had significant computer science and HCI experience. To test the robustness and utility of claims creation, this first case study describes its use at a smaller 4-year college in an undergraduate, junior level, HCI course in a mathematical sciences discipline. Students in this course are required to take a broader set of courses and may lack many of the experiences that students in a pure computer science major may have.

This class introduces students to interface design and testing through scenario-based or task-based analysis. Students learn why interface design is one of the most important parts of software development and proceed to learn the proper techniques for ensuring good design. The focus is on applying techniques learned in class to real-world examples of interfaces and software systems. As a first offering of this course at a small, 4-year, liberal arts college, the enrollment was only three students. Anecdotal evidence suggests enrollment will increase by a factor of five or more for the next offering.

LINK-UP was used to show the students how the ideas about software reuse can be applied to interface design in the form of claims. Students were already familiar with claims through the natural progression of the course. LINK-UP was specifically used as part of a homework assignment to allow the students to enter claims about interfaces they had read about in published papers from the HCI field. The goal was to illustrate to the students how knowledge capture and reuse could benefit ongoing and future system development projects, through a focus on the specific goals unique to the targeted system. Upon completion of the assignment, the students then wrote a short (1-2 page) critique of the LINK-UP system. Some results and discussion of this specific example of LINK-UP usage follow. With only three students using the system in this particular example, one must be cautious about generalizing the results. However, the feedback and information gleaned from these students is interesting and useful in considering the potential LINK-UP may have for supporting student learning and actual system development.

The critiques provided by the students indicate mostly positive feedback on LINK-UP. The students indicated that claims were useful for knowledge representation and that having a repository for them could benefit future software development projects. For example, one student noted: “The system LINK-UP is a very helpful instrument in helping individuals to develop a system for use. …I like the LINK-UP system and would use it to develop a system of my own. I wish I could have used this system with the development of my group’s software in my software engineering class.” Another student also indicated the potential utility of LINK-UP: “This system seems to be a good way to allow users to communicate their claims with other users and link related claims.” LINK-UP seemed to support the idea of knowledge reuse.

Of course, LINK-UP is not perfect and the student responses indicate some areas of the system that could be improved. One such area was in the claims browsing. A student noted that “when browsing claims you are started in a point that seems to be in the middle of the claims for no apparent reason.” and “…I think there should be some sort of counter that tells you how many claims that exist.” Helping a user to understand the search space could support more efficient browsing. Another possible area for improvement, identified by these students, was in the search functionality. A student noted: “The search did not produce good results for me. I think to search this system the user would have to have prior knowledge of what existed in the system.” This seems to be getting at a less obvious problem with the LINK-UP system and how it relies on the notion of an IRC (interruption, reaction, comprehension) score for all knowledge related to notification systems. Providing some information on what the IRC score is, and what it is used for may alleviate some of the confusion. These students did not have prior knowledge of IRC but were familiar with notification systems at a cursory level, so the LINK-UP reliance upon this measure could have caused some confusion with the searching and browsing functionality. A simple description of what I, R, and C stand for and how they are used in LINK-UP could have alleviated most of the confusion experience by these students.

Using LINK-UP to Inform Large Courses

While LINK-UP experienced significant use in small groups, an important next step is to exercise its use in a larger classroom setting: a junior-level CS 3724 class titled "Introduction to Human-Computer Interaction" with a one-semester enrollment of 43 students. Students were required to take numerous computer science courses as prerequisites, and all students had significant experience in developing computer applications in numerous languages and settings. Typical assignments include exams, a group project, in-class activities, and homeworks like the one described here.

In this homework, students were asked to write a claim and add it to LINK-UP. They were told that a good claim communicates insightful and interesting knowledge about a system. They were asked to choose a paper from a reading list of notification systems papers and explore the notification aspects of a system. Based on the system that is described in the paper they chose, students had to extract a claim describing an aspect of the system interface. They also were asked to assigned values ranging from 0 to 1 for three notification systems critical parameters: interruption, reaction, and comprehension (IRC). Often, claims are treated as ephemeral objects, used to guide and inform the early stages of design. However, in this assignment great care was taken to encourage students to seriously consider each aspect of the claim: title, feature, upsides/downsides, rationale, references, scenario, and critical parameter value. In-depth definitions of each of these aspects were provided to the students, and their answers were graded on a four-point scale.

Scores on this homework were around 75%, reasonable for a junior-level course. A review of the grade sheets for the students reveals that they had the most difficulty (measured by scores of 0 or 1 on the four-point scale) identifying a well-defined effect of the interface on users (rather than merely summarizing some aspect of the interface without considering its effect on users) with almost a third of the class receiving a low score on this portion of the assignment. Almost a sixth of the students had difficulty extracting rationale for their claims from the reading. While it was disappointing that students failed to adequately identify these two aspects of a claim, the high standards to which we held the students tended to result in better claims for projects later in the semester—when selection of quality claims to be used throughout their own design had much higher impact on the quality of an end product. The structure of the claims and the way in which the LINK-UP tool captured students' views of the structure enabled important feedback to be provided to the students early on, resulting in better understanding later when it truly mattered.

Using LINK-UP to Guide Technical Writers

To exercise the multidisciplinary nature of the LINK-UP system, it was used in a 25-person senior-level English 4814 class titled "Writing for the Web". This effort builds on previous successes using LINK-UP in English classes (Evia, 2006). English 4814 guides students in the process of developing technical and professional documents to be presented in online environments. Students do not need previous experience in web design in order to take this course. English 4814 includes an introduction to Extensible HyperText Markup Language and Cascading Style Sheets. However, it is not a tools course. Students do not learn how to use commercial software applications to design and write web pages. Instead, Writing for the Web has the following components: 1) Developing strategies leading to detailed tasks and audience analysis involved in planning and prototyping web pages, 2) Writing, revising, and editing modular content for professional web documents, and 3) Testing the usability and readability of websites. Students hand-code sample websites and evaluate distributed authoring solutions for content management and web logs. Typical assignments include working with a database to document design knowledge experiences, a collaborative client project, and reading responses.

One of the main purposes of this course is to make students reuse web content in order to save time (and money) when working in projects. So, if we reuse content, how can we reuse our experience when designing websites? Let's say a reader finds an interesting article with a good tip on how to do a trick with CSS. Designers may want to use it and then reuse it in another project or can even share it with another team or colleague. This course assignment tested the LINK-UP environment for storing and searching design knowledge entered in the form of claims as a concrete way to express and document abstract knowledge. From a list of brief academic papers on web design, students selected a topic and extract claims that document useful points of the article that could applied to projects. Students extracted a claim from a paper and entered it to the LINK-UP database. Their focus was on establishing a good and concise description of a key feature in the paper such that others could use it at a later time.

Students using LINK-UP provided many insightful comments that reflected the ability of LINK-UP to guide their authoring, such as "The user interface for LINK-UP is very simple. There's not a lot of clutter in the design of the

system, so it is easy to find what you are looking for" and "The page for the creation of the claims themselves is very intuitive and streamlined". This feedback is encouraging as it shows that students found obvious the required information that they should be extracting from a paper. As such, they could spend time not on interface issues but on reading, understanding and writing. However, other comments reflected the need for a clearer focus on the specific LINK-UP goals, comments like "While the system is simple to use, it is rather difficult to understand the basis of why it's there other than to learn how to use content management systems" and "The upsides, downsides, and scenarios are straightforward, but what about relationships? Where is the explanation for the design tasks?" The suggestion was to include additional help, like help documents and mouseover options.

In summary, students found that they could effectively express knowledge in the form of claims, but the process of entering those claims into the system was still foreign. Students successfully enter claims, but they wonder how they would be reused in future projects. However, the students and the instructor did find that the claims format helped to make their design knowledge explicit and enabled comparisons to information found by others.

Bringing Cases Together: Creating a Multidisciplinary Knowledge Sharing Environment

It was encouraging that students were able to complete their assignments to the general satisfaction of the instructors. The similarities in the assignments and the fact that virtually identical tools (built on identical databases) were used to demonstrate LINK-UP's utility across multiple disciplines. It is this accumulation of materials within a similar structure by multiple domains that facilitate knowledge reuse, motivate further multidisciplinary research, and inspire high-impact innovative development.

Lacking in the assignments was the tight connection between the identification of interesting and falsifiable claims and the ability of designers to build on them in their own designs—the use of the accumulated materials. While our prior efforts have investigated this potential use (e.g., (Lee et al., 2004)), ongoing work must examine ways in which we can capture and represent relationships and interactions—both existing and possible—between claims, toward effective designs that draw on multidisciplinary experiences.

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