Understanding, Representing, and Transforming Student Learning through Digital Video

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The rapid development and the widespread use of affordable and high-quality video technology is changing the field of educational research. In particular, digital video has been increasingly employed in classroom research in two different ways: as a tool for documenting classroom practice and as a stimulus for reflecting upon practice. The advantage of video technology in providing researchers with powerful "microscopes" into classroom practice amenable for a range of analysis has been widely acknowledged (e.g. Derry, et al., 2010; Jacobs, et al., 1999; Jordan & Henderson, 1995). However, both the construction and the interpretation of video data should not be regarded as linear processes. Instead, both involve a series of selection and representational acts by the researcher, the consequences of which warrant careful consideration. Drawing upon my involvement in video studies of both science and mathematics classrooms, this presentation will critically reflect upon several issues related to understanding and representing student learning through the use of digital video. I will also discuss the potential of digital video as a tool for enabling teacher reflection and transforming student learning.

The Power of Video Technology in Studying Classrooms

The rapid development and the widespread use of affordable and high-quality video technology is changing the field of educational research. In particular, digital video has been increasingly employed in classroom research in two different ways: as a documenting tool of classroom practice and as an instrument for interviews. The advantage of video technology in providing researchers with powerful "microscopes" into classroom practice amenable for a range of analysis has been widely acknowledged by many researchers (e.g. Jordan & Henderson, 1995; Jacobs et. al., 2007; Derry et. al., 2010), and the use of video records as a useful stimulus for participants' reconstruction of events was also recognized (Clarke, 2001; Jordan & Henderson, 1995). In spite of the wide recognition of its power and its increasing employment by classroom researchers, very few papers provide critical reflections on issues related to the use of video technology in studies of teaching and learning in classrooms. In this paper, drawing upon my involvement in video studies of both

science and mathematics classrooms, I attempt to illustrate the ways in which classroom practice is "reconstructed" in the process of data generation and data analysis. I argue that both the generation and the interpretation of video data involve a series of selection and representational decisions made by a researcher driven by particular research interests, the consequences of which warrant careful consideration. It should be an obligation of the researcher to make transparent these decisions in research writings in order for video research to be a fruitful and productive field that contributes to our understanding and theorizing of student learning in classroom settings.

Video as a Representation of the "Classroom Reality"

The recent popularity of using video technology in educational research reflects the many advantages that it entails. One of the advantages of a video record is that it provides density of contextual data (Derry, *et al*., 2010; DuFon, 2002), which not only include accurate record of verbal communication, but also information about gestures, facial expressions, and other visual or material aspects of a setting. Video data is also acknowledged to have the advantage of documenting the history of classroom interactions and providing an additional detailed record of events that can be "triangulated" with other accounts, such as researcher's field notes or retrospective interviews with participants. In this regard, video data could help to generate more accurate and complete capture of student learning processes (Hodder, 2000). Moreover, the deployment of video technology provides the possibility of reviewing and reinterpreting an event more than once and by more than one person, and therefore could enhance the richness and possibly the validity of interpretation of the data (Jacobs, *et al*., 1999; Jordan & Henderson, 1995).

In both studies that I was involved, multiple cameras and microphones were used in order to provide a richer coverage of classroom activities. For example, the Learner's Perspective Study (LPS), which is a 16-country study of mathematics classrooms, employed three cameras to capture the activities of the teacher, of the whole class, and of one student pair. The Science Study employed a refined version of the LPS design, in which two focus student cameras were set up to record the activities of two student groups continuously through a lesson sequence.

Clarke (2001) argued that a classroom takes on different aspects according to how you are positioned within it or in relation to it. And more recently, he and his colleagues argued that rather than primarily being technology-driven, the shift from single-microphone audio, via single-camera video, to multi-camera and multi-audio is motivated by recent developments in the field of learning theories and the associated research questions sought to be answered (Clarke, *et al*., 2007). A combination of the above two arguments suggests that different approaches to documenting classroom interactions might in fact depict a very different classroom, prioritizing the activities of some participants while silencing the voice of others. Even the four-camera approach employed in the Science Study is still to some extent, vulnerable to the same bias by privileging and marginalizing the voices of particular groups of participants. Ethical considerations (particularly the issue of equity) behind the decisions regarding whom to film and how to film, and the potential for *educational colonialism* (Goldman, 2007, p. 33) should be recognized and addressed at the outset.

Two other issues are crucial here: one is data reduction and the other is the issue of intrusiveness caused by the presence of the cameras and observers. Data reduction occurred long before the actual fieldwork commenced, starting from what types of cameras and microphones to be purchased, what software to be used for mixing and digitalizing of the video data, to decisions about how many cameras to be used and who should be under focus in the classroom. Every time a lesson was filmed, a series of decisions also had to be made about which angle to shoot, when to zoom in and zoom out, and so forth. The process of making these decisions depends on the research questions one seek to address, the extent to which the research purpose is understood by those generating the data on-site in the classroom, as well as their awareness of particular consequences of any decisions. However small, these decisions will affect and limit what can later be seen and analyzed. In other words, far from capturing "what really happened", video (and audio) recording is always theory-laden, driven by particular interests of a researcher. While video recording is argued to replace the researcher's bias with that of the machine (Jordan & Henderson, 1995), in practice, the researcher's bias does not go away either during the video recording or the following reviewing of the video footage. Rather, the video recorded data compounds the researcher's bias with that of the camera. Indeed, as Hall (2000) argued, capturing relevant phenomena in video and audio recording should be regarded as a sampling problem that should be taken into careful consideration in the design of research projects.

While the intention in using multiple cameras and microphones in both studies was to maximize the richness of data, the presence of cameras and a group of researchers in the classroom could have inevitable impact on the "naturalistic" practice of the class. Bogdan and Biklen (1998) argued that the presence of an observer changes any social settings to be observed, and a photographer or videographers can change it in more noticeable ways. Goldman (2007) pointed out a different negative consequence of the presence of cameras. For him, "our practice of gathering video could allow unfettered video surveillance" (p. 28). In both studies mentioned above, the research teams were aware of such intrusiveness and made every effort to minimize any discomfort for the participants and any interruption to the class. A technical familiarization period of two lessons beforehand was one such method intended to allow the class and the researcher to become accustomed to each others' presence and practices. However, even after such a familiarization period, the presence of cameras and researchers in the room may still have impact on some participants. Studies that systematically investigate the impact of cameras and observers on participants' behaviors in similar social settings could help us to demystify the issue of intrusiveness and benefit studies that attempt to stay as close as possible to naturally occurring classroom events.

Video as a Stimulus for Interviews

In both studies, video records of lessons were used in interviews to support the interviewee's reconstruction of relevant lesson events. The advantage of conducting video-stimulated interviews has been elaborated by Clarke in his chapter on *Complementary Accounts Methodology* (Clarke, 2001), in which he stated that video records provide "a specific and immediate stimulus that optimizes the conditions for

effective recall of associated feelings and thoughts" and the verbal reports obtained with the assistance from such a stimuli, can offer "useful insights into those individuals' learning behaviour" (p.16). Moreover, it is argued that elicitation based on videotapes is likely to have greater ecological validity because of the advantage of staying close to the actual event (Jordan & Henderson, 1995).

In spite of its potential for providing legitimate data about student feelings and thoughts during classroom interactions, it was also acknowledged that an individual's video-stimulated account might be vulnerable to the same problems of unintentional misrepresentation and deliberate distortion as in other similar social situations (Clarke, 2001). In fact, the process of video-stimulated interview and its impact seem to be more complicated than was previously anticipated. In particular, when given the opportunity to interact with the video of a lesson, students may pick up "new" information in viewing the lesson to which they did not pay attention in class, and thus generate "new" connections which otherwise would not exist. This means that rather than simply providing *a stimulus for recalling* what they thought or felt, the video in front of the interviewees could sometimes be used as *a learning tool* for constructing new knowledge, which is an unintended consequence of the research design.

Furthermore, the opportunity to reflect on the lesson might also have direct impact on the students themselves. This is particularly relevant to the Science Study in which the same two groups of students were followed throughout the lesson sequence. On the one hand, students' reflection in the interviews could have helped them to reconstruct their understanding of the subject matter, which could potentially have changed their learning behaviours in the following lessons. On the other hand, their familiarization with the interview protocol might have made them more aware of their own learning and thinking in the lessons, and, therefore more reflective, which could alter their social behaviours in the lessons, and further change their reconstruction of classroom events in the post-lesson interviews. In other words, rather than providing complementary sources of data, the simultaneous use of videotaping and interviewing could result in the cumulative effects on the participants and therefore have consequences for the classroom data generated and its analysis.

While these effects on the participants are the unintended consequences of the research decisions and cannot be reduced, one of the criteria that could be employed during data analysis to ensure the accuracy of interpretation is to inspect the consistency between student interview accounts and their classroom interactions. Member checking with research participants is another way to ensure that the interpretations reported are justified and supported by empirical evidence.

Selecting and Analyzing Data from Video Recordings

Video analysis of classroom practice is a time-consuming and expensive process. Researchers who conduct video analysis usually start with selecting parts of the video for further detailed analysis. The selection process can shape the results of video research in significant ways. In their guide for video research, Derry and her colleagues (2010) differentiated between two approaches to selection: (1) to locate and analyze data for the purpose of finding patterns within and across events; (2) to use video clips more holistically to support a evolving narrative account of practice.

The first approach is to describe the frequencies of certain events, and the second approach attempts to select episodes to contextualize and substantiate story telling about the practice. As Derry and her colleagues argued, while these two approaches could be blended together in practice, it is important that the rationale behind the selection process should be made clear to avoid misinterpretation of research.

The first approach to selection is usually done by segmenting, annotating, and coding of video footage. With the availability of video analysis software such as StudioCode, researchers now have the opportunities to work directly with videos without a need for intermediate representations such as transcripts. The use of StudioCode, for example, provides a powerful visual display of the duration, frequency, and distribution of certain events of interest in a lesson. For example, in our analysis of a classroom event "Kikan-Shido" (Between Desks Instruction) (O'Keefe, *et al.*, 2006) and more recently, the analysis of spoken mathematics (Clarke, *et al.*, forthcoming), StudioCode allowed us to create visual displays that show the frequency and the distribution of particular classroom events, such as the students' use of technical mathematical terms in public classroom discussion. The analysis on student utilization of physical and conceptual artefacts in a secondary science classroom provides another different picture of a classroom (Xu & Clarke, 2006). Similar to video recording, the choice made during video analysis about the analytical focus and its representational forms is a sampling issue, highlighting certain acts of a certain group of participants, while silencing the acts of other participants. Moreover, the visual displays offered by software packages are powerful tools for helping researchers to find patterns in the data, but they are less suitable for studies investigating the situated nature of social interactions in classrooms.

Regardless of whether computer software is used for data selection, it is very common for researchers to generate transcriptions of verbal and non-verbal information captured in video records. The transcribing process may occur at any stage of the analysis phase. The decision regarding what to transcribe is important because transcripts serve as an intermediate representation of video records from which researchers could carry out further analysis. In many cases, transcripts are also used in research writings to communicate findings to readers who do not have direct access to the recorded practice. Given that transcripts are created with a certain purpose in mind, what a transcript includes and what it leaves out is an important analytical decision. In the Science Study, three PhD students carried out their analysis on the same data set obtained from a Year 7 science classroom. Each examined the data set from a different theoretical perspective. The differences in research focus are evident even in the comparison of the transcripts used in research writings. For example, the study by Seah focuses on the use of Systematic Functional Grammar and the transcripts highlight the use of *linguistic* elements, such as lexical grammatical resources, in classroom conversations, which were then compared to student written work. The study by Arnold, on the other hand, seeks to understand the identity formation performed in classroom interactions using Positioning Theory. One key aspect that differs from the other two studies is the use of transcription conventions adopted from discourse analysis. It highlights the *affective* dimension of interaction by paying attention to things such as intonation, silence, emphasis, or prolonged speech. In contrast, derived from a distributed perspective to cognition, Xu

paid attention to the *material* aspects of the interaction, such as pointing or gesturing on diagrams. In this case, the creation of transcripts is indeed an analytical process and reflects the particular research interests and theoretical positions that the analyst brought to bear on their understanding of the classroom.

Conclusion

The availability of video technology provides researchers with unique opportunities to generate rich and contextual data of interactions in classroom settings. Video records of classroom practice provide us with powerful media from which understanding of learning can be advanced and theories of learning can be formulated and refined. While there are increasing recommendations about the benefits of using video in classroom research, this paper argues that both the generation and the interpretation of video data should not be regarded as linear processes. Instead, I have demonstrated that both involve a series of selection and representational decisions by the researcher. Each decision brings with it several methodological and ethical issues that should be addressed explicitly in research writings. Finally, it is important to remember that video approach, similar to other research methods, provide only a partial and temporal account of the social practice that we seek to understand.

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