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An Ethnographic Approach to the Design of Video Research Software

Abstract
The aim of this paper is to explore some ways of linking ethnographic studies of work in context with the design of software which facilitates collaborative scholarly research using video sources. Ethnographic methods are introduced, and applied to identifying the social organization of this type of work and the existing corpus of tools used. Models for meaning, workflow, and interaction are presented, along with basic wireframes/prototypes. Findings, limitations, and future studies are discussed.

Overview

It has become evident that research libraries could provide better services to the scholarly community if they can become more integrated in the research process (ARL, 2009). While more and more research libraries are now providing digital archive services for scholars, challenges have arisen around a number of issues from scholar participation to the preservation of a myriad of native formats that need to be archived and potentially reused, particularly highly valuable raw datasets. However, by developing sophisticated and highly usable tools to facilitate research, libraries can become content repositories at the point of content creation, and overcome these challenges in that they can dictate the storage format and ensure easy deposit into the archives.

At the same time, researchers are using video in their work more than ever before. The low cost of high quality video and the richness of information it captures make it a perfect solution for all types of scholars to do observational field research. Furthermore, new technologies have emerged which allow developers to create sophisticated, web-based software to allow for the collaboration of video research across time and space.

With this in mind, a research team at Rutgers University Libraries has been charged with the exploration and development of two web-based tools which will support scholars in the extraction of both qualitative and quantitative data from video. The first tool is a simple annotation tool, which could be used to make "deep" notes and tags at specific cue points in a video resource by any number of scholars or students. The second tool is a more sophisticated application which will allow researchers to collaboratively analyze video by developing coding ontologies, coding events in the video, and aggregating the data into meaningful statistics. Both will enable the user to edit any number of video sources into a single "playlist" for use in sample selection or basic presentation purposes.

The intent of both of these tools is, as stated earlier, to allow the Libraries' to take a much more active role in the research process, thus allowing the real-time capture of scholarly data at the point of creation. This way, the researcher does not have to worry about taking additional steps towards the distribution or preservation of their data, which should instead be automated by the tools and somewhat invisible to the user. In addition, the tools should ultimately provide unique, cross-disciplinary ways of analyzing and reusing the data.

The project team decided it would be helpful to apply an ethnographic approach to the requirements gathering phase of the project since the developers are neither experienced researchers or familiar in any way with how video is used in the research process. Thus, this paper focuses mainly on the research "analytic" tool, not the annotation tool, though there are a number of overlapping features and commonalities. The design team needed a clear idea of the tasks involved from the researcher's perspective if there is to be any chance of competition with existing tools as well as adoption by the research community. Though tools exist which support the video research process, they are lacking in a number of key areas, such as: data aggregation and analysis, multi-disciplinary cross-

pollination, collaborative research through social networking, and direct integration with an institutional repository for preservation and dissemination.

Literature Review

Ethnographic approaches to social research have their roots in anthropology, but over the past several decades researchers in many domains have appropriated the process to learn more about the people, groups, and systems they study from an "insider's point of view". Ethnography can be defined as both a qualitative research method and an outcome whose aim is cultural interpretation (Hoey, 2009). The ethnographer goes further than simply reporting events and details of experience. Instead, he or she attempts to explain how these represent what we might call "webs of meaning" (Geertz,1973), or the cultural structures and boundaries in which we live.

There are many types of ethnographic approaches. For example, long-term engagement in the field setting or place where the ethnography takes place, is called *participant observation*. This is perhaps the primary source of ethnographic data in the most thorough studies. Another ethnographic technique is that of conducting interviews, which provide for what might be called "targeted" data collection by asking specific but open-ended questions. The point of the ethnographic interviews is to allow the person or persons being interviewed to answer without being limited by pre-defined choices -- something which clearly differentiates qualitative from more quantitative or demographic approaches (Hoey, 2009).

The application of ethnography to the process of systems design can be traced back to the early 1980s when computers were moving out of research labs and into mainstream office settings. Designers and developers realized that they could no longer rely exclusively on their own experiences as a guide for the user requirements of these

new systems. Social scientists working at the Xerox Palo Alto Research Center began exploring ways to bring insights from ethnographic research into a productive relationship with the design of new technologies (Blomberg et al., 2003).

Moreover, the growth in networked systems created an awareness among designers that the information and communication practices of collaborative social groups would need to be studied as well. As a result, a group of computer scientists, human-factors engineers, and social scientists founded the field of Computer Supported Cooperative Work (CSCW) (e.g., Grief, 1988). One particular group of sociologists at Lancaster University and another group researchers at the Xerox Research Center in Cambridge, England played a major role in shaping the ethnographic research agenda within CSCW (Hughes, Randall & Shapiro, 1992).

As the Internet exploded onto the scene in the late 1990s, information technologies moved out of the workplace and into people's homes. This has presented new challenges for designers who are now asked to design and build software for people of all ages, engaged in countless different activities in diverse contexts. Such an environment has rekindled interest in the ethnographic viewpoint as a valuable tool in the design of new technologies (Blomberg, Burrell & Guest, 2003).

Research Methodology

Ultimately, the project team is interested in supporting research in all types of disciplines and domains with the video tools being developed. However, each discipline has unique demands from the video and their approach differs not only in ontology, but also in the process of analysis. Therefore, the initial phase of the project is to support research in social sciences, particularly Learning Theory, and so the ethnographic focus for this phase was conducted at the University of Wisconsin's Center for Educational

Research (UWCER) laboratory in Madison, WI. Even within this realm it is understood that there is much diversity in approach.

While the research team was not able to do an embedded participant observation, other less formal ethnographic techniques were employed, such as interview, discussion, gathering of artifacts, as well as a small amount of actual observation of the work involved, which for which an audio recording was made. In addition, there was a concerted effort to study the existing tools which were used for video research by this community. There were a number of them and the research team was fortunate to receive demonstrations of each of these tools by members of the research community at UWCER, with added commentary about what each product was used for and why. The tools used by a culture have great value in understanding the focus of the work (Hutchins,).

The research team was also fortunate in this case to be comprised of the system developers. Much of the literature on using ethnography to inform design designates a major obstacle to the success of the process is the quality of communication channel between the ethnographer and the system developers. The ethnographer often becomes the advocate for the end users because he or she is the one who best understands their needs and goals. It is imperitive that the designers approach the software systems with a degree of empathy for the users if they want to develop highly usable systems, and this is often relayed through an iterative design process with the ethnographer.

In addition to later providing feedback to designer prototypes throughout the design process, the ethnographer must convey an understanding of the culture and work to the developers. This is done up-front, before any design takes place, by illustrating the workflow, flow of work, mental models, and vocabularies used. Workflow is an administrative model of how work should be accomplished. The workflow often exists in a formal document, but if it does not the ethnographer should do his or her best to

replicate it by talking with managers in the work place. The *flow of work*, on the other hand, is interested in describing work with all its contingencies: Interruptions, good and bad practices, seeking help, making mistakes, and so on, rather than picturing work in terms of an idealised conception of how it ought to flow (Randall, Harper & Rouncefield, 2007). It is the ethnographer's role to fill in the "gaps" of how work is supposed to be accomplished and how work is actually accomplished, and the comparison of these models is critical to finding those gaps. Even though in this case the ethnographers were also members of the design team and the communication from social scientist to designer was not an issue, this documentation was produced both to validate it with the community and to inform other stakeholders of the models used for development.

Finally, all data is theoretically laden and the theoretical frameworks used to formulate questions and organize results matters (Randall, Harper & Rouncefield, 2007). Because the project team is aware of the fact that tools exist which cumulatively solve the researchers problems, and because there is a commitment to collaboration on the part of the UWCER, we have decided to adopt a combination of a Participatory Design (PD) approach and a Grounded Theory approach.

PD involves *rapid prototyping* and iterative feedback from a sample of end users (Schuler & Namioka, 1993). This not only allows the project team to develop a one-stop tool to meet all of their needs, but it sets expectations in the end users and reduces the risk of resistance to change in their current process (Ehn, Kyng, Bodker, Bjerknes and Bratteteig, Greenbaum).

Grounded Theory is an inductive process that resists the urge to fit observations into pre-defined abstract categories (Glaser & Strauss, 1967). Grounded theory relies on moving from the particular to the general. This is an important approach because it

allows the system to be modeled around an existing flow of work and also improves the chances of adoption. However, it should be noted that the researchers are not the only end users and stakeholders in the development of the tool, which is why a Grounded Theory alone will not serve our purposes. Rutgers University Library stakeholders also have a vision for how such a tool will make data curation and sharing easier and it is the combination of these two viewpoints which will result in any technological innovation.

Other theoretical frameworks described by Randall, Harper and Rouncefield, such as Distributed Cognition, Activity Theory, Conversation Analysis, Ethnomethodology, Soft Systems Analysis, or Business Process Re-engineering were either not relevant to the process or provided an approach that was more removed from the user than the team needed to be. and thus introduced more risk to the design.

Findings

Several assumptions about the video research process of social scientists were discovered by the project team during the study. One of the most illuminating methods used by the design team to understand the research process was the critique of the first prototype, which was a wireframe created by the design team before any ethnographic research was done. This was done to facilitate a discussion of the designers initial assumptions in hopes to learn from the correcting of those assumptions. When scholars are presented with a prototype of a tool, they can immediately respond to its shortcomings. The figure below is the main page of the wireframe presented (Figure 1).

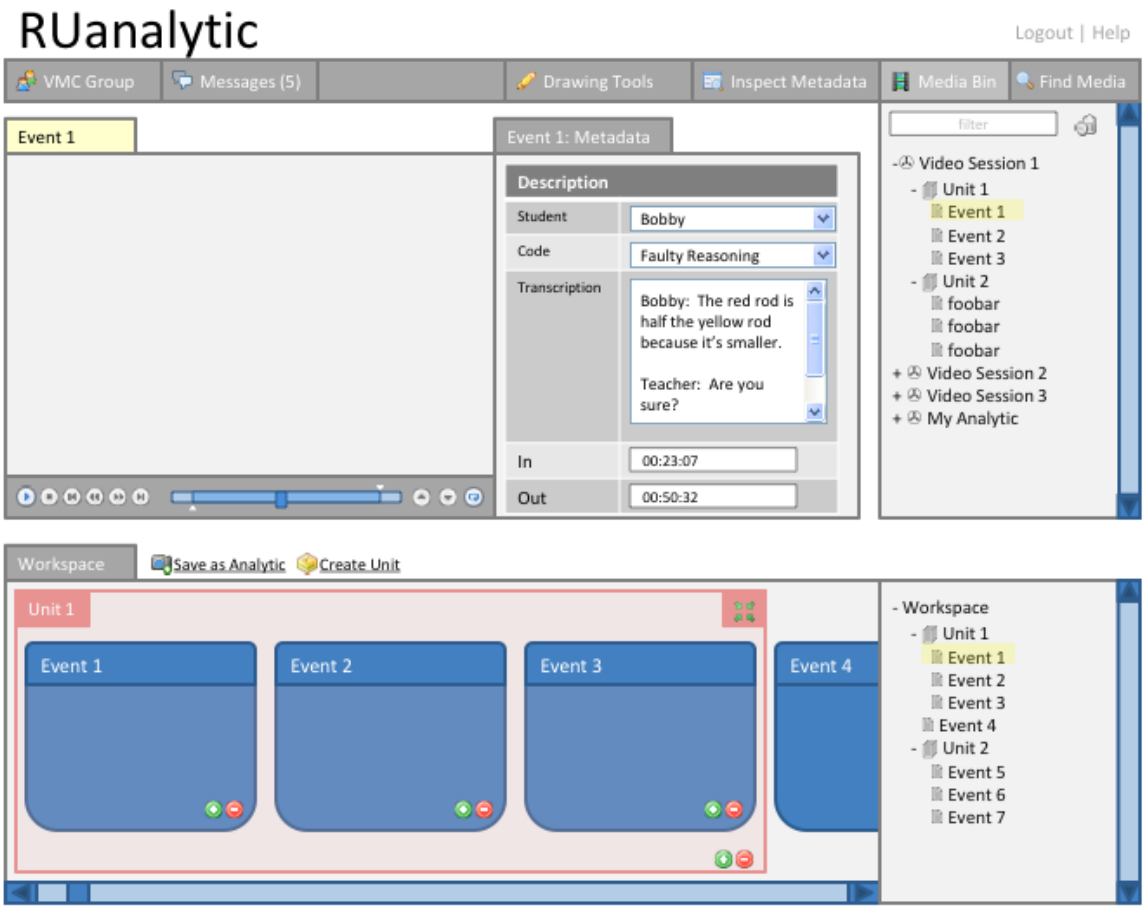

Figure 1: Initial wireframe presented by design team

A Wireframe Critique resulted in one researcher summarizing a high level view of the entire research process at UWCER. Her summary was incredibly helpful because the study was originally focused only on the process of coding video, but it became obvious that a much broader view of how coding fits into the overall research lifecycle was necessary. Figure 1 represents this process, with the "intervention" being the object of analysis, such as a lesson. The scholars also provided the project team with a high level view of the video research workflow process based on the work of Roy Pea (Pea & Hoffert, 2007). Figure 2 represents a detail view of the highlighted area in Pea's workflow (Figure 3).

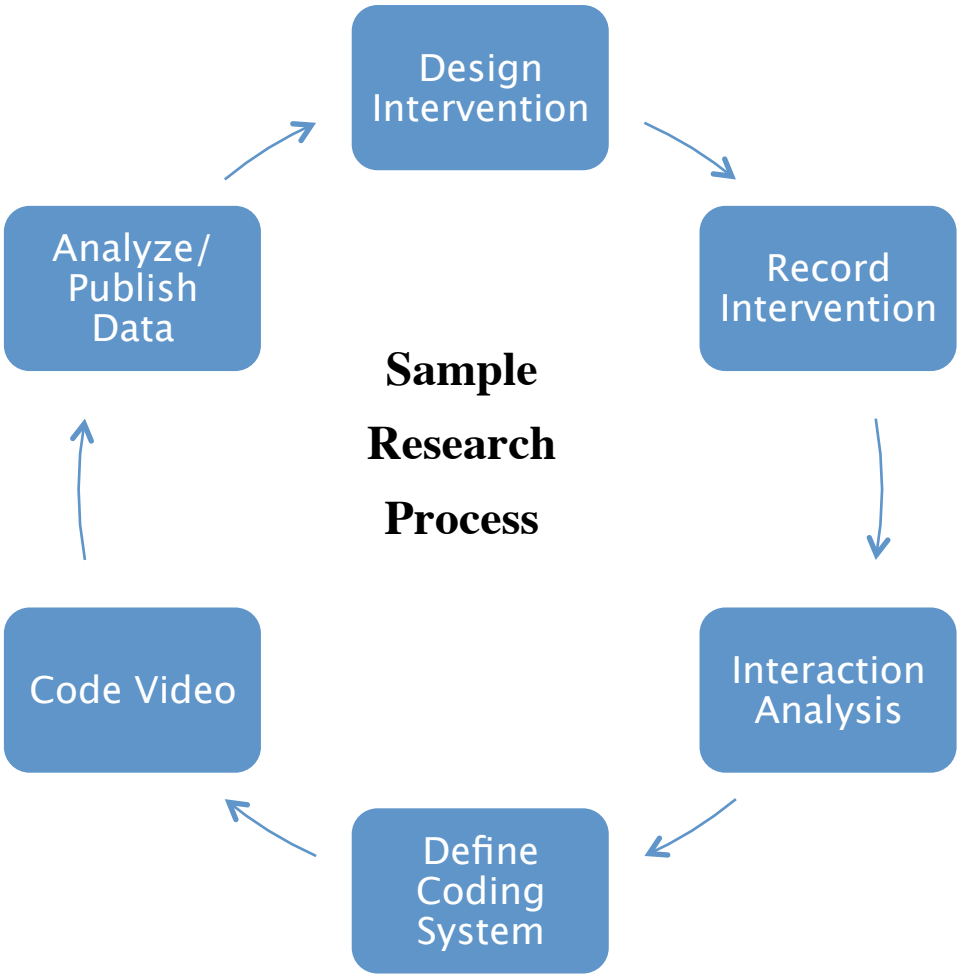

Figure 2: Wisconsin's Research Process

One of the researchers was not happy with the wireframe because the design appeared to limit the "selection" process to the initial stage. She wanted it to be clear that the "selection" process can happen at any stage in the research process and that video could

be added or removed from the "media bin" (current selection of video resources) at any time.

She also emphasized that the "selection" process will be different for researchers and educators. For example, educators may be interested in finding clips which best illustrate certain concepts and have the highest quality audio and visual components. Researchers, on the other hand, may still find clips with varying degrees of quality valuable because the content meets their research needs. Furthermore, researchers in the social sciences may have different selection needs than those in other domains. Ethnographers will often look for specific stories in their corpus, while others may want a truly unbiased "random sample" selection tool.

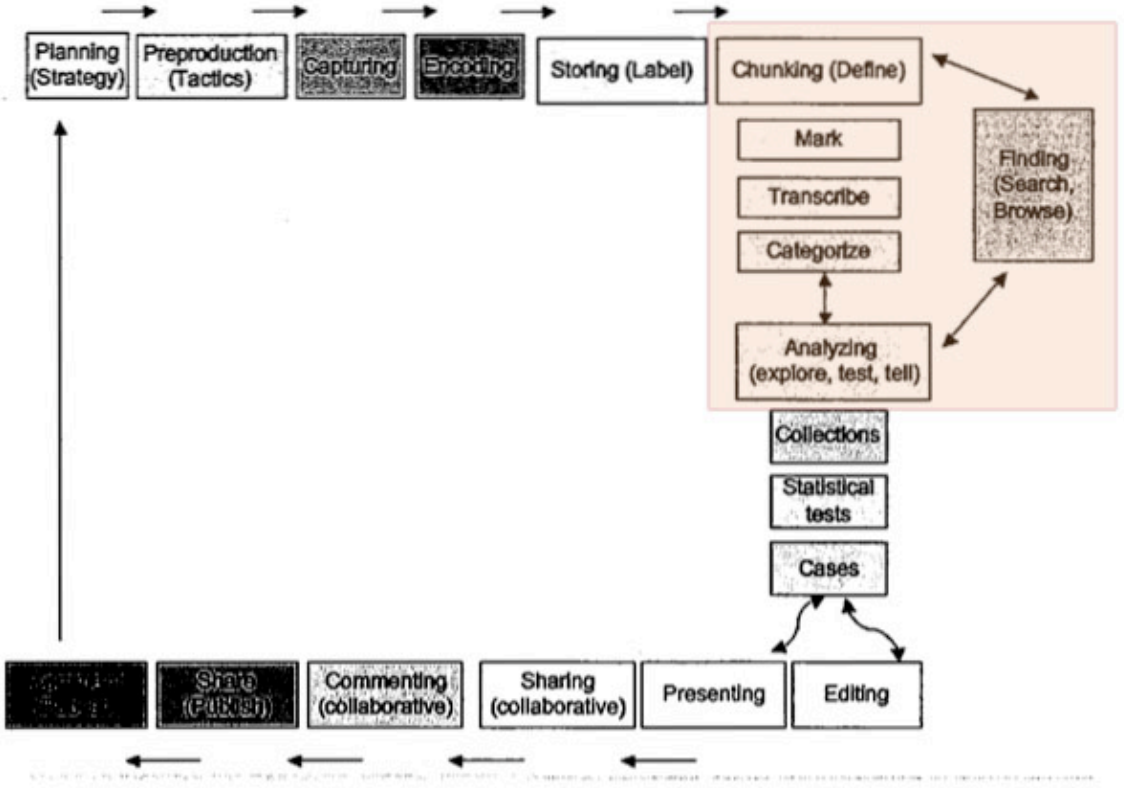

Figure 3: Diagram of Video Research Workflow Processes (Pea & Hoffert, 2007)

Another area of learning occurred when one of the scholars at UWCER described a project they hoped would be supported by the tools being developed. The project was a web site which provides educators with different lesson plans for use in the teaching of elementary school mathematics. The team at UWCER was interested in selecting a number of videos by mining their corpus based on previous analysis, compiling appropriate segments, and finally publishing these videos to their "educators web site," called the Video Mosaic Collaboratory (VMC). While this did not have to do directly with the process of coding and analyzing the video, the design team noticed that the analysis the tool should support would serve an additional "publishing process" which would support practicing educators. Since the tool supports only a small component of the overall process, the import and export of information is critical to the adoption of the end product.

The following is an excerpt of field notes during the discussion of how the tools being developed would fit into the UWCER's vision of the VMC:

> *Researchers want to study successful and less successful cases of teacher education that make use of mathematics classroom videos available in the VMC to help teachers acquire mathematics understanding and modify their beliefs and knowledge of how children think about mathematics. A sample of sites promising to use the VMC for these purposes is available to the researchers. The researchers help teacher educators at these sites incorporate VMC videos into their existing curriculum. To measure success of their efforts, sites are asked to use the same pre and post-test battery measuring teacher-learners' intervention-related mathematics knowledge, beliefs about student learning, and ability to analyze student problem solving. Details of site implementations as well as scores from the assessment battery are input to the VMC by each site as workflows, using a format that is standardized across all sites. The workflow protocols of*

successful sites are then compared with workflows of less successful ones, to help develop hypotheses about what makes different implementations more or less successful. These hypotheses are further explored with on-site observations and interviews. After establishing a good hypothesis about what makes inventions work well, target sites are helped to redesign their offerings in accordance with research findings, while control sites are allowed to continue their current trajectory. If design interventions improve performance at research sites that received the design intervention, then the hypothesis about successful learning from video is supported.

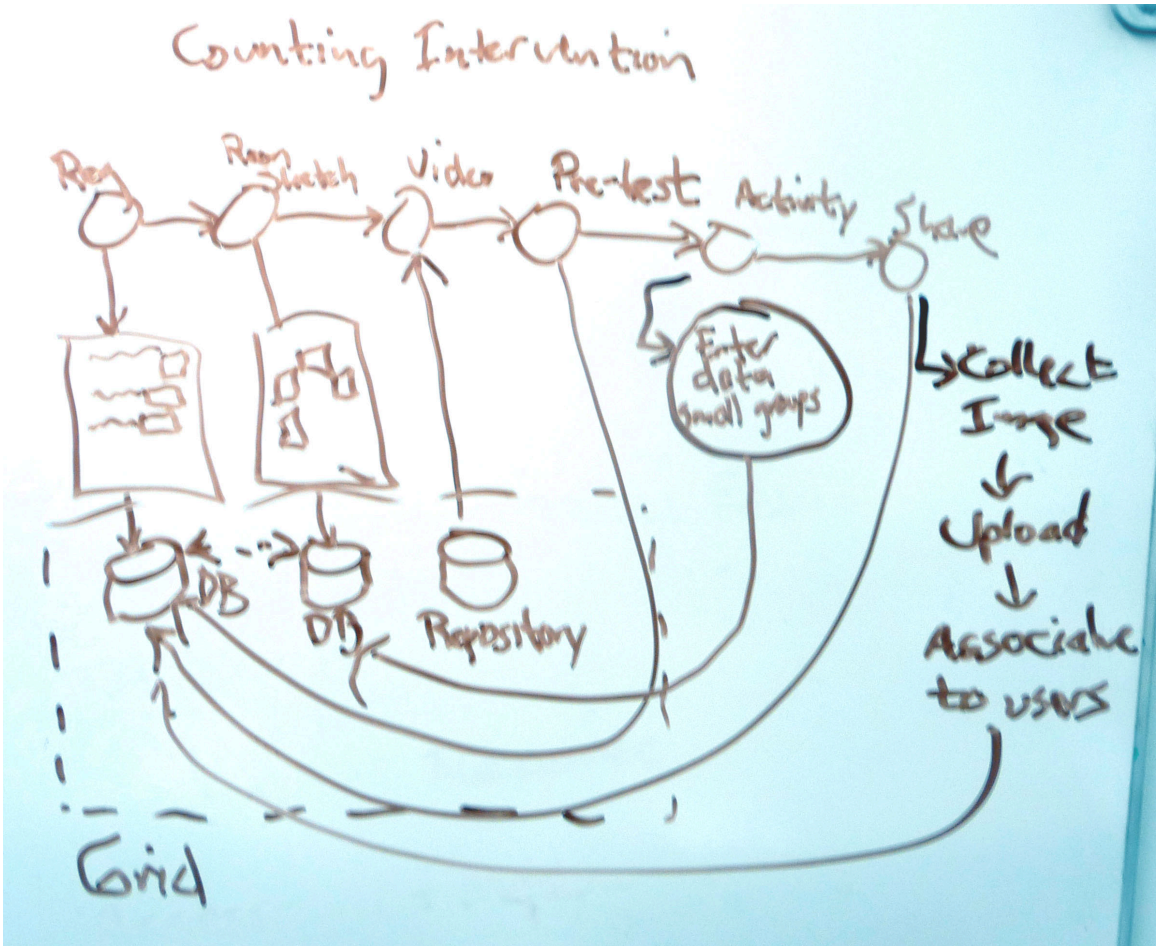

Figure 4: Workflow of VMC Use of Video and Analytic Data

Two topics emerged from our discussion around a use regarding the actual recording of interventions. There was some talk about the need for multiple camera support, a feature that the project team had never even considered. Video researchers often use more than one camera and microphone when taping the scenarios they want to analyze. The scholar may edit together the different angles to best tell the story or support their research, or they may want to watch, or toggle between all angles at once. This led to a discussion about synchronization, and how it would be handled.

There are various ways to approach synchronization, but it was thought that exact frame accuracy would not be necessary, and that sync within a few seconds should be more than fine. Recommendations may need to be added to a field manual and/or digitization standards based on the type of synching techniques used. One synching technique discussed was the "clap-board" method used in film, which puts an spike in the waveform and allows the footage to be lined up fairly well. Field researchers would probably want to do "clap the board" several times throughout a session. If the "clap board" was used only once, in the beginning of the tapes, then the entire raw video would need to be uploaded to preserve the "sync".

One other item of note is that video is often uploaded with other supplementary documents which were used in or are artifacts of the session. In fact, not only will someone need to submit supplementary documents, but the process also requires the input of a large amount of rich, contextual metadata. It would be preferable if a streamlined approach could be integrated into the recording workflow which would allow for the digitization of documents and the capture of relevant metadata on the scene, to both reduce workload and error when later ingesting the video into the repository.

The design team was invited to participate in a session of Interaction Analysis at the UWCER. Interaction Analysis (IA) is a process that can help researchers gain insight into coding strategies by studying the perspectives of different observers of the same

video. For example, experts in Discourse Analysis, Gesture Analysis, and Math Education will all come away with different interpretations of what is taking place in a simple, five-minute math instruction scene. IA often takes place synchronously, with all participants in the same room and sharing their perspectives with one another. The session at Wisconsin involved several people who were present, as well as videos of the experts in a variety of fields who were video-taped during a previous session.

One researcher mentioned that, while there would be some key differences, she did not think a great deal would be lost by conducting virtual and even asynchronous Interaction Analysis sessions. The same researcher thought it would be a very good idea if the Analytic Tool could support some type of virtual Interaction Analysis. This would involve some type of invitation to participate, a way of viewing the video, and a way to respond to specific sections of the video. It would also need to support the easy viewing of any associated documents or materials used in the study.

This led to a brief discussion about the process for defining a coding system. A single video may be coded several times by the same researcher for different types of analysis. Defining a coding system is rarely done by a single person, and is usually the collaborative product of a team. (It was mentioned that Orion (http://orion.njit.edu/) supports a distributed coding system development process.) Some researchers start with a process called "free coding" or "open coding" as they observe the video, knowing that the codes will later be honed and edited. There's also a process known as "chunking" to indicate where the main sections or events in the video are. One researcher also mentioned that some scholars do not use coding at all, but will instead compose analytical commentary for entire sections of video (in-depth annotation).

The discussion of IA and scholarly collaboration led to the following flow of "group" collaboration features in the research tool, including the development of standardized and controlled coding templates:

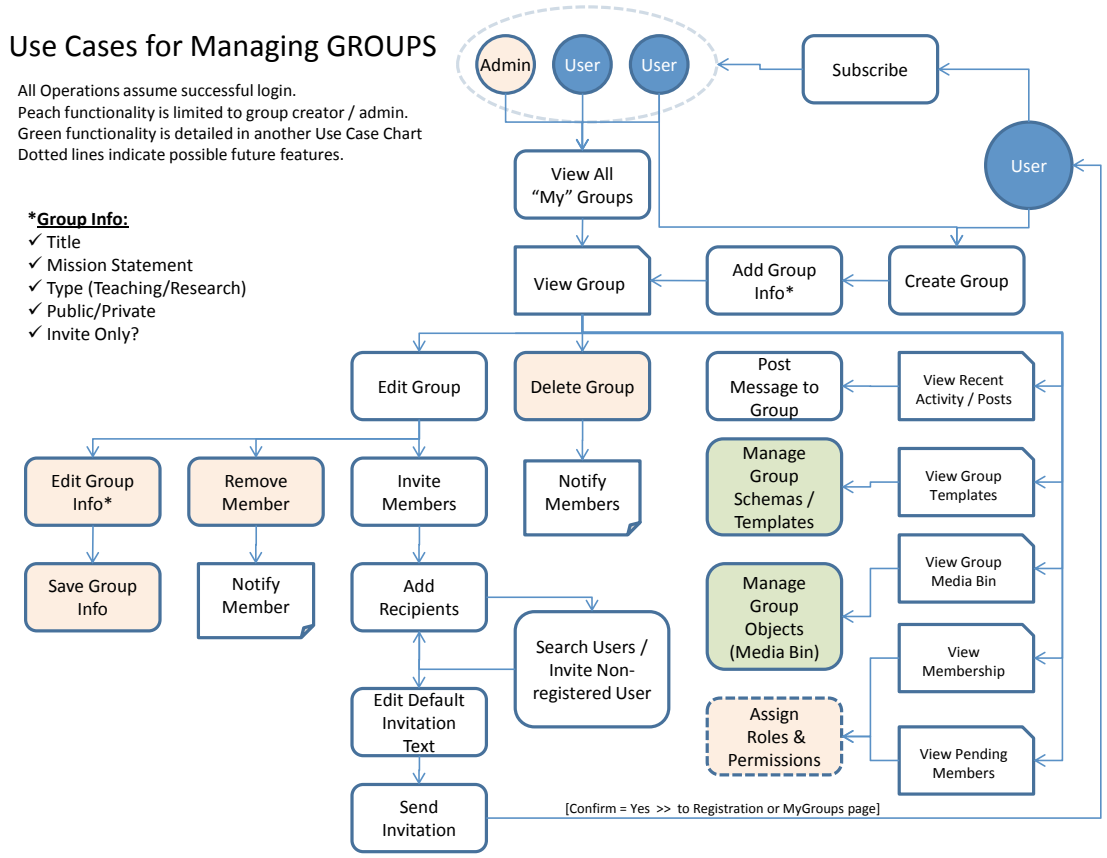

Figure 5: Group Interaction and Management based on discussions with researchers

The same researcher mentioned that open coding does not work well for her process. She prefers to take specific theoretical perspectives. The design team asked if it would be useful to be able to create "synonyms" for certain codes which may be called different things depending on the user. The team agreed that such a feature would be helpful and suggested other types of "mapping" of terms such as "nesting" where specific codes could be generalized to other codes and vice versa.

Throughout the ethnography, the design team was surprised to discover that most video research tools are tightly tied to the concept of the transcript, likely because we have only been exposed to the education and social science fields so far. In general, these domains focus on qualitative research, and thus language and interpersonal interaction are

usually what is being studied. Once a coding system has been defined, the process of coding a video is relatively straightforward.

The design team conducted a single observational interview with one researcher who used Transana, a tool supporting video research, to code a video for her Master's thesis project. Her thesis focused on gestures and body language of students explaining concepts they learn from a tutorial. The following notes were taken both during the process, and during a listening session of the recorded audio:

> *The researcher's raw video segments ranged from 25 minutes to 40 minutes. First she digitizes and transcribes the videos, which involve conversations. She organizes her videos based on file name conventions. For example, she has two groups of students, A and B, based on which of two tutorials they watched. A19 would be the label for a video of the 19th test subject who watched tutorial A.*
>
> *She loads partial transcripts in RTF format into Transana, which contain interviewer questions based on her script. She also uses Transana to finish her transcriptions based on the subject's responses.*
>
> *She uses lots of keyboard shortcuts to control video and add in and out points. Control-D starts and pauses the video. Control-A rewinds 10 seconds, while Control-S rewinds a user-defined amount of time (3 seconds in her case). Control-F fast forwards 10 seconds. Control-T adds a time code to the transcript. She always adds one in the beginning for a start point. She adds all her start and end points first, before analyzing what they are doing. This is because her research is based on a question and answer, and the questions are scripted. She "chunks" the video based on both a predetermined structure, and also using the*

visual waveform as she has some sections of video that have no sound, which she's not interested in.

She often uses the transcript to play the video at different points by using a key command and clicking on a paragraph in the transcription. She doesn't use the visual video controls, she thinks because the Mac version of the software does not provide fast forward or rewind controls. She sometimes adds bold style to text in the transcript to flag important parts.

She organizes her video clips (aka Events) into collections (aka Units) based on time period and subject grouping (control group, treatment group, etc.) She uses clip labels to order her clips sequentially. However, several other researchers working on the same project are also transcribing and coding videos. Sometimes she will use the filename of a clip to ask another researcher a question, like "Finger-pointing gesture?"

She codes who the speaker was (participant or interviewer) and whether the speech was text-based or inferences (paraphrases). As she talked to advisor, she kept adding new codes, such as original speech, which refers to participant knowledge prior to tutorial. She keeps all the definitions of codes (keywords) in Transana, and they are a big help because sometimes several months can go by between coding sessions.

She searches for codes in Transana to count the number of clips that contain those codes. She also uses the "keyword maps" (aka, piano roll) view to check her own work to make sure that no clips are free from certain types of codes. She also creates codes for everything that comes up in the participants' speech. Early in the study she would encounter something interesting to her

several videos in, create a new code, and often go back and painstakingly [sic] apply it to earlier videos.

She's not entirely comfortable with the multi-user features in Transana, but she does know that she can share collections, video, and codes with people in her research group. One would have to go looking for shared codes. She doesn't want to be bombarded by information, such as every time a user creates a clip.

She sometimes adds notes/messages to a clip or a collection for "non-code-based" information. She uses them for personal reminders, though she imagines it being useful when communicating among researchers because one can add a name of who posted the note. She uses it to record the score for each of the participant's questions. She wishes that she could export these notes to Excel because right now she has to go back through each and record it in Excel. She also had to design her coding scheme to be able to use Transana search totals to transfer data to Excel, for data analysis. However, when she has questions to share with others, she usually just copies a clip into a collection called "Questions" and adds a question in the clip label.

Her biggest complaint is the difficulty in transferring the data from Transana to Excel, though she admits the new version may have features she is not aware of. Even if she does analysis in SPSS later, she likes to keep it in Excel first.

There were a handful of miscellaneous features mentioned. Chat features exist, but none of the other researchers use it, so it's not useful to her. She would really like a "spell check" feature for when she's transcribing.

If she was to use someone else's video in her research, she would need to know exactly who is on camera (and how often), not simply who was in the room,

as well as full contextual information about the scene, such as grade level and academic material being covered.

This narrative provides the design team with a rich view of the shortcomings of the current process. It also points to key features of existing tools which were not considered in the design team's initial prototype, such as the high degree of dependency on transcript and keyboard shortcuts.

Discussion

Ethnography is ill-suited to provide detailed instruction for specific interface design of a software system. However, an ethnographic approach in the beginning, requirements gathering phase is incredibly helpful to the understanding of existing technical and social systems that go into the completion of specific tasks. Ethnography provides an overarching view from the point of the end user, which often dispells assumptions of designers and managers of how the work actually gets accomplished.

The artifacts of an ethnography, when communicated appropriately to all stakeholders and team members, creates a "design space" that reduces error, facilitates communication, and supports expectations of the systems design process. The design team in this study has considered the notes gained from this ethnography and applied them to the design of a prototype, which garner further feedback from the end users.

The study has several limitations and is not intended to provide a generalized view of how video work gets accomplished. The fact that the sample size was so small, and isolated to only Learning Theory scholars, indicates that further ethnographic studies must be conducted in other realms if the tools are to support different domains (and even in the studied domain). Before comprehensive models defining the workflow and the flow of work for various tasks, more extensive observation needs to take place.

Finally, how does one determine whether the ethnographic study was successful or not. A systematic evaluation of the system must take place to measure the success of the software in dealing with pre-existing workflow problems. Usability tests are one technique that should be employed to determine whether the new tools allow for faster and higher quality work. Usability tests measure a number of potential improvements such as Effectiveness, Efficiency, Satisfaction, Ease of Learning, Memorability, and Error Frequency and Severity(Usability.gov, 2009).

Conclusion

The use of ethnography should be a value component in the study of technology and

organizational change. However, as Randall and ___ point out, a serious re-appraisal of systems design work which emphasises the evaluative nature of large parts of the process (Randall, Harper & Rouncefield, 2007). We must understand that the design of computer systems is in essence the design of work and organizations. The true value of the ethnography in systems design is that it can fill in the gaps between the ideal workflow and the reality of the "flow of work".

One key ingredient to a successful design would involve a collaborative and iterative design process involving both end users and ethnographer. The other key ingredient would be the evaluation of the design by way of usability testing, which ensures that tasks are easier and faster in the new system than they were in the old. Ethnography is only an initial step towards more usable, satisfying, and effective systems.

One final conclusion that can be drawn is that ethnography does not provide any

shortcuts to systems or interface design. Excellent methods for this process already exits (Singer, 2009). It only provides problematic areas in existing organizational and technological systems, and helps to rectify invalid assumptions. Furthermore, there is rarely concensus among members of the same community about how work should be done. The great challenge in making sense of ethnographic data is somehow finding consensus in the many opinions that surface about the cultural constructions of an organization. The management of that consensus in terms of distilling ethnographic narratives into system requirements is still an unresolved issue and requires further inquiry.

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