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International Journal of
Educational Research 31 (1999) 717–724

International Journal of
Educational
Research

www.elsevier.com/locate/ijedures

Chapter 5

Integrating qualitative and quantitative approaches to the analysis of video data on classroom teaching

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Abstract

Video data provide a means of integrating quantitative and qualitative approaches to the study of classroom teaching. This chapter begins by discussing the usefulness of integrating quantitative and qualitative analyses, and then describes how large-scale video surveys can enable a cyclical process of generating and validating discoveries. The importance of sampling and technology as they bear on efforts to implement the process is noted. The advantages video data offer to researchers are described. Finally, the TIMSS Video Study, a large-scale international video survey of mathematics lessons, is used to illustrate how this cyclical process can be applied to the analysis of lesson content. © 1999 Elsevier Science Ltd. All rights reserved.

Keywords: Qualitative and quantitative research methods; Cross-cultural comparison; Classroom teaching; Video data; Mathematics instruction; TIMSS

Two distinct methodological traditions characterize most of the research on teaching that has been conducted over the past few decades (Gage, 1978). One tradition is quantitative, in which researchers characterize classroom instruction through numeric summaries of a relatively large set of data. Some of the most well-known quantitative studies of classrooms are process-product studies, which explore the effects of isolated teaching behaviors on student achievement (Brophy & Good, 1986). In the qualitative tradition, researchers typically explore teaching through detailed observation, or small case studies. Very common in this tradition are in-depth field studies and narrative reports from inside school classrooms.

Both of these approaches to educational research have advantages and disadvantages. The main strengths of quantitative data are that they can be aggregated,

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PII: S0883-0355(99)00036-1

summarized, and subjected to statistical analyses. Provided these data are from large representative samples, the findings may ultimately be generalized to similar populations. One limitation of quantitative research, however, is that this method depends on the availability of prior theories and hypotheses. Previously developed and validated measures are also required for the collection of quantitative data. Another disadvantage is that researchers with only numeric data may find it difficult to meaningfully communicate their research findings to a broad audience.

A major advantage of the qualitative approach is that it more easily allows for the discovery of new ideas and unanticipated occurrences. Such research helps focus novel questions, formulate hypotheses, develop useful measures, and produce grounded theory. However, because of the small-scale exploratory nature of most qualitative studies, it is usually not possible to aggregate a sufficiently large body of data from a single study to conduct conventional statistical analyses. Furthermore, investigators with only case study data may have trouble arguing for the external validity of their research findings.

1. A cyclical analytical process

Recently, academics have begun to argue that qualitative and quantitative approaches can serve complementary functions: qualitative research can be used to generate new questions and theories, which are then tested through quantitative means, and later revised or expanded through further qualitative study, and so on. The call is now frequently made for researchers to incorporate these two traditions, and when possible, to draw on the strengths of both in a single-study design (e.g., Creswell, 1994; Rossman & Wilson, 1985). Video data collected on a large scale can enable such an integration. As is illustrated in this chapter, videos allow for novel research questions to emerge from the data, while at the same time providing a means to test these questions in a quantitative manner.

Video data make possible a cyclical analytical process that takes advantage of the fact that they can be used as both quantitative and qualitative research tools. This cycle includes watching, coding, and analyzing the data, with the goal of transforming the video images into objective and verifiable information (see Fig. 1). Conventional quantitative or qualitative data must be collected and analyzed linearly, but video data allow for a unique iterative process.

The first step in the cycle is to use the video data in the qualitative tradition, in order to help make discoveries. The cycle begins as researchers watch and discuss the tapes, and let the rich visual images lead them to frame hypotheses. Once they have generated one or more hypotheses, the researchers can begin to develop a coding system to test their ideas. The development of this system might require watching additional tapes or repeated viewings of particular tapes. The researcher's goal in this phase of the cycle is to develop objective codes, so that independent coders will make the same judgement about a particular segment of video.

In the next step the tapes serve as a quantitative tool, as the coding system is applied to corroborate or disconfirm the researchers' initial discoveries. In this phase

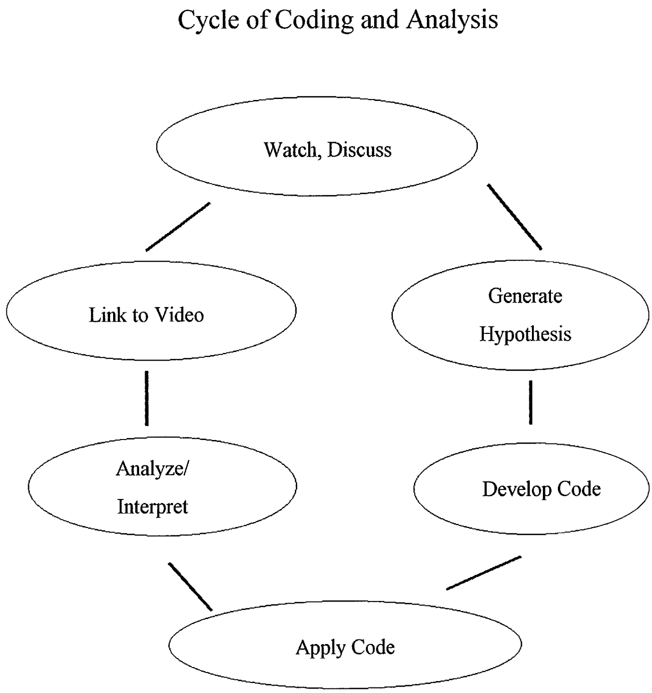

Fig. 1. Cycle of coding and analysis of videotape data.

researchers test the extent to which their hypotheses generalize to the entire sample. Statistical analyses can subsequently be performed to test the validity of the qualitative discoveries. Finally, the numerical findings can be linked back to the visual images, as the researchers again use the tapes as a qualitative tool to help interpret the results.

This analytical process can be repeated. First continual viewings of the tapes help generate informed ideas and analyses. Next, quantitative analysis allows for the validation of discoveries made by watching the videos. Then, qualitative analysis leads to clearer interpretations of the results from the statistical analyses. Looping through the cycle many times helps to generate new questions, refine coding systems, and locate footage that can serve to exemplify particular findings.

2. Facilitating factors for the analysis of video data

To effectively use video data for quantitative as well as qualitative purposes, several facilitating factors should be taken into account. For example, it is critical to have a large enough sample size to apply the cyclical process described above. In the past, video data has been used successfully only in conjunction with small, qualitative studies of classroom teaching (eg. Cobb, Wood, Yackel & McNeal, 1992; Pirie, 1996;

Schoenfeld, 1988). However, a small number of videotapes provide only descriptive images, which cannot be validated by quantifiable indicators. To obtain such indicators, discoveries made through qualitative analysis must be subjected to statistical analysis using the entire set of videos. Only video surveys collected on a large scale can support this type of hypothesis testing.

Another factor that should be considered when working with video data is the use of new technology. One of the major weaknesses of videotapes used to be that they were not very durable and, consequently, would wear out with repeated usage. This problem can be solved by storing and accessing the video data using personal computers. Video data can be easily digitized and stored on CD-ROMs, computer servers, or other computer devices. A second common complaint about videotapes was that they were too cumbersome, which made working with them difficult. Constantly having to fast-forward or rewind to watch, code, and analyze the video content was simply too time-consuming to make video data feasible for large quantitative studies. However new computer software, such as that described by Knoll and Stigler (next chapter), allows users to instantaneously access any part of the video simply by clicking on the appropriate part of the videotape or transcript. Certainly, at the present time many of the technical limitations of videotapes have been overcome and video data is easier to store and analyze than ever before.

In addition, researchers can take advantage of the Internet as an extremely useful vehicle for disseminating and analyzing video data. Videos can be made available over the Internet for a variety of purposes, with both qualitative and quantitative paradigms in mind. Using the Internet, for example, video data could be accessed by remote colleagues who would be able to offer insight and generate new research questions. Similarly, they could be used by coders working at different sites. Powerful visual images seen over the internet could be used to help disperse one's findings, more effectively communicate particular results, or encourage discussion groups.

3. Additional advantages of video data

As an information source that is relatively unfiltered through the eyes of researchers and unconstrained by preliminary hypotheses, video has a number of distinct advantages over other types of data. Video data is arguably more "raw" than other forms of data, such as observational data, and can more easily be brought back to a laboratory setting for analysis. Researchers interested in understanding teaching, for example, do not have to train a limited number of coders to go into the field and bring back their notes or coded observations. Instead, video can be used to capture the lesson content and classroom events, including visual (such as the writing on the blackboard) as well as verbal content. Later the video data can be watched, critiqued, and discussed by members of the research team. In this kind of controlled, collaborative setting, multiple viewers can work together to make discoveries, develop codes, and establish inter-rater reliability.

Video data are much more versatile than other forms of data and can be viewed by researchers from diverse backgrounds and disciplines, who might bring fresh perspectives to the data analyses. Based on their particular interests, observers from various cultural and linguistic backgrounds can examine many facets of the data, including topics ranging from gestures to behavioral or speech patterns. Specialists with domain-specific expertise can also join in on various analyses of the content. In addition, video data have the potential to be re-coded and analyzed for purposes completely different from those for which the tapes were originally collected. They have a long shelf life and can be kept for *post hoc* or secondary analyses, as research questions and theories change over time.

As a permanent data source, video data can be watched, coded, and analyzed in multiple passes. Videos enable researchers to watch the same sample of events over and over, each time looking into a different dimension of the recorded verbal and physical behavior. In addition, new technology enables researchers to have great control over the viewing of these videotaped events. For example, researchers can choose to watch behaviors in slow motion, or take "frame-grabs" of events for more careful study. Not only can video document behaviors in minute detail, it also has the potential to capture unexpected behaviors that might have otherwise gone unnoticed. Thus, video allows for sophisticated analyses of both planned and unplanned observations.

4. Overview of the TIMSS Videotape Classroom Study

To demonstrate the unique advantages of video data and how they can be used as part of a cyclical analytical process, an example from the video component of the Third International Math and Science Study (TIMSS) is used. The TIMSS Videotape Classroom Study is the first large-scale study to investigate classroom instruction using videotaped records. The goal of the study was to learn how eighth grade mathematics is taught in Germany, Japan, and the United States. Video data from 231 eighth-grade mathematics lessons in these three countries were collected; 100 lessons were filmed in Germany, 50 in Japan, and 81 in the United States. The videos are from randomly selected, nationally representative samples of teachers, with one lesson filmed per teacher.

Collecting video data requires careful consideration of a number of context-specific issues. For example, the TIMSS Videotape Classroom Study research team found that they needed to develop standardized procedures for filming the classrooms, so that biases due to videography would be minimized. For this study, videographers shot each lesson using a single camera in the classroom, capturing what an ideal student would be focusing on during the lesson, which usually was the teacher. The teachers were informed that the goal of the study was to videotape typical lessons, and that they should do whatever they normally do in their mathematics classroom.

Once collected, all of the video footage from the TIMSS Videotape Classroom Study was digitized and stored in a multimedia database. The tapes were transcribed and translated into English, and each transcript was linked by time codes to the accompanying video. This multimedia database was then accessed, coded, and analyzed using vPrism computer software that was developed specifically for the TIMSS Videotape Classroom Study. (See Knoll & Stigler, 1999, Chapter 6).

Based on the TIMSS Videotape Classroom Study data, different instructional patterns are apparent in German, Japanese, and United States mathematics classrooms (Stigler, Gonzales, Kawanaka, Knoll & Serrano, 1997). In German eighth grade lessons, the teacher typically presents a task to the class, and then guides the students in developing the relevant information. The teacher then summarizes the new concept or principle and assigns practice problems. In Japanese lessons, the teacher generally poses a problem and has students work at their seats to generate solution methods. Next the children share their ideas, the teacher summarizes them, and sometimes the students work on practice problems. In American lessons, the teacher typically demonstrates how to solve a few sample problems, and then assigns similar problems for the students to complete themselves.

5. A sample analysis

When the TIMSS Videotape Classroom Study research team initially began watching the videos, one of their first discoveries what that classroom interactions were structured differently in German, Japan, and the United States (Stigler et al., 1997). Specifically, they noticed whole class work and independent seatwork were the two main forms of interaction, but that these interactions occurred with differential frequencies across the three countries. The team developed a coding system to test the hypothesis that although lessons in all countries contain whole class work and independent seatwork segments, German lessons contain less seatwork and more class work compared to Japanese and United States lessons.

The coding results support this hypothesis, as shown in Fig. 2 (Stigler et al., 1997). Japanese and US teachers both spent approximately sixty percent of their time in class work and 40% of their time in seatwork. German teachers, on the other

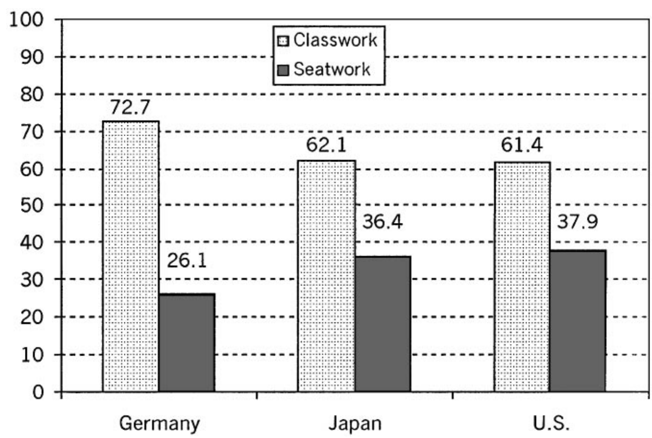

Fig. 2. Average percentage of time during the lesson spent in classwork and seatwork in each country. Source: U.S. Department of Education, National Center for Education Statistics, Third International Mathematics and Science Study, Videotape Classroom Study, 1994–95.

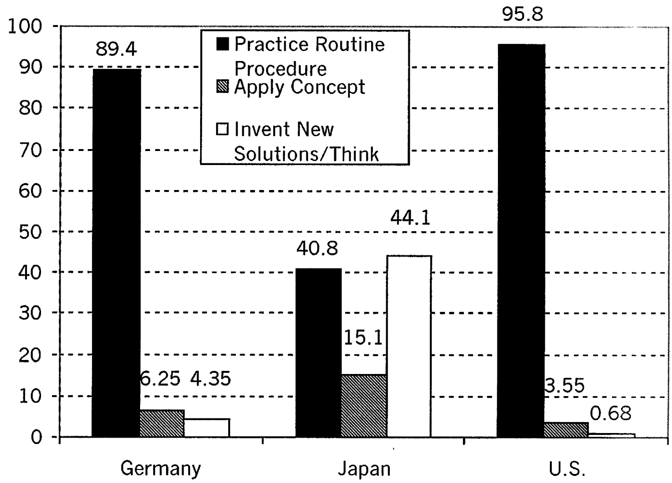

Fig. 3. Average percentage of seatwork time spent in three kinds of tasks. Source: U.S. Department of Education, National Center for Education Statistics, Third International Mathematics and Science Study, Videotape Classroom Study, 1994–95.

hand, spent a considerably higher percentage of their lesson time in class work (more than 70%).

These results provide one quantifiable indicator of cross-national instructional differences, but as they continued to study the videotaped lessons the research team began to develop more specific questions. For example, what kind of work students are expected to do during seatwork? Their hypothesis was that Japanese teachers may have higher performance expectations of students compared to American and German teachers. The research team tested this hypothesis by coding whether the tasks that students were asked to do during seatwork required them to (1) practice routine procedures, (2) apply procedures in new situations, or (3) invent new procedures.

As Fig. 3 depicts, German and US students spent almost all of their time in seatwork practicing routine procedures (Stigler et al., 1997). In other words, they simply practiced a procedure that the teacher had already developed or demonstrated. By contrast, Japanese students spent less time practicing and more time applying and inventing procedures than their peers in the other countries. In a similar fashion, the TIMSS Video Study research team continued watching tapes, noticing patterns, and developing and testing more detailed hypotheses. More of their findings, along with specific examples, are reported in Stigler et al., 1997 and Stigler and Hiebert (1997).

6. Conclusion

Video data provide the kind of detailed permanent real-time records of behavior that enable researchers to detect patterns and to code a variety of characteristics reliably within and among the tapes. Although large-scale video surveys are not very common at the present time, new technology and advanced software now allow for video data to be readily subjected to a cycle incorporating both qualitative and quantitative analyses. Such a process has been used successfully in the TIMSS Videotape Classroom Study and has enabled the identification of patterns of instruction across mathematics lessons from the Germany, Japan, and the United States. While the collection, coding, and analysis of such a large quantity of data still pose a formidable challenge, the benefits of videos are far-reaching. The potential that video data has to offer to the field of educational research is just being realized.

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