Software Design Principles for Video Research in the Learning Sciences and CSCL: Two Studies Use the Perspectivity Framework & Orion™

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Abstract: Collaborative analysis of digital data has become an important factor for research in the learning sciences and the computer supported collaborative learning (CSCL) communities. The purpose of this investigation was to deduce design principles to inform future video research software as well as social network development. To uncover these design principles, a meta-analysis was conducted of two dissertational studies that applied the Perspectivity Framework and the video analysis tool, Orion™. The first was a qualitatively-informed quantitative study; the second applied balanced mixed methodology—also referred to as quisitive research. The 7 design principles found include: stakeholder involvement; elastic coding; collections as selections and vice versa; applied authenticity; unfolding interpretations; layered critique; and revision tracking.

Introduction
Over the past decade, the analysis and interpretation of video and audio data have become important components of the research process in the learning sciences and computer-supported collaborative learning communities. While research using video is now an essential part of the design method for learning systems, established research approaches used for analyzing digital data have yet to yield design principles that promote the design of “Generation 2 (Gen 2.0)” digital video and audio analysis software. The approaches we are referring to are interactional ethnography (Green et al., 2007), epistemic mediation (Roth, 2007), amplification of mental functioning (Pea, 1985), observational investigation and theory articulation (Smith & Reiser, 2005), ethno-methodology (Garfinkle, 1967; Koshmann, Stahl, & Zemel, 2007), critical design ethnography (Barab, 2004), and digital video design ethnography (Goldman, 2004). This paper addresses how using the Goldman & Maxwell’s methodological approach called the Perspectivity Framework (2002) and the video research tool Orion™ led to the emergence of design principles that may be applicable to future video research designers as well as social network environments. Both Dong and Lansiquot used both the framework and tool in their dissertation studies. In this paper, we deduce and construct design principles from these two recent empirical studies.

Perspectivity Framework
The perspectivity framework proposes that negotiating the meaning of events by layering stakeholder points of viewing produces a clearer understanding of the complexity involved in knowing what happened in a given time and place. The framework addresses the need for interacting with the artifacts or representations that are continually being created in the process of communication about meaning. As Rowland points out: “We come to know through interpretation, dialog, and negotiation of meaning with… others, through a conversation with manipulation of the materials of a situation” (Rowland, 2004, p. 43).

The framework acts as a conceptual scaffold to address the journey from bits and segments (video-data-in-the-small) into meaningful stories and valid results (video-interpretations-in-the-large). This framework is open, flexible, and inclusive of the diverse theories and methodological approaches that have emerged (and will continue to emerge) as researchers use digital video into their research. In the learning sciences, the theoretical approaches include constructionism (Papert, 1991), situated cognition (Lave &Wenger, 1991), anchored instruction (Bransford, 1988), design theory (Kolodner, 1995), and computer-supported collaborative learning (Stahl, 2006), to name but a few. The methods run the full range from quantitative to qualitative, and to what Goldman and colleagues (2002) have called quisitive research—a form of research that includes triangulating multi-modes and diverse research methods.

Dissertation Studies Use Framework and Tool
The first study conducted by Dong was a qualitatively-informed quantitative study dissertation study of emotions and cognition. The qualitative audiotaped interviews complemented the quantitative data to explore how students responded to different interface designs: black-and-white versus color images, for example. Her research premise, building upon Miller’s (1956) working memory model, Sweller’s (1994) cognitive load theory, and Mayer’s (2001) cognitive theory of multimedia learning was that colored, aesthetically pleasing design induces positive emotions from students. The induced positive emotions enhance information processing...
in the working memory, which solves the problem indicated in the three theories above that the capacity of the working memory is limited. Therefore, the induced positive emotions enhance multimedia learning. The researcher consolidated the data, selected chunks of audio interviews, and then uploaded the audio chunks into the Orion digital media database, where she coded, analyzed, and interpreted her data.

Lansiquot conducted the second study, a three-month, mixed-methodology dissertation study that examined how ancient interactive iconography impacts social studies and critical writing skills. Groups of three first- and second-generation immigrant middle-school students constructed museum labels (textual descriptions of artifacts) using an application that Lansiquot (2008a, 2008b) designed called Scope Out™, an experimental online revision tool that makes iconography interactive. This revisions tool was designed with Lansiquot’s Visual Scope Theory in mind, which allows for unique observations “from different perspectives.” (Herein lies the close connection of Lansiquot’s theory to Goldman’s “Points of Viewing Theory” (1998) that is based on observing using video and analyzing data from diverse perspectives.)

In Lansiquot’s Scope Out, students are able to alternate from a larger picture to its separate parts and back again. Video was taken while students used this revision tool. The design of this study enables students and researchers to easily use of Orion to review chunked footage of group interaction and to rate their thinking (i.e., chronological and spatial thinking, use of evidence, multiple perspectives and diversity, interpretations, and significance) as a reflexive activity (Goldman-Segall, 1993; Lansiquot, 2007; Lansiquot & Goldman, 2008).

Construction of Design Principles
Using the framework and the tool as a supplement to Dong’s quantitative study enabled her to reach more valid conclusions for her research questions. When interviewing her participants using an audio recorder, she became engaged not only with their responses but also with the research questions in new ways. The use of Orion and the perspectivity framework made the layering and inter-connectedness among the qualitative data layer concrete in ways she did not expect. The coding of the audio data became elastic (Davenport, 1995), stretching and unfolding her interpretations. The numerical coding was not only a significance rating, as Goldman-Segall had pointed out in 1993; the numbers on Dong’s Likert scale became infused with the deep engagement of her “stakeholders” or participants in her study.

Lansiquot’s study was designed as a qualitative methods study. The quantitative study overlapped with the qualitative, each informing the other at every moment. Moreover, using the perspectivity framework and Orion enabled her to compare her numerical codes as a triangulation activity. She was also able to engage students in the coding of the data in much the same way as Goldman-Segall had done at the Bayside Middle School from the early 1990s. The design principles that became important to Lansiquot included stakeholder involvement. When kids saw things that other kids did, they learned from each other, and Lansiquot learned from them at the same time. Stakeholder involvement created an applied authenticity to the relationships from text, video, and audio data. Lansiquot (2008a, 2008b) points out software design and problems being addressed should be as close as possible to the real world. The structure of the software should mimic the structure of the problem domain. Using Orion, she was able to keep what Vygotsky (1978) calls “the zone of proximal distance” very close. Elastic coding also enabled her to see the themes more easily. Most importantly, the notion of review, layered critique, and revisions became key design principles, much as it had for Goldman-Segall’s digital ethnography study at the Hennigan School in the late 1980s. Goldman-Segall (1998) had found that Geertz’s (1973) thick description could be applied in multimedia studies enabling the layering of viewpoints. Lansiquot added the idea of revisions to the mix, a critical part of the way researchers reach conclusions and learners learn when using new technologies.

Conclusion: Design Principles
By analyzing the use of the perspectivity framework and Orion in two studies, researchers found 7 design principles (see Figure 1). Most of these seven principles have recently informed the design Orion 2.0™, to be found at http://www.videoresearch.org. Orion 2.0 is the most recent version of a digital video-audio-text analysis tool and is available upon application.

In future investigations of design principles, researchers will conduct an expanded analysis of design principles in both commercially available video tools and learning science research environments to deduce a larger range of design principles that will enable CSCL design researchers to build software that takes advantage of the affordances of social networking environments. Possible software to be studied includes Pea’s (2007) DIVER tool, Hay’s Video Case Tool, and MacWhinney’s (2007) TalkBank.

In conclusion, a large range of emerging tools will need to be studied to benefit not only designers and researchers but also learners and teachers in schools who need to use research tools in their own investigations. A future is envisioned where tools will be open platforms with easy-to-use applets for specific kinds of research. As we move into an age of change, the focus of our tools will be on community activity and, yes, social activism to enhance our current individuated notion of learning, teaching, and research.
1. **Stakeholder involvement:** CSCL community building is at the core of design principles for designing more valid conclusions. CSCL members should focus on community analysis while providing individual researchers with the opportunity to keep their data open to only those who have permission for sharing.

2. **Elastic coding:** This principle addresses flexible tagging and rating schemes that can easily be translated into graphical representations - for example, graphs and spreadsheets.

3. **Collections as selections and vice versa:** This principle will enable groups to create a finer grained selection from the array of related video or audio data clips and also move from finer grained selections to collections that are new groupings.

4. **Applied authenticity:** The structure of the software design should (whenever possible) match the structure of the problem domain.

5. **Unfolding interpretations:** Learning environments should be designed so that users can survey past actions and performance as video already allows. User controlled animation and saved user-written revisions allow for discussion.

6. **Layered critique:** Creating layers of data for critique will enable users to see new juxtapositions and relationships among data.

7. **Revision Tracking:** The need to revise and keep track of revisions and changes. With video-audio-text data, the challenge of this design principle being implemented may be a glimmer in our eyes, but it should be included in this list. Simple saves of selected clusters would be a good beginning for this to principle to be actualized.

**Figure 1** Design principles

**References**

http://www.videoresearch.org