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Video-Based Educational Research:
What Happens After Recording With Two Cameras?

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Abstract: Video-based research is enjoying increasing popularity in social science research in general, as well as in educational and classroom research in particular. It is used in various methodological approaches, and recording frequently employs a multi-perspective approach implemented with the help of two cameras (two-camera strategy). However, what happens in the subsequent phases of research often remains unclear, as detailed information on how multi-perspectivity is dealt with during data processing and descriptions of relevant analysis techniques are largely missing in the relevant literature. Referring to three situations we experienced in our video-based research project, which we conducted in Swiss kindergarten classrooms, we identify opportunities for new insights. They were mainly achieved by systematically integrating the material gained from the second camera during data processing. By doing so, we aim to contribute to current methodological discussions which accompany the increasing use of videos in social science research.

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1. Introduction

Video-based research is enjoying increasing popularity in social science research in general, as well as in educational and classroom research in particular. Videos created by the researchers themselves as well as recordings done by different stakeholders are used in this context. Distinguishing creatorship is key, as the identity of the creator is also reflected in diverse thematic and methodical approaches (SCHNETTLER & RAAB, 2008). Video recordings are marked by unique characteristics, including the combination of sound and single images, as well as their reproduction in real time. Furthermore, they allow for specific playback and editing possibilities as well as for long-term accessibility of the original material. These characteristics, therefore, permit in depth insights into interactions in a way that is not possible when using other approaches (DINKELAKER & HERRLE, 2009; JEWITT, 2012; TUMA, SCHNETTLER & KNOBLAUCH, 2013). In recent years, videography[1] or video analysis, emerged as a specific method used in research focusing on interactions (KNOBLAUCH, 2012). While videography is based on ethnomethodology and conversation analysis, other methods, such as documentary analysis (ASBRAND & MARTENS, 2018; BOHNSACK, FRITZSCHE & WAGNER-WILLI, 2015) or hermeneutic video analysis (REICHERTZ & ENGLERT, 2011), are equally recognized and used for interpretative video analysis. [1]

While qualitative approaches in video research dominate many fields of social research, the situation in the field of classroom research presents somewhat differently: Large scale studies using quantitative approaches have not only contributed significantly to the increasing popularity of videos, but also constituted a significant influence for research practice (JANÍK, SEIDEL & NAJVAR, 2009; PAULI & REUSSER, 2006). Seminal studies include the international TIMSS project (Trends in International Mathematics and Science Study, see U.S. DEPARTMENT OF EDUCATION, NATIONAL CENTER FOR EDUCATION STATISTICS, 1999, 2003), as well as any related work (CLAUSEN, REUSSER & KLIEME, 2003; NEUBRAND, 2002; ROTH, 2009) and the ongoing TALIS video study (Teaching and Learning International Survey, see OECD, 2018). These studies, some of which are long-term, provide a context in which the interaction between technological developments and an evolution of the understanding of teaching and learning from a process product paradigm to a systematic approach (PETKO, WALDIS, PAULI & REUSSER, 2003) can be particularly well observed. One indicator of the close relationship between content and methodical questions is the number of cameras employed: Whereas researches working for TIMSS 1995 recorded with one camera, which was almost always used to follow the teacher, thereby reflecting predominant contemporary understanding of teaching, two cameras were used in 1999, to get more information about the students' behavior, reflecting a more systematic approach (JACOBS, HOLLINGSWORTH & GIVVIN, 2016). JANÍK et al. (2009) showed that, in classroom research, recordings are often done with the help of two cameras. Moreover, even though

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1 The term videography denotes both a specific approach, in the context of which it derives from the combination of video analysis and ethnography (TUMA et al., 2013), as well as any video recordings generally (CORSTEN, 2018; DINKELAKER & HERRLE, 2009).

the studies presented can be assigned to a quantitative paradigm, in qualitative studies also two cameras had been utilized (among others: BRINKMANN & RÖDEL, 2018; KADE, NOLDA, DINKELAKER & HERRLE, 2014; WOLFF, 2017). One frequently presented argument in this context is that videos "enable retracing the selection undertaken by the researchers in view of specific objectives, and the exploration of thought experiments, as well as the discussion of alternative possibilities particularly well" (HERRLE, RAUIN & ENGARTNER, 2016, p.13[2]). Furthermore, various authors have stressed that the (comparatively) new work with videos entails an increased willingness to engage in dialogue by both sides. Already in the context of TIMSS, JACOBS and her colleagues pointed out that working with videos presents an opportunity to integrate qualitative and quantitative approaches (JACOBS et al., 2016; JACOBS, KAWANAKA & STIGLER, 1999). Their explanations of the development of the coding schemes that refer to "top-down" and "bottom-up" processes (JACOBS et al., 2016, pp.293f.) or the "cycle of coding and analysis" (JACOBS et al., 1999) presented vivid examples of this integration. Other researchers who implemented video-based studies independently of TIMSS, have demonstrated a willingness and openness to approaches that encompass different paradigms as well as their practical compatibility and complementarity (KLETTE, BLIKSTAD-BALAS & ROE, 2017; SNELL, 2011). HERRLE et al. (2016) argued that this willingness to engage in dialogue stems from the fact that both research paradigms face the same challenge, "namely to undertake selections, to substantiate them in view of the respective research question and characteristics of the research object and to analyze them with the help of adequate methods in order to enable the creation of new insights" (p.13). [2]

The increased use of videos is accompanied by various practical, methodical, and methodological discussions contributing to establishing the diverse approaches (for a German overview of qualitative approaches, see MORITZ & CORSTEN, 2018; for an overview of its use in the learning sciences, see GOLDMAN, PEA, BARRON & DERRY, 2007). Discussions focus on camera effects, sometimes also referred to as reactivity or invasiveness (e.g., BLIKSTAD-BALAS, 2016; DREISCHENKÄMPER & STANIK, 2014; FANKHAUSER, 2012; HEE, 2018), or challenges faced in the transcription of video records (MARKLE, WEST & RICH, 2011; MORITZ, 2014, 2018). More generally, the issue under consideration is how to deal with the extreme complexity of audio-visual material during data processing and analysis. This topic has also been addressed under the heading selectivity (e.g., DINKELAKER, 2018) or sampling (JEWITT, 2012; TUMA et al., 2013)[3]. Finally, challenges associated with the presentation of results (e.g., HEATH, HINDMARSH & LUFF, 2010; MORITZ & CORSTEN, 2018), as well as

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2   All English translations from German texts are ours.

3   A number of researchers, particularly Anglophone ones, used the terms "selection" and "sampling" interchangeably (ERICKSON, 2006; JEWITT, 2012). TUMA et al. (2013) referred to external or ethnographic sampling when describing the selection of a specific situation to record; they referred to internal sampling when selecting specific sequences for fine-grained analysis. In this article, we therefore use the term "selection" to avoid confusion with "sampling," as it is employed in the context of quantitative studies to generally describe the selection of individuals or situations for research.

ethical and legal questions, have been raised (e.g., SONNLEITNER, PROCK, RANK & KIRCHHOFF, 2018). [3]

In what follows, we discuss work undertaken with two cameras in the field of video-based classroom research,[4] with a focus on the issue of selectivity. We emphasize the question of how researchers undertake selections when recording and processing videos, in view of the complexity of social situations. We show that arguments in favor of working with two cameras are generally presented in a transparent manner. However, equally transparent explanations of the phases of data processing and analysis are frequently lacking, even though selections must be undertaken during these steps also (Section 2). Afterward, we refer to our own experiences, which we had during a research project undertaken at the kindergarten level in Switzerland and present some exemplary insights, which we gained by systematically integrating both cameras during data processing (Section 3). In our closing remarks, we provide some explanations of our findings and identify some implications for further research practice (Section 4). In doing so, we refer to both qualitative and quantitative approaches[5], as we are primarily interested in how research with two cameras is executed when processing and analyzing data. The use of videos in the context of a specific research project is always undertaken with the goal of generating relevant insights and knowledge. It is, therefore, closely connected to chosen methods as well as specific understandings of the research subject, as we mentioned briefly in our introduction. We are particularly interested in what happens after researchers have decided—on the basis of a specific understanding of their field of research as well as their defined research interest—to record with the help of two cameras. In other words, we are interested in the consequences that this decision in favor of two cameras has for the subsequent work, when processing and analyzing data. We argue that the decisions and courses of action taken during these phases are rarely communicated in a transparent manner, thereby abandoning potential opportunities to generate insights. [4]

2. Using the Two-Camera Strategy Throughout the Research Process

The partly conflicting positioning of quantitatively and qualitatively oriented research projects are, not least of all, reflected in distinct research processes (FLICK, 2017; PRZYBORSKI & WOHLRAB-SAHR, 2014), which are prototypically reflected in a linear and a circular structure, respectively: the former is associated with the quantitative, the latter with the qualitative paradigm (WITT, 2001). However, in the context or our discussion of selectivity, the general form of the research process becomes less important. What seems more critical to us is DINKELAKER's (2014) argument that, when working with videos, the phases of

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4   This thematic focus is chosen, because for videographic studies outside of the educational context it is usually recommended to work with one camera only (HEATH et al., 2010; TUMA et al., 2013).

5   Generally, we refer to quantitative and qualitative approaches, knowing that this simplified terminology neglects the occasionally considerable differences between specific interpretative and reconstructive approaches (see e.g., HITZLER, 2016 and the respective replies by FLICK, 2016, MEY, 2016, and STRÜBING, 2017). When referring to particular contributions, we usually use the respective authors' terms.

recording and analyzing data become circularly entwined. Data processing should not be considered a mere technical procedure, but rather a process of generating data. DINKELAKER referred to ERICKSON, who said "[t]he videotape itself is not data. It is a resource for data construction, an information source containing potential data out of which actual data must be defined and searched for" (2006, p.178). DINKELAKER (2014) correspondingly argued that "analyzing the research object starts with the moment of data processing" (pp.55f.). As such, for our discussion, two moments in the research process seem key when dealing with the issue of selectivity: first, the moment of deciding how to implement the video recordings; and second, the moment in which the processing of the recordings begins. The question, therefore, is what is recorded and what is turned into data—*sensu* ERICKSON. [5]

The starting point for planning any data collection is a specific interest in knowledge, a precise research question. The subsequently developed research designs can be considered to constitute answers to the question of "how one can deal with the complex type of data that videos are, in order to handle the respective research questions" (HERRLE et al., 2016, p.11). It has been stressed repeatedly that, in view of the effort required for video-based research, the fit between research question and method is a particularly relevant one and, considering the manifold possibilities, not a trivial one (DERRY, 2007). Selecting specific locations and moments for recording is a logical consequence of the chosen approach. In case of videographic studies, for example, observations in the field are undertaken as a first step to use the thereby acquired contextual knowledge to choose relevant situations and positions for recording (e.g., WAGNER-WILLI, 2005; WOLFF, 2017). In the context of standardized research focusing on instructional quality, however, classes are sampled according to specific criteria and recordings are undertaken in a manner that is as standardized as possible, with the help of explicit and specific guidelines (e.g., SEIDEL, PRENZEL, DUIT & LEHRKE, 2003). During this phase, decisions in favor or against specific technological equipment play an important role: Cameras with wide-angle lenses or head mounted cameras can be used to produce qualitatively different images than cameras with standard lenses or cameras that are mounted on a fixed tripod. The use of additional microphones ideally results in higher quality soundtracks, which make it easier to understand individuals' statements. However, the integration of different soundtracks must be considered, at the latest, when processing this material. Therefore, the technologies used not only determine the quality of the recordings, but also the processing possibilities, which one can make use of later on. Not all software, for example, comes with features allowing to play back more than one video or parallel soundtracks. [6]

In the following two subsections, we focus on the two moments of data collection and data processing and describe how these phases were dealt with in the context of different projects. In our arguments, we refer to the extensive documentation available from large quantitative studies (e.g., HUGENER, PAULI & REUSSER, 2006; SEIDEL, PRENZEL et al., 2003; U.S. DEPARTMENT OF EDUCATION, NATIONAL CENTER FOR EDUCATION STATISTICS, 1999).

Furthermore, we discuss the method of *erziehungswissenschaftliche Videografie* [educational videography], as this approach likewise employs two cameras and is well documented, at least in German texts (e.g., DINKELAKER & HERRLE, 2009; KADE et al., 2014; RAUIN, HERRLE & ENGARTNER, 2016). Additionally, we consider publications from qualitatively oriented projects in the field of classroom research, particularly doctoral theses and contributions in anthologies or journals (e.g., KERSCHHOFER-PUHALO, LALOUSCHEK & MAYER, 2018; WOLFF, 2017). The latter are often characterized by formal restrictions in length, and therefore usually contain limited information on the detailed procedures undertaken. [7]

2.1 Data recording

Selectivity during data recording is very closely linked to the instrument of the camera and further technologies such as special microphones. It has been stressed repeatedly that, in spite of their seeming objectivity, camera recordings cannot be considered replications of reality, but merely retain selected extracts thereof. The extracts are thereby determined by the number of cameras, as well as their position and movement (e.g., HERRLE & BREITENBACH, 2016; NOLDA, 2007). In particular, Anglo-Saxon authors have pointed out repeatedly that there is one key decision in this context in favor of or against mobile or fixed cameras (HEATH et al., 2010; JEWITT, 2012). Bearing in mind that a first selection process is already taking place when recording, we wish to differentiate three approaches to recording, as they are frequently employed in video-based, educational research:

- The use of one hand camera, with which—in line with the ethnographic tradition—a clear focus is set and no attempt is undertaken to capture what is happening completely: This approach is generally known as camera ethnography. Selective *Blickschneisen* [camera perspectives] (MOHN, 2013, p.171) are developed during the recording process and what is recorded is understood as field notes. Recording and analysis are merged and are superseded by phases of knowing and not knowing, corresponding respectively to seeing and not yet being able to see. The researcher determines selectivity during the course of the recording;

- The use of two cameras, as established in the context of TIMSS in 1999: This was, on the one hand, due to the insight that using only one camera, as it was done for TIMSS 1995, left "little freedom for the videographer to film activities not involving the teacher" (U.S. DEPARTMENT OF EDUCATION, NATIONAL CENTRE FOR STATISTICS, 2003, p.5). On the other hand, by a changed understanding of the teaching and learning process a more decisive role was ascribed to students, which could be captured more adequately with two cameras. Two key concerns when working with two cameras are reducing one's dependence on the camera's perspective and achieving coverage of the situation in the classroom that is as complete as possible (HERRLE & BREITENBACH, 2016). In addition, safety measures are considered: In case of technical problems with one camera, the recordings of the second can still

be of use (REUSSER & PAULI, 2003). Decisions about selectivity in the context of working with two cameras are reflected mainly in the planning of their positioning in the room, with various possibilities being documented extensively in literature (HERRLE & BREITENBACH, 2016; HUGENER, PAULI et al., 2006);

- The use of more than two cameras (for an example of research undertaken with three cameras, see CLARKE, 2006) and special cameras, such as head-mounted cameras (BLIKSTAD-BALAS & SØRVIK, 2015) or cameras that record more than one angle at the same time (KANE & STAIGER, 2012): The authors of these studies argued that using more than two cameras provides the possibility to capture additional perspectives (such as specific groups of students). A further concern is the objective of documenting the context of recording as completely as possible, for example, to facilitate secondary analysis (ANDERSSON & SØRVIK, 2013). [8]

Of course, these three approaches, which we sketch only briefly here, are implemented in much more multifaceted manners. KÖNIG (2009), for example, used a hand-held camera, but analyzed her recordings with standardized instruments, rather than following a qualitative approach, as is usually connected to the use of a hand-held camera. WAGNER-WILLI (2005) implemented a contrary approach in that she generated standardized recordings with one fixed camera but used a reconstructive approach for their analysis. Either way, the specific recording situations (particularly camera positioning), created consciously by the researchers, can be considered to constitute distinct answers to the question of what to select in the process of recording: A clear focus is undertaken when working with one camera—whether on the basis of decisions taken *before* the recording and then implemented in a standardized manner or because of decisions of the person operating the camera *during* the recording. Two cameras are often used with the aim of achieving a compromise for which one camera also sets a clear focus—in classroom research, this is usually the teacher—and the second camera is used to document the context. Use of further cameras is generally motivated by additional foci deriving from the research interest. Whatever approach is chosen, the reasons for choosing it are usually presented explicitly and transparently. The related publications typically contain information on why the authors chose a specific technical set-up for the recording. In the following chapter, we show that this transparency is much rarer when it comes to justifying selections during data processing. [9]

2.2 Data processing

Data processing material from two (or even more) cameras and possibly further audio tracks is obviously more complex than working with material from only one camera. This fact leads to the question of how to deal with (over)complexity during data processing. One can find separate chapters dedicated to "processing video data" in the relevant technical documentations (e.g., LOTZ, LIPOWSKY & FAUST, 2013; SEIDEL, PRENZEL et al., 2003). This is also the case in the introduction by DINKELAKER and HERRLE (2009) or KADE et al. (2014), who

presented empirical results, as well as methodological reflections, in their publication. All of these sources share the characteristic of containing elaborate technical information on video formats, along with their assets and drawbacks, as well as possibilities for converting them. Furthermore, they addressed different possibilities for the fixation of the video recordings—mainly in the form of text or images. In particular, quantitative studies contain detailed transcription rules, which can be understood to represent a selection of verbal aspects. However, even this elaborate information hardly contains any indication of whether all recordings that exist, for example, of the same moment in a classroom, have been taken into consideration during data processing. Statements, such as the following, remain the exception:

> "The two cameras (teacher and class) were not integrated into one strand of film, rather each recorded lesson is documented by two parallel videos, each enabling another perspective during its recording. Teacher and class camera, however, both possess the same audio tracks" (BERNER, CORVACHO DEL TORO, GABRIEL & DENN, 2013, p.69). [10]

Similarly, HERRLE provided explicit information, and wrote: "For analytic purposes the recordings have been cut together into a dual perspective" (2013, p.605). However, in spite of the information presented on the available material, it remains unclear in both cases, how the available material was handled in the subsequent research process. We therefore do not know, which of the two videos or how the integrated cut was used in the further processing of text and/or image. The authors did not address the required selection in the analytic context. Explicit information regarding the specific possibilities for processing visual and audio tracks, such as the following, are a rare find (and even in this example, the authors did not state explicitly whether or how they used the available possible combinations of varying perspectives):

> "[...] if several children worked simultaneously on a task [...] an additional mobile hand camera was used in order to be closer to what was happening and to have two perspectives [...]. These *can* be processed jointly in the linguistic annotation software which we used" (KERSCHHOFER-PUHALO et al., 2018, p.591, our italics). [11]

Every now and then, it is possible to identify indirect evidence for the use of different recordings. It is, however, often hard to find, as it tends to be presented in highly diverse and frequently unexpected text passages. The following statement, for example, is from a chapter entitled "Collecting Video Data": "The video material of this [whole class] camera is consulted during data analysis, if uncertainties arise with regard to the interpretation of the situation when viewing the teacher camera" (REUSSER & PAULI, 2003, p.22). In other instances, the transcription guidelines contained information on how to deal with two videos: "Then simply listen and start writing (if you have a problem with understanding what is being said, just listen again to the same scene in the class video)" (SEIDEL, KOBARG & RIMMELE, 2003, p.88). Such specific information about transcription, and a lack of corresponding information on dealing with visual information, represents an implicit selection during data processing, namely one

that focuses auditory and verbal aspects. Similarly, ERICKSON (2011) identified a predominance of language in US-American classroom research. Yet, LOTZ (2016), among others, stressed that it is never the transcription "by itself that is the analytic basis [...], rather *the* video itself is being viewed in order to be able to integrate all information into the coding and rating" (p.165; our italics).[6] [12]

In comparison, authors describing the approach of educational videography stressed that, during data processing, it is possible to generate written and visual data. In doing so, however, it is rare for all recordings to be processed to the same extent. Content-driven selections take place, with criteria emerging over the course of repeated viewings (DINKELAKER, 2016). There is frequent talk of meaningful statements, events or situations, which "emerge from the stream of what can be observed" (p.53). However, this approach does not explicitly address the issue of how to deal with recordings from different cameras, nor with the role that potentially different perspectives play when it comes to drawing the researchers' attention to some phenomenon. Along the lines of the singular, which is used implicitly when, as was the case in the quote presented at the end of the last paragraph, the authors talked about working with *the* video, the figures or sketches of still images generally only show one perspective or present a sequence taken from one camera (e.g., DINKELAKER, 2014). This gives rise to the impression that, whereas material from two different recordings is available, work being done at a given point in time focuses mainly on that of one camera. Analyses of spatial issues, such as sketching floor plans or more systematic work in the context of configurative analysis (DINKELAKER & HERRLE, 2009) remain an exception to these observations. [13]

We have shown that there is hardly any information available on research practice in the phases of processing and analyzing data from video recordings taken with several cameras. Specific guidelines are mainly found in the documentation of large quantitative studies. In these guidelines, the authors repeatedly stressed that the recordings from the second, usually the so-called whole class camera, should be consulted particularly during transcription, if the audio from the teacher camera is incomprehensible (among others, REUSSER & PAULI, 2003; SEIDEL, KOBARG & RIMMELE, 2005). Furthermore, mentions of such actions as the synchronization of recordings (DINKELAKER & HERRLE, 2009 or KADE et al., 2014) can be interpreted in terms of the principle of both camera perspectives being made available for analysis. Details of such undertakings, such as what is done with the respective audio tracks, often remain unclear. This leads to the impression that decisions concerning specific selections during data processing often focus on the form in which verbal and/or visual aspects are presented and less on the available perspectives from diverse cameras that are potentially chosen and further processed. [14]

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6   The presence of the original recordings in video-based research stands in particularly stark contrast to work with interviews, where the original data are rarely considered for analysis, as it focuses on working with transcripts.

3. Systematic Integration During Data Processing

Based on the available information the impression arises that there are two ways to deal with recordings from several cameras during data processing. First, a lack of clarity with regard to the recordings of the first camera is the reason to consult those of the second camera. This is often the case if it is not possible to understand or transcribe certain utterances. Second, the integration of the second camera is not addressed, or it is motivated by significance: Significant statements, events, or situations are focused upon for analysis without saying whether significance is ascribed on the basis of viewing recordings from two cameras. It would, however, be desirable for way of handling recordings from several cameras to be documented with the help of selection criteria. If in a research design a multi-perspective approach, using several cameras, is described and arguments beyond security aspects are presented, the question arises of how to implement this multi-perspective approach in a more consistent manner during data processing and analysis. The insights, which researchers aim to generate when employing two cameras to record, must also be ensured for data analysis through adequate processing. In the following chapters, we present three insightful moments that we experienced during the course of our project. Systematically viewing the recordings from the second camera in relation to those of the first constituted a specific insightful moment in all three situations. We are of the opinion that the insights could not have been gained to the same extent by viewing only one camera. [15]

3.1 Project background

In the context of the project "The Situation of Kindergartens in the Canton of Zurich," which was mandated by the relevant cantonal Department of Education, 20 select classes were investigated in the spring of 2017 using a multi method approach. The objective of the study was to generate empirical knowledge in three thematic areas: lesson design, competences acquired by the children, and the transition into kindergarten, as well as the subsequent primary school level. It was furthermore planned to use the collected material for further analysis. The subproject of the video study focused on the area of lesson design in kindergarten. More specifically, the following four questions were identified:

1. How do teachers structure (and rhythmize) one morning of kindergarten classes?
2. What methods do they use?
3. How are playing and learning opportunities presented in the classroom?
4. Which modalities of individualization can be described? [16]

Although these questions are formulated in a very open manner, they focus on the teacher and his/her activities.[7] To establish a basic understanding of the

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7   For detailed information about the contextual as well as methodical aspects of the project, please consult the study report as well as the related documentation (EDELMANN, WANNACK & SCHNEIDER, 2018a, 2018b).

context, it is important to know the following: Kindergarten in Switzerland is subject to state control. The responsible authorities of each canton define the starting age, which is generally set at four years. Kindergarten is considered to constitute a site of education with specific methods and didactics oriented toward school structures. Teachers working in kindergartens possess the same diplomas as those working at the primary school level. Attendance is free of charge and no day care is provided. Children attend between five and seven half-days per week, usually every morning, as well as one or two afternoons. [17]

To collect material on the basis of which our guiding research questions could be answered, we recorded one morning of teaching, from the arrival of the first child until the discharge of all children, in each of the select classes.[8] In doing so, we used two cameras, a teacher camera and a whole class camera.[9] Both cameras were mounted on tripods and operated by one person each, whereby the teacher camera's tripod was set up on a dolly[10] and could therefore be moved more easily. With the teacher camera, we followed the teacher, and with the class camera, we recorded either the entire class or followed smaller groups of children to other rooms or outdoors in a complimentary manner (EDELMANN et al., 2018b). The teacher camera was used to simultaneously record the sound of a wireless microphone with which the teachers were equipped; an additional directional microphone was fixed on top of the class camera (l.c.). This set-up allowed us to document the teachers' actions completely, and particularly to record their statements in high quality. The created recordings made it possible to find answers to the previously identified research questions focusing on the teachers. At the same time, we used the second camera to capture additional aspects of the context. These recordings constitute relevant supplements in view of the planned further analyses. In addition to the recording, the person who operated the class camera documented the key events in writing, such as the start of an episode of circle time. In total, we generated some 77.5 hours of video material with the shortest recording covering 3:34 hours of class teaching time, the longest 4:02 hours (l.c.). [18]

3.2 Data processing and analyzing

We based our analytic approach on the method of educational videography, as described by DINKELAKER and HERRLE (2009), particularly their segmentation analysis. The aim of this procedure was to generate "an overview of how interactions are developing by rendering visible partitions of the entire process" (p.54). This approach allowed us to find answers to our first two research

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8   Due to scarce resources, it was not possible to visit all kindergartens before recording to obtain specific on-site information. We conducted extensive preparatory phone calls with each teacher, which served to clarify their questions, as well as our own. Furthermore, the teachers provided their rough lesson plan for the day of the recording.

9   The specific equipment we used included SONY handycams (HDR-CX625), which we equipped with 64GB memory cards and large batteries. If we were able to connect the camera to a power outlet for some 30 minutes during the recording, it was possible to film an entire morning without any interruption.

10 Dolly denotes any camera platform, such as a wheeled cart, which is used to create smoother horizontal camera movements.

questions, focusing on the structures of an entire morning, as well as the methods used in the classes investigated. We used the following software for our data processing[11]: If a recording was interrupted during the morning, for example, because a teacher had to go to the toilet, we first put together all recordings of one camera with Final Cut Pro[12]. Afterward, we synchronized the two records from the same class: We cut both files so that one point in time in one video corresponds to exactly the same moment in the other. We kept the initial audio tracks for all video files. Afterward, we imported all files into Transana. This software contains features permitting simultaneous play of several videos, while their individual audio tracks can be included or suppressed based on need (see the rectangle in the upper right corner of Figure 1). Furthermore, it offers the option to create several transcripts for one video file (the lower left corner of Figure 1 displays one transcript). One can, for example, create a transcript for verbal statements, another for gestures, and another for the movements of the observed teacher; it is also possible to create one individual transcript for all persons present in a recording. Another advantageous feature of the software is that several people can work simultaneously on the same project (further remarks about Transana can be found in WOODS & DEMPSTER, 2011).
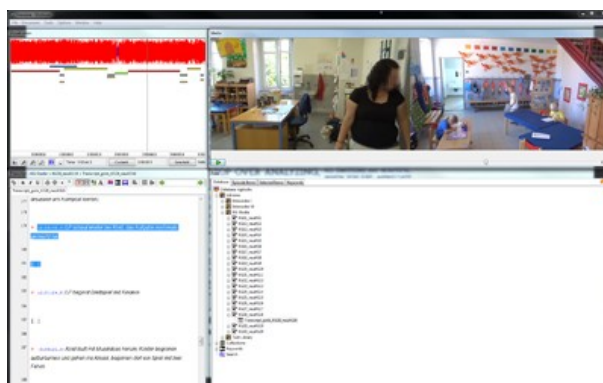

Figure 1: Screenshot of Transana. Please click on the icon for an enlarged image. [19]

Due to the focus on the teacher's actions entailed in the first two questions, we then continued to work mainly with the records of the teacher camera. On one hand, we used a media player (VLC[13] and/or the Windows Media Player[14]) to watch these videos at increased speed. We used this possibility to identify fundamental differences in the teacher's behavior in an effort to identify different phases of teaching. As such, the teachers' movements were of particular interest,

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11 Most of the video data processing and analysis was carried out by three people, all of whom were also involved in the recording. Overall, seven people helped to make all recordings: two scientific collaborators, who were responsible for operating the teacher cameras; and five assistants, who operated the whole class cameras and took notes of what was happening. Data processing and analysis was carried out mainly by the two scientific collaborators and one assistant.

12 Final Cut Pro is a commercial software for video editing. It runs exclusively on Mac operating systems.

13 VLC is a free and open-source multimedia player, which runs on a variety of operating systems and can reply numerous types of media files.

14 The Windows Media Player is also a multimedia player that is an integral part of the Windows operating system and is equally used to play a broad variety of audio and video files.

as they either roamed the entire classroom speaking to individual children or small groups of children or they remained stationary (frequently during circle time) and interacted with the entire class. On the other hand, we used Transana to focus on those moments in the recordings during which significant changes happened in the teaching. We identified these with the help of the aforementioned written records. We created one transcript per class containing the teacher's statements, the children's activities, and the activities of other people present during these moments of transition. All three co-workers involved in this process not only worked in the same office, but sometimes also simultaneously on the same material. This provided the basis for some intense and continuous informal exchange. At least one of the three was involved in the respective recording and could therefore answer questions about specific aspects that appeared unclear when merely watching the video (see KNOBLAUCH & SCHNETTLER, 2012, p.352, who stressed the importance of "ethnographers" in this context). During these informal exchanges, we realized how our impressions of the material differed, depending on whether we watched the (frequently sped up) recordings from only one camera or simultaneously viewed the recordings from both cameras. We therefore started to more systematically, using Transana to view the recordings from both cameras simultaneously, particularly when working on the third and fourth research questions (specific arrangements for playing and learning, as well as forms of individualization). In doing so, we experienced different insightful moments, which were induced by precisely this multi-perspectivity gleaned from two cameras and enabled by the specificities of Transana. The insights we gained were not always equally relevant to answering our primarily descriptive questions, but in our opinion, they point to an idle potential that recordings from several cameras possess during data processing and analysis. We sought to systematically explore this potential for the ongoing secondary analysis. In the following chapters, we present three exemplary insightful situations, which were created by a systematic integration of the recordings from two cameras. These insights are framed by our overarching research questions, which focus on the teacher and are of descriptive character, and present themselves differently in other contexts. [20]

3.2.1 Example 1

One important argument in favor of using a second camera is the capacity to document the context in which the recordings are made as completely as possible. The situation, as it is presented in Figure 2, is an example of how a parallel viewing of both cameras' recordings helped to document the context, as well as the teacher's actions in a more complete manner than would have been the case when using just one camera. With the second camera more of what was happening in a specific location was captured, namely within the circle of chairs used mainly for circle time. In other words, it is possible to watch the same events from two different perspectives—an option that we call a *triangulative* consultation, meaning a consultation of the second image in view of triangulation. Although it was possible to follow what was happening by watching only the teacher camera's records (presented in the left half of Figure 2), so that there

was no reason to consult the class camera, certain aspects were brought to the fore more clearly when watching both recordings simultaneously.

Figure 2: Dancing during circle time [21]

The scene that is presented in Figure 2 took place during a sequence of circle time when the entire class was sitting in their circle of chairs. Together, the children and the teacher were singing a few songs, after which the teacher asked five girls—one after the other—to find themselves a boy for a dance. Once these five pairs of children were standing in a row within the circle of chairs, the teacher noted that space was becoming tight and moved the pairs further apart, thereby pushing the pair located closest to the camera out of the circle. This spatial shift is much more obvious in the class camera's images (right half of Figure 2) than in those of the teacher camera, which creates the impression that the pair of children was placed directly next to the boy sitting on the edge of the circle and thereby still constituting a part of the circle. This detail bears no direct relevance on answering our research questions focused on the lesson's sequencing or structure. However, it may point us to further, potentially interesting, themes for secondary analysis. The meaning we assign to this detail and how we deal with it depends on the respective research question. On one hand, it may be directly relevant for a specific analysis; for example, if in the context of a quantitative approach, the focus is on the exclusive use of specific spaces, such as the circle of chairs for certain activities. On the other hand, it may influence the complete subsequent analysis if we attribute a specific meaning to this moment. The multi-perspectivity enabled by simultaneously watching the recordings of both cameras therefore contributes either to a deepened understanding of the registered situation influencing the perception and evaluation of a select moment, or it influences the interpretation of the following recording. The precise meaning attributed to it, however, depends on the chosen method that was judged to be adequate to generate new knowledge and therefore selected for the process of finding answers to a previously formulated question. [22]

3.2.2 Example 2

The second example is taken from a kindergarten in which two separate rooms and the connecting hallway, where also the wardrobe is located, are used for classes. The pictures in Figure 3 are taken from a phase, during which the children spread out across all three rooms and used them for their free play. The left half of Figure 3 shows the view recorded with the help of the teacher camera. It followed the teacher, who circulated between the different rooms talking to different children or groups of children—sometimes for a short moment, sometimes for a bit longer. At the same time, the class camera was used to record the activities of some children, who were outside of the teacher's circle of control, thereby complementing the teacher camera, as laid down in our camera guidelines. The right half of Figure 3 shows three children engaged in school role-play in the hallway. It matches the view the teacher had at this moment, as she passed by the door and threw a glance into the hallway (hence the teacher's turned head in the left picture of Figure 3).
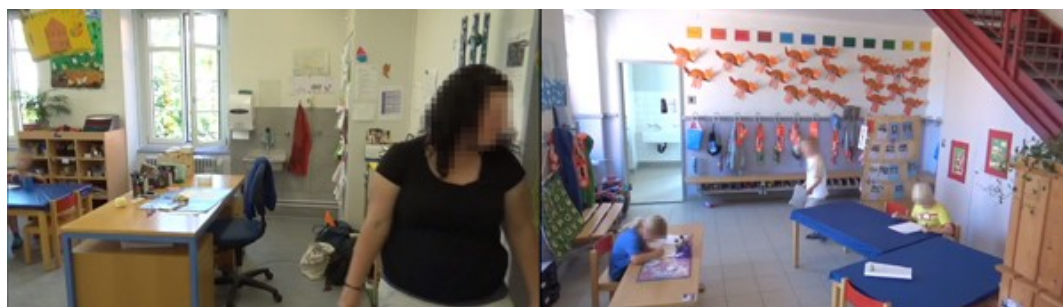

Figure 3: Teacher circulating in the classrooms during free play time [23]

At this moment, the person operating the second camera recorded almost exactly what the teacher saw at that point in time. As such, these records provide contextual information from her perspective, thereby enabling a reconstruction of the selectivity immanent in this situation. This perspective is particularly helpful when interpreting the teacher's actions. For us, it confirmed the first impression we developed when watching the accelerated videos from the teacher camera, namely that there are two different patterns that teachers follow when attending to the children's free play: 1. some teachers circulate throughout the entire kindergarten and focus on having an overview, correspondingly throwing repeated glances at the different areas of their classroom(s); and 2. some teachers remain in one place for a longer time and focus their attention on one child or a small group of children (EDELMANN et al., 2018a). Contrary to the first situation, in which the recordings of the second camera showed the same situation from a different perspective, this example displays two parallel situations, which are presented in two separate spaces but drawn together through the person of the teacher. We therefore argue that the insight gained is different: The records from the second camera allow for the pursuit of what the teacher deemed as relevant. They help to understand her actions—a key concern of interpretative approaches employed in video analysis (TUMA et al., 2013). For us, this served to confirm an assumption that we drew on the basis of the teacher

camera, which was that the teacher threw glances at individual students or groups of children and did not react if she saw no need. [24]

3.2.3 Example 3

Contrary to the insights identified in the first two examples, which were based on rather short observations, our last example is based on a longer viewing (almost 20 minutes) of both cameras. Furthermore, we relied heavily on the two related audio tracks. The recording, from which Figure 4 is drawn, was made at the beginning of the class during the so-called arrival time. This time slot allows children to arrive individually at kindergarten[15]. Many teachers, including the one presented in this example, use this phase in the morning to offer the children an individually tailored play and learning activity. As can be seen in the left half of Figure 4, the teacher guided one child in cutting out a spiral from a sheet of paper, while others seated at the same table work on different jigsaw puzzles. Another group of children was sitting in the circle of chairs, with the teacher assistant working on a creative task (shown in the background or on the edge of the two pictures in Figure 4). The teacher presented in this example displayed a way of attending to the children's playing and learning activities that was similar to the one in the previous example: She circulated throughout the entire kindergarten and stopped at different instances, for example, when children explicitly asked her to do so or if she saw a need. While doing so, she repeatedly stopped by the boy who can be seen at the very left edge of Figure 4. His task was to construct different figures presented on cards using various cubes. However, he could not tackle the task and based on the teacher camera's recordings, the impression arises that the teacher noticed his difficulties, supported him accordingly, and that he was therefore able to move on. The class camera was used to record the entire sequence from a different, stable angle, in which the boy was in the center (right half of Figure 4). From this perspective, it becomes clear that the boy continued to struggle despite the teacher's interventions, and he spent the best part of the time sitting idly at the table. Almost immediately after the short interactions with the teacher, he turned away from the task at hand and started to either fidget in his chair, twist and turn some cubes in his fingers, or watch his neighbor at the table or the children in the circle. He occasionally notified the teacher of his need for support by raising his hand— a gesture that was not caught on the teacher's camera due to the lack of a simultaneous verbal utterance, as well as the presence of another child between the boy and the camera in the decisive moment. Further interaction was demanded by the boy, by hand signals, as well as the teacher, following up. Repeatedly, she asked questions in passing, such as "Did you manage?" or "Is it correct now?" So, whereas the teacher camera's records left us with the impression that the teacher was the one identifying the boy's needs, due to her observations, and that she was reacting supportively, the complimentary perspective of the class camera constitutes the basis for other insights: The boy registered his needs and the teacher's inputs did not lead to a successful

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15 The duration of arrival time was determined by the respective schools—usually, it lasted between 15 and 30 minutes. However, many teachers extended the activities initiated during this period beyond that time span.

execution of the task. The twofold camera work, therefore, allows us to follow different event strands, as well as to link them. According to DINKELAKER (2010), this *simultane Sequentialität* [simultaneous sequentiality], the interlacing of two parallel stands of activities, constitutes one of the key achievements of video-based classroom research. It sheds new light on the teacher's behavior in its entirety. On the basis of this finding—namely an essentially different evaluation of a teacher's behavior on the basis of a second camera—we identified some fundamental questions, particularly for quantitative research, where coding and rating approaches are widely used.[16]

Figure 4: Teacher attends to children and their individual activities at the beginning of the morning [25]

The three examples all point to the potential that multi-perspectivity possesses to enable insights, particularly during the process of data procession. In this sense, they confirm DINKELAKER's (2014) diagnosis, which we quoted at the beginning of this article, namely that analysis commences at the moment of data processing. So, in view of our experience, the question arises of how to deal with recordings from several cameras and the thereby created multi-perspectivity during data processing and analysis. In either case, the insights have consequences for the subsequent research process, even though their specificity depends on the chosen analytic approach. That is why, at this moment, we wish to briefly return to the basic differentiation of qualitative and quantitative approaches: The latter focus on using coding or rating schemes, with the aim of creating numerical data, on the basis of which it is possible to make statements about correlations between specific criteria. Example 3 has shown that, due to integrating the perspectives of two cameras, the teacher's behavior had to be reassessed. That raises two questions for quantitatively oriented approaches: At which moment in the cyclical process of category development (JACOBS et al., 1999) does it make sense to refer to the recordings of both cameras? Does their integration depend on the type of coding (high-inference vs. low-inference rating, see CLAUSEN et al., 2003, or HUGENER, RAKOCZY et al., 2006)? If both perspectives are used when developing the analytic scheme, they must also be available when carrying out the actual coding, which in these projects is

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16 Quantitative video studies focus on correlational hypotheses that are formulated on the basis of theoretical assumptions or after watching the recorded videos. They use video records to assess frequencies and/or scales. This process is called coding or rating and particularly in the context of large projects, such as TIMSS, people are trained specifically to carry out this task only (see HUGENER, PAULI et al., 2006 for a differentiation of coding and rating processes). In this context, reliability is an important criterion for assessing the quality of the analysis (HUGENER, RAKOCZY, PAULI & REUSSER, 2006).

frequently undertaken by people specifically trained for the task. Interpretative approaches have repeatedly raised the question of how the (often very short) segments, which are analyzed in depth, are chosen (KNOBLAUCH & SCHNETTLER, 2012). With the help of Example 1, we have shown how the additional perspective can highlight the teacher's actions, thereby pointing to a potential analytical focus. If, as is the case for videography, the aim is to understand what motivates action (TUMA et al., 2013), viewing this scene may trigger researchers to focus on similar situations. This may, for example, result in further recording situations that seek to penetrate the spatial limitation of the circle of chairs. Researchers, therefore, can use the process of *relationing*, by which we mean relating recordings from multiple cameras to each other, to present their selections of segments more transparently and comprehensively in a context of interpretative approaches. In addition to this specific function, namely rendering one element of the recordings as meaningful (DINKELAKER, 2016), the recordings from the second camera can also be used to document specific aspects of the ethnographic fieldwork. TUMA et al. (2013) stressed the relevance of ethnographically acquired knowledge, particularly for the analytic phase (see also KNOBLAUCH & SCHNETTLER, 2012). Hence, the question arises as to the extent to which video recordings from a second camera are useful during data sessions to make certain information available to everybody. [26]

All three examples show that, putting two camera perspectives in relation to each other potentially impacts the research work subsequently undertaken. Whereas the previously briefly described insights, based on the integration of the second camera, happened rather accidentally, they become more relevant to our secondary analysis. The recordings from one camera sufficed to answer our questions that focused mainly on the teacher. More generally, from the point of view of research practice, the question arises as to how data processing and analysis, in the context of specific methodical approaches leading to multi-perspective recordings, must be arranged. We assume that researchers implementing a more deliberate, and thereby focused, approach when working with multi-perspective recordings, can create insights to an increasing degree. Although they lay the foundations for doing so when recording with two or more cameras, this potential is hardly realized in the further research process. [27]

4. Discussion and Outlook

In the previous chapter, we have shown, that a deliberate use of the recordings of two cameras during data processing can have two possible effects: a deeper understanding of the general research context or a different assessment of a specific situation. Moreover, even though the related insights are frequently mentioned as arguments for specific recording set-ups, we have the impression of a lack of correspondingly consistent implementation during data processing and analysis. As we have previously shown, relevant publications hardly contain extensive descriptions in this respect. Although there are detailed guidelines for different types of transcripts (DINKELAKER, 2014; HEATH et al., 2010), similar information as to how to proceed when working with several cameras during processing and analysis is missing. Were, as a first step, all recordings viewed

individually? Was the work divided up among a number of collaborators who systematically worked with one part of the recordings? Was the first step to watch all recordings in parallel? Even if such and other questions can only be answered meaningfully in view of particular research questions and specific methods, they must be asked and their answers documented. As we have shown above, a multi-perspective viewing can influence one's understanding of the recordings and thereby the work done subsequently. We presume that one reason that such information is frequently missing is that technological changes in particular, happen rapidly, making it difficult to stay abreast of all changes (not least of all in-depth knowledge of the possibilities and limitations of currently available software). There is a tendency to adopt or continue what has been done before. Meager resources, frequently a reality in a research context, are one of the reasons that arguments that once led to using two cameras in a classroom, to buying specific equipment or software, are being taken up again and, at best, updated. Sometimes fundamental technological developments, however, offer new possibilities for research that remain unexploited because researchers tend to continue relying on tried and tested approaches. [28]

In the context of our research project, we also stuck to what has worked previously and we took over the two-camera strategy, with its justification for capturing a situation as completely as possible. However, conditions specific to our project made the challenges created by multi-perspectivity, particularly during data processing, much more visible than in many other projects. These conditions include the spatial and the didactical arrangements of teaching in kindergarten, as well as the project's relatively open questions and our plan to use the material for secondary analysis. Contrary to classrooms at other school levels, teaching and learning in kindergarten only rarely happens in one square room that can be captured more or less completely with two cameras. One kindergarten, for example, was housed in a former family home, which led to numerous rooms being used during free play and children accordingly being active on three different floors. Due to the open questions, the camera guidelines were drawn up in a relatively general manner. This left a lot of freedom for the person operating the camera, particularly the whole class camera, to react spontaneously when recording. Not least of all, that the videos are also going to be used for secondary analysis and publications other than the project report, probably led collaborators to follow their interests also when recording. Our impression is that the specificity of kindergarten, as well as the openness of the research questions, were the main reasons for very heterogeneous recordings, the characteristics of which made the question of selection much more prominent during data processing than is presumably the case in other projects. [29]

It remains to be seen whether our experience and the related reflections are equally relevant in other contexts. We see our article as a contribution to the ongoing methodical discussions of specific, methodologically reflected approaches, as for example KNOBLAUCH and SCHNETTLER (2012) have done by firmly grounding their practice in ethnography. For us, the specific work undertaken during data processing and analysis, with recordings from two cameras, remains in the foreground. This must always be put to the test in

relation to particular research questions, as well as the respectively chosen research design. The overarching issue, which we think deserves more attention, should be formulated along the following lines: How can multi-perspectivity be integrated more systematically during data processing to realize insights for which the foundations were laid with recordings from several cameras? What is required is, on one hand, an awareness of the possibilities in order to employ the respective technology in a targeted manner. That includes, for example, knowledge about software that can be used to play two (or more) videos with their individual audio tracks at the same time. On the other hand, it seems essential to plan the integration of multiple cameras in a deliberate manner throughout the research process and is not only undertaken if, for example, recordings from one camera are considered to be deficient, because statements cannot be understood, or someone steps in and conceals something. Researchers who are prompted by such instances of insecurity to consult the recordings of the second camera are therefore differently motivated than a systematic viewing of the second camera is. The latter can, for example, be motivated by the perspective of simultaneous sequentiality. From the point of view of research practice, the following issues deserve careful deliberation:

- Identifying helpful practices when working with recordings from multiple cameras during data processing and analysis in the context of specific methodical approaches: In line with the insights we sketched, the following questions stand at center: Which phenomena become significant only because of the simultaneous viewing of two recordings? How does one's perception of the documented interactions change, depending on whether the recordings from two cameras are viewed sequentially or simultaneously?

- Transparency related to documenting the criteria for selection: How can decisions related to the selection and generation of data from two cameras, as well as the connected insights, be presented in a comprehensible manner? Whereas there have been repeated demands for the documentation of decisions regarding selection (among others: HERRLE & BREITENBACH, 2016), the lack of accompanying information does not point to a consequently consistent implementation thereof. We suppose, however, that particularly researchers implementing a qualitative analysis, which is predominantly based on records from one camera (even when two cameras were used for the recording), arrive at insights that are unlike those derived from an analysis that systematically integrates both recordings of the same situation.

- An informed usage of the available technology: It is indispensable to acquire current technological knowledge in one form or another. Although this was done in the context of several projects (e.g., LOTZ et al., 2013 hired a sound engineer to record and process the material who also had the task of cutting one audio track from three different ones), such engagements are usually limited to the phase of recording. However, specific technological knowledge is required throughout the entire research process. This is a particular challenge for smaller projects. In this context, the question arises as to the most efficient and effective manner for the exchange and development of specific experience. [30]

Beyond implicating research practice, working with multi-perspective videos accentuates more fundamental questions that have been addressed repeatedly, also within *FQS*:

- Interactions between specific technologies and the research process (EVERS, 2011; KONOPÁSEK, 2008): Working with videos depends on the use of varied hardware and software—a number of analytic tools were developed in the context of video-based research projects (e.g., CLARKE, 2006; KNOLL & STIGLER, 1999). Technological developments are closely connected with methodical and theoretical changes (CLARKE, MITCHELL & BOWMAN, 2009; MARKLE et al., 2011). Videos help to capture aspects that cannot be caught with other methods. The consequences of the work with videos on classroom research, as well as on other fields, remain to be seen.

- The status of secondary analyses in qualitative research (CORTI, WITZEL & BISHOP, 2005; MEDJEDOVIĆ, 2014): Various authors have stressed that, because of their characteristics, videos are particularly suitable for different approaches and secondary analysis (JANÍK et al., 2009; REUSSER & PAULI, 2003). If, however, we consider that video records are the result of selection decisions, which have been taken at specific moments of the research process in view of equally specific questions, the question arises as to how this is dealt with in the subsequent phases. On the one hand, videos offer an opportunity for the documentation of the recording context (ANDERSSON & SØRVIK, 2013), one of the areas of discussion. On the other hand, it is a matter of debate as whether experience and insights from other qualitative secondary analyses (particularly interviews) can be transferred to work with videos. [31]

To this end, we hope that this article contributes to deepening the ongoing methodical discussions about video-based research practice. [32]

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