Using Contextual Design for Digital Library Field Studies

Mark Notess
Indiana University
USA

Introduction

Contextual Design (CD) is a popular human-centered design method from the field of information systems design [1]. CD practitioners conduct focused field observations, validate or adjust their interpretations in discussion with participants, and use diagrammatic work models to represent, analyze, and communicate findings. The work models also guide the design of new or revised systems.

Recently, CD has been at least partially used in the study and design of digital library systems [2] [3] [4] [5]. However, CD has not been consistently applied, and few work models have been published. The question remains unexplored how helpful CD can be in the study and development of digital libraries. Might CD make it easier to design digital library systems that are broadly useful? Is it possible that CD models could be effective as a standard language for comparing digital library use contexts? Apart from its potential practical uses, might CD also be valuable as a methodology for descriptive research? The purpose of this paper is to introduce CD briefly, illustrate its use in two examples drawn from actual field studies of digital music libraries, and to assess its utility in field studies of digital library use.

Contextual Design Described

Contextual Design developed as a systems design method rather than as an academic research method. The full CD process includes six steps:

1. Contextual inquiry – interactive observations of people doing real work in their normal contexts. The observer watches the activity, forms explanations of what is happening and why, and then tests these hypotheses in discussion with the person being observed.
2. Work modeling – the design team hears a verbal account of the contextual inquiry session and puts the reported data into formalized work models. Work models include flow, sequence, culture, artifact, and physical. A running list of brief "work notes" is also kept.
3. Consolidation – data from multiple observation sessions are combined, yielding a holistic picture of work practice. Individual work model types are consolidated, and the work notes are organized into an affinity diagram.
4. Work redesign – using a visioning and storyboarding process, the team generates ideas for improving the work practice.
5. User environment design – the functions and structures needed by the redesigned system are expressed in a detailed architectural model.
6. Paper prototyping – a series of transformations are applied to the user environment design to create testable paper prototypes, which are taken back to the field and put in front of users. Data from contextual prototype interviews are folded back into the design process.

Although CD is not based explicitly on a set of theories, like any design process it reflects beliefs about work and about design. I have elsewhere [6, pp. 83-84] identified several broad principles given here in slightly abridged form.

1. Context. Work data are largely embedded in a context. To get at those data you have to examine the context. Apart from this examination, the data are not trustworthy.
2. Partnership. The contextual inquiry and paper prototyping steps of CD involve users in design as expert partners. This improves design and facilitates acceptance.
3. Visualization. A key strength of CD is the diagrammatic representation of data and design throughout the process, which helps keep designers grounded in customer data.
4. Iteration. CD is not strictly linear. Paper prototyping assumes design iteration is necessary and leads to refinement of the work products from earlier phases of the process.

It is worth noting that the first principle, context, clearly springs from an Activity Theory perspective. In fact, Beyer and Holtzblatt acknowledge their debt to Activity Theory [1, p. 444]. Activity Theory offers an approach to thinking about work that Contextual Design embodies in a design process.

As a design process, CD helps teams address the following questions.

- What work is going on in a given environment? Why?
- What cultural forces are at work in the

environment, and how do they shape the work practice?

- How is the work practice structured, by role, by time, and by location?
- How are artifacts used in the process of accomplishing the work?
- What breakdowns are occurring in the current work practice? How can the work practice be improved?
- How well do proposed improvements fit existing contexts?

Usage & Results

Our own work designing the Variations2 digital music library [7] has primarily made use of the early steps of CD. We conducted two separate CD studies using contextual inquiry, work modeling, and consolidation. Our use of these data for work redesign and paper prototyping has been more *ad hoc*.

Study 1

Our first use of CD is described in detail elsewhere [6]. Five researchers (4 graduate students in an HCI class and myself) each conducted contextual inquiries with undergraduate music students, each of whom were using the online audio reserve system, Variations (the predecessor to Variations2) in the Indiana University Cook Music Library. The researchers worked as a team to create and consolidate the work models. We then brainstormed ideas for improving student work practice, created paper prototypes, tested those prototypes with students, and modified our designs. Although this was a class project, the results were presented to the Variations2 design team and did influence the design of Variations2. For example, in our observations we noted students' need to listen repeatedly to a small section of audio. Variations2 now permits students to define their own excerpts.

Study 2

Our second study using CD is partially described elsewhere [5]. In this study, I conducted 14 contextual inquiries with graduate voice students, mainly at the music library but also in some of their other learning contexts (voice lessons, rehearsals, classroom). After the inquiries, I did limited work modeling and model consolidation. I used the findings in design discussions with the Variations2 team. The findings from contextual inquires were influential in feature and prioritization discussions with the development team. For example, I observed several students having difficulty determining the duration of an audio track. They need this information for recital planning assignments, where the recital has to fit within a narrow time window. In our design of Variations2, we put the track duration adjacent to each track so this important information was not hard to find.

Assessment

Contextual Design offers significant benefits to designers of digital library systems. Its strongest benefit is the disciplined way in which it connects designers closely with those whom their systems will serve. Too often developers make unwarranted assumptions about how users will want to use their systems, basing those assumptions on personal preference or on the system's technical capabilities. CD helps ground design in real work practice and offers tools for validating designs throughout the design processes. Clifford Lynch writes of the need to design from such a grounded understanding.

> Ultimately, we are going to have to develop information retrieval and management systems that actually empower the user in his or her day-to-day activities, and those systems are going to require an understanding of which systems the user employs and why and when each system is utilized. It will require a holistic view of user behavior, both as an individual and as a member of multiple workgroups and communities (and an understanding of how these workgroups and communities overlap and relate to each other). [9, pp. 213-214]

Contextual Design can provide this holistic view.

Another benefit is the richness of the data yielded by contextual inquiry. Although we have used other tools for field research, such as surveys and system logging, these latter methods often leave us with more questions than they answer. Contextual inquiry allows us to ask *why* users do something, right when they do it, in the place where they do it. Knowing users' motivations—the intents that drive their activities—is very important data for system designers.

A challenge of CD is that it requires one to figure out who one's users actually are, locate them, and convince them to participate. For digital library projects such as ours, this has not been difficult. We have a large local user base who has been willing to participate in exchange for small incentives such as gift cards. Other digital library projects may not have such easy access to a known, willing population. Another challenge of CD is that, if you use the full process, it has a fairly steep learning curve and requires a large resource investment. However, a recent book [8] describes lighter-weight approaches to CD, and we have been able to derive significant value for a small investment by picking the steps that appeared most applicable.

Qualitative research methods often lack standardized ways to present results. For example, it can be difficult

to compare findings from two ethnographic studies. A possible advantage of CD work models is that they can provide a more formalized language for representing qualitative fieldwork data. Even in our own two studies, we were able to compare consolidated sequence models to identify similarities and differences in the kinds of activities undertaken by the undergraduate and graduate students. Digital library technologists sometimes assume it is adequate to build systems to deliver a specific media type such as journal articles, art images, or streaming audio. But without comparing usage of those materials by different stakeholders, we cannot be sure the interface to the delivery system should be the same for everyone. Likewise, by comparing work practice across various types of media, we may find opportunities to use the same technology with different types of media.

Apart from its potential practical uses, might CD also be valuable as a methodology for descriptive research? It is primarily the first three steps that might be helpful: contextual inquiry, work modeling, and consolidation. The current difficulty is that these steps, while fairly well specified, are not defined rigorously enough to be employed consistently. This is not unusual for a design process, where adaptability is desired. To become a research method, the constructs expressed in the work models need operational definitions, and the inquiry, modeling, and consolidation processes must be defined in such a way as to guarantee reproducibility of results. Despite this lack, it is worth considering whether the CD models in particular might be a useful first step towards a more standardized, comparable language for specifying qualitative fieldwork results.

Acknowledgements

This material is based upon work supported by the National Science Foundation under Grant No. 9909068. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author and do not necessarily reflect the views of the National Science Foundation.

References

[1] H. Beyer and K. Holtzblatt, *Contextual design: defining customer-centered systems*. San Francisco, Calif.: Morgan Kaufmann, 1998.

[2] M. Dalmau. "Reviving DIDO: Using contextual inquiry to inform the redesign of an art image resource." Retrieved 31 May 2005, from http://www.dlib.indiana.edu/~mdalmau/dlf2004/

[3] A. Dong and A. Agogino, M., "Design principles for the information architecture of a SMET education digital library," in *Proceedings of the 1st ACM/IEEE-CS joint conference on Digital libraries*. Roanoke, Virginia, United States: ACM Press, 2001, pp. 314-321.

[4] A. Druin, "Cooperative inquiry: developing new technologies for children with children," in *Proceedings of the CHI '99 Conference on Human Factors in Computing Systems*. New York: ACM Press, 1999, pp. 592-599.

[5] M. Notess, "Three looks at users: a comparison of methods for studying digital library use," *Information Research*, vol. 9, 2004.

[6] M. Notess, "Applying contextual design to educational software development," in *Instructional design in the real world: a view from the trenches*, A.-M. Armstrong, Ed. Hershey, PA: Idea Group Publishers, 2004.

[7] Variations2. "Variations2 Project Website." Retrieved 1 June 2005, from http://variations2.indiana.edu/research/

[8] K. Holtzblatt, J. B. Wendell, and S. Wood, *Rapid contextual design: a how-to guide to key techniques for user-centered design*. San Francisco: Morgan Kaufmann, 2005.

[9] C. Lynch, "Colliding with the real world: heresies and unexplored questions about audience, economics, and control of digital libraries," in *Digital library use: social practice in design and evaluation*, A.P. Bishop, N.A. Van House, and B.P. Buttenfield, Eds. Cambridge, MA: MIT Press, 2003.