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Title: **Video analysis in Design-Based Research – Findings of a project on self-organised learning at a vocational school**

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Abstract

The use of video analysis in Design-Based Research (DBR) seems to be promising, because the quality of video data matches the reality of educational fields. Educational fields are multidimensional and complex. And more than other types of data, video may capture, for example, the simultaneity of verbal and non-verbal interactions. This seems to be valuable in the quest for new insights and better designs of educational interventions. However, to date there has been limited use of video data in researching their design. This paper aims at reflecting how the benefits of video-based analysis may be utilised in DBR. Experiences with the collection and analysis of video data in a project to design self-organised learning (SOL) at a vocational school in Germany will be used as a case study to illustrate the type of findings that may feed into the DBR process. In this case, the project school had already introduced a sophisticated SOL model but was experiencing various implementation difficulties. Resolving issues like this requires insights into how exactly a concept is realised and what happens in the field. Therefore, video data on classroom interactions was gathered and sub-sequently analysed using the documentary method. This led to the reconstruction of two different types of orientation that were guiding the students when they dealt with their self-organised learning environment. In a subversive orientation, students playfully infiltrate the formal learning space with peer activities. In a confirming orientation, students stick to both, the (informal) rules of the (formal) learning arrangement and of the peer environment, thus expressing

respect for the boundary between these two worlds. These findings have been used to redesign the SOL intervention.

Keywords Video analysis
Design-Based Research (DBR)
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Documentary analysis
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Video analysis in Design-Based Research – Findings of a project on self-organised learning at a vocational school

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1.0 Introduction

As Design-Based Research (DBR) in educational fields relies on an understanding of how interventions work on the ground in order to improve design and to contribute to theory development, it includes the collection and analysis of empirical data. To date, most DBR projects have relied on data sources such as protocols on interventions and meetings, on work results produced while testing pilots, on observation sheets, transcripts of interviews with teachers and learners, and on questionnaire-based responses of participants. Video, however, has rarely been used as a source of data, even when design researchers are interested in doing so (e. g. Brahm, 2017, 9). This is in spite of the potential benefits of video analysis, which are rooted in the multimodal nature of video data that allows for a study of interactions that are happening simultaneously. This transcends the capacity of other forms of data collection. Yet, the sheer volume of data that is generated by recording videos poses one of the problems that must be dealt with, when creating insight from a video analysis.

In this context, the aim of this paper is to present the documentary method as a feasible way of generating insights from video data. The collection and analysis of video data is illustrated using as an example a DBR-project at a vocational school in Germany. The school had introduced a sophisticated model of self-organised learning (SOL) and yet was experiencing several implementation issues. The reflection on video analysis in this case study includes a discussion of the limitations and possibilities for the exploitation of video-based insights in the DBR process. This paper shall therefore be guided by the following research question: how can insights gained through the collection and analysis of video data be exploited to enhance designs and develop theory in DBR?

2.0 Video analysis in educational fields

During the past decade, the use of video data has become popular in general educational research (e. g. de Freitas, 2016) and can also be applied in DBR (Borko et al., 2008;

Koschmann et al., 2009). The potential of analysing video data for educational research is rooted in the multimodal nature of videos, as they combine the modes of simultaneity and sequentiality, mirroring a quality they share with social reality itself. Simultaneity refers to the potential of video to capture various forms of interaction at the same time, such as verbal and non-verbal acts, postures, gestures, facial expressions, modulation of the voice, and use of objects (cf. Reichertz, 2005; Goodman, 2007). Sequentiality refers to video data and its capacity to record multi-level communication over time, including sounds from visible sources and from sources offstage (outside the camera section), as well as context conditions (Dinkelaker & Herrle, 2009, 41ff.). With the introduction of easy-to-use cameras, video data becomes more available. However, in educational fields, ethical concerns during the stage of data collection need to be respected, since protecting the rights of recorded research participants, including issues of confidentiality and ownership, is critical (e. g. Schuck & Kearney, 2006). Once the difficulties of data collection have been overcome, video data must be analysed. In terms of features such as complexity and volume of data, videos are very different from other sources such as text-based protocols or self-reported information acquired by questionnaires. This is to say, what makes videos rich and meaningful, is also what makes them difficult to analyse, because one has to deal with large amounts of data (cf. Erikson, 2006; de Freitas, 2016). Qualitative-reconstructive analysis may be one of the ways to overcome these difficulties. To put this in context, alternative approaches to working with video data in educational research are introduced in the following subsection.

2.1 Forms of video analysis in educational research

Video data can be used in many ways. For educational research, Dinkelaker & Herrle (2009, 11) distinguish three forms of analysis, partly based on different types of video data:

1. *Film analysis*: If the film itself is made the main subject of exploration, the approach is called film analysis. This is relevant for media-related research, in which a film is seen as a cultural manifestation. That may also be applied to educational films. Furthermore, this type of analysis is also used in field research, for example in the form of 'photovoice', a method by which participants are asked to photograph or videotape their life-world in a way that expresses their points of view in relation to a specific research focus. An advantage of this approach is

that those under research may not only be in front of the camera, but also behind the camera, deciding how the photo or video is produced by themselves (for the use of student-recorded selfies in a DBR project, see Schwabl, 2017).

2. *Video-based teaching quality research*: This approach is based on the collection of large numbers of videos of school lessons. The video data is categorised by pre-defined categories in order to evaluate the correlation between categories of the recorded instructions and the learning processes. This approach was used as a support measure for studies such as TIMMS (e. g. Prenzel et al., 2001; Pauli & Reusser, 2006). It has also been applied for researching vocational schools (see e. g. Siemon, Scholkmann & Paulsen, 2018).

3. *Educational videography*: This form of using video data in educational research uses cameras as instruments in the hands of researchers who collect data about social interactions in a specific field. The video data is qualitatively analysed in order to reconstruct interaction processes in education, without reducing their complexity through coding. This way of handling video data limits the analysis to rather short sequences, and only a thorough check of the material can identify those sequences that should be subject to an indepth analysis. This form of video-based research leads to contextualised knowledge about the structural conditions of the educational field (for examples of studies following this approach see Nolda, 2007; Herrle & Nolda, 2010; Lamprecht, 2015).

In the present study, it is the third form of video-based research that is undertaken. The implications of this for data collection are summarised in the following subsections.

2.2 Video analysis in Design-Based Research

Both qualitative and quantitative methods are being applied in educational research to analyse video data. Studies using quantitative methods often spot the frequency of certain teaching or learning activities. Thus, many different classroom events can be analysed and compared. Qualitative video research usually focuses on only a few situations or cases, creating the opportunity to explore classroom interaction in more detail (cf. de Freitas, 2016, 555). Since we were interested in an indepth analysis of critical incidents in the implementation of SOL, we decided to use a qualitative approach.

In adopting a qualitative approach, the documentary method (Bohnsack, 2013) was used. In this method, Mannheim's differentiation of two types of knowledge is fundamental. On the one hand, there is communicative knowledge, in the explicit, literal, and immanent meaning of the word. It is the knowledge that students and teachers have about the SOL design, or in other words, common-sense observations. Conjunctive knowledge, on the other hand, is implicit and documented in the actions of people sharing a 'conjunctive space of experience', such as similar biographies, or attachment to certain milieu settings. This knowledge is usually prereflexive and results from experiences within a social world. It is also what enables humans to act as part of a community (Bohnsack 2013, 220, 225). Based on these categorical distinctions, common sense observations will be distinguished from what are observations of (everyday) observations. For this, Niclas Luhmann introduced the term 'observations of the second order'.

In research practice, the difference between those two types of knowledge is dealt with by using two separate steps of analysis: first, the formulating interpretation serves to identify what was 'literally' said and to create a topical structure ('what was said?'). Second, the reflecting interpretation moves beyond the 'what' by analysing in which framework a topic is dealt with. In this way, the framework of orientation (or habitus) is reconstructed, and this is the central category of analysis within the documentary method (Bohnsack 2013, 225ff.). To keep the reflecting interpretation methodologically controlled, 'functionally equivalent reactions' are identified using horizons of comparison that are grounded in empirical cases of comparison (Bohnsack 2013, 224). The purpose of this is to make the reflective interpretation independent of standpoint bonds (or biases) of researchers doing the interpretation. This requires an analytical attitude, by which the researchers 'put in brackets' (Bohnsack 2013, 218) the matter of the normative rightness and the validity of expressions and behaviour.

Frameworks of orientation can also be identified by analysing images and videos instead of (interview) texts. Just like Karl Mannheim shifted from the interpretation of explicit knowledge to tacit knowledge, according to Erwin Panofsky, the analysis of (moving) pictures can switch from an iconographical interpretation (What can be seen in an image?) to iconological interpretation (How is the image created?). Following the work of Max Imdahl, accessing the internal (iconic) logic of pictures is possible when treating

them as self-referential systems. Thereto an interpretation of its formal structure, including planimetry, perspectivic projection and scenic choreography is conducted, bracketing – in a methodical way – language-bound and textual pre-knowledge. An important peculiarity of this self-referentiality of pictures (the iconic meaning) is its complex 'transcontrariness'" (in German: 'eine Sinnkomplexität des Übergegensätzlichen', Imdahl, 1996, 107). In other words, there is a complexity of meaning in pictures which can hardly be expressed in words. It is, for example, quite common in pictures, and thereby in social reality based on and produced by images, that a thing appears in two different ways at the same time, thus transcending simple iconography.

Since the reflective interpretation of video passages is a time-consuming, indepth analysis that cannot be applied to the whole body of data, it is necessary to select some video sequences. In particular, all sequences with a high level of 'performative density' (Wagner-Willi, 2004, 64) are suitable for this, because such expressed behaviour may be a tipping point to reconstruct frameworks of orientation. However, performative density is a criterion that can only be identified after a general review of the material, a review that takes place during formulating interpretation and early stages of reflective interpretation (Wagner-Willi 2007, 144). Where the reflective interpretation is confirmed by fruitful results, the reflection is continued. This will be illustrated by the case study in the following section.

3.0 Case study: Using video data at a vocational school implementing self-organised learning

The video-based study presented in this paper refers to a pilot project on implementing self-organised learning at a vocational school in Germany. The teachers at this school developed their own specific model of self-organised learning, targeting a group of students with problematic prior experiences in the school system. According to their model, self-organised learning is not just another method in the context of conventional teaching, but a holistic approach to improve schooling. However, implementing this new learning system was not straightforward, and the teachers were dissatisfied with progress. At this point the Design-based researchers were invited to join the ongoing work on the SOL model. It was agreed to incorporate a video-based analysis in order to understand better how the current model was working, what the actual classroom practices were and how the design could be improved. The context of this case study is explained below.

3.1 The 'transition system' as the school context

The teachers at the pilot school have developed their SOL model for those students who are attending the 'transition system'[1]. In Germany, the transition system aims at preparing for vocational training those young people who did not succeed in finding a training position directly after graduation respectively dropout from compulsory general school (cf. Frehe & Kremer, 2016). Programmes like these accept the challenge of working with previously under-performing students, preparing them for vocational training and through this for future employment. Troubled by the poor results that traditional ex-cathedra teaching created in this context, the teachers at the pilot school started to search for alternative approaches more suitable for realising ambitious goals such as facilitating the personal, social and professional competences necessary for lifelong learning and sustained employment.

[1] The term 'transition system' is the translation of the German word 'Übergangssystem'. It is an umbrella term for numerous school-based programmes that usually last a year.

3.2 3.2 The conceptual framework for self-organised learning

According to the conceptual foundations of self-organised learning, it may have a higher positive impact on the development of social, personal and professional competences than teacher-centred instructions – at least in theory. This conceptual advantage is created by an environment, in which the abilities that shall be facilitated are already put into action during the educational programme. The fundamental paradox here is that skills must be deployed which are not fully developed, yet. This problem is usually overcome by ideas based upon the Vygotskzian (1978) zone of proximal development (ZPD). According to this, effective learning takes place in a 'zone' outside of what a learner is already able to do, but below a level of overload that could lead to panic. In this learning zone, the required actions can be performed with the support ('scaffolding') of a knowledgeable peer or an instructor/teacher (Palincsar & Brown, 1984; Herrenkohl, Palincsar, DeWater, & Kawasaki, 1999). The support is supposed to fade out while the learner's abilities increase. All this requires a sweeping change of roles for both students and teachers. In their new role, teachers should reduce the level of support they offer as students' ability to self-organise their learning increases. This is particularly relevant because further research indicates that in educational practice measures of support tend to be minimized before learners have developed sufficient ability to organise their own learning (e. g. Kirschner, Sweller & Clark 2006). This has a negative impact on the overall effectiveness of interventions designed to facilitate self-organised learning by means of e. g. group work,

jigsaw cooperative learning and other typical SOL features (see section 3.3).

Difficulties in handling this learning paradox at classroom level may make SOL less effective than might be expected based on the conceptual premises. This is borne out by at least mixed results in empirical educational research. Thus, self-organised learning, like many other innovative educational interventions that are theoretically promising, tends to fail during practical implementation. While a positive effect on learning processes and outcomes might have been confirmed using empirical evidence in test environments, realising self-organised learning under field conditions seems to remain tricky. Hence, in a study by Barron (2003), it could be shown that students working in collaborative groups may indeed develop problem solving skills beyond their individual prior achievements, even though collaborative groups with low interaction quality tend to be less successful. According to Järvelä & Järvenoja (2011) collaborative group work also enhances self-regulated learning and motivation regulation. Furthermore, it has been suggested that the use of jigsaw cooperative learning positively affects the self-concept and academic achievement of students (Box & Little, 2003; Doymus, 2008). However, these results were not confirmed in further studies. For example, in an examination of students' development of vocational competence and problem-solving abilities Nickolaus et al. (2007) point out that there are no significant differences between self-regulated learning and teacher-centred approaches. Furthermore, meta-analyses revealed that, on average, correlations between self-regulated learning strategies and academic achievement are small (cf. Dent & Koenka, 2016), but their variance is high, indicating that the effect size depends upon contextual factors (Zimmermann, 2000; Ben-Eliyahu & Bernacki, 2015).

Due to such conflicting empirical results on SOL and other learning designs, it has been concluded that it is not the type of intervention that has the greatest impact on the development of competences, but the achieved implementation quality of a particular intervention (cf. Nickolaus, 2010, 57). Therefore, detailed analyses of the interaction quality in classes are needed, particularly in pilot projects (cf. Nickolaus, 2018, 15; Sloane, 2014). This is also the case in the DBR process at the pilot school given as an example in the following subsection.

3.3 Development of the self-organised learning design at the pilot school

When the teachers developed their initial design, they fol-

lowed a specific SOL concept of Herold (cf. Herold & Landherr, 2003). According to this concept, the weekly schedule shall be structured by learning objectives linked to prior knowledge and activated by 'advanced organisers'. The intention is that students work on projects, including phases of individual and group work ('sandwich principle'). Cooperative learning is facilitated by 'group jigsaws', where expert groups work on specific topics, which are then further elaborated in core groups. Students receive credit points for finished work assignments that are documented in a corresponding credit account and this is used as input for the final grades. Acknowledging that students must get used to this way of learning, at the beginning of a school year teachers follow a more active and instructional role, intending to leave it more and more to the students to take the initiative as time goes by. Based on the assumptions underpinning the concept, by the end of a school year, the amount of instruction by the teachers shall be reduced to a minimum and only given on topics requested by the students.

The teachers used this concept to create a SOL design which is not seen as a marginal change in teaching methods but rather as a comprehensive approach to reorganise schooling within the transition system. To this end, an entire floor of the school building was converted, essentially dissolving the traditional classroom setting in favour of new group-learning rooms and 'corners' in an open space environment. This newly developed learning space serves two to three classes at the same time. In this way, the former classroom teachers can now simultaneously practice team teaching. During lessons, they shall serve as learning mentors.

However, working with this new design, the teachers soon realised that the results fell short of their expectations. Given the conceptual challenges, this might have been met with no surprises. However, at this point the school chose to go into collaboration with a group of Design-based researchers in order to better understand these issues and to elaborate new ways of dealing with this situation.

3.4 Collection and analysis of video data on classroom interactions

At the beginning of this joint project, teachers gave feedback on their experiences with the new SOL design that was based on observations made during the teachers' own lessons. They were asked to name key problems regarding teaching and learning within the new learning environment. All participating teachers agreed on the fact that there had been an increase in the level of classroom disturbance caused by a group of (apparently predominant

male) students after the SOL concept was implemented. Those students were described as using the special features of the open learning space – in particular lack of permanent teacher supervision – to meet with their peers for activities such as wrangling, straying, and playing, blatantly rejecting the learning arrangement. The teachers additionally concluded that those who were seen as rejecting the SOL concept also actively disturbed other students. Considering the limits of classroom observations like this, lessons were videotaped. Several camera perspectives were used to obtain a more comprehensive understanding of classroom interactions. This was intended to be used as input for a problem analysis and subsequent improvement of the SOL design. By this means, the DBR team tried to avoid premature conclusions and speculation about the design quality and the students' handling of this learning environment. By recording videos, a further data source was added into the DBR process, while still gathering protocols, additional observations, and carrying out surveys and interviews. However, given the aim of this paper, its focus will be on the video data and the empirical findings that emerge from this.

With this starting point and based on the methodological premises outlined in section 2, the following research question will guide the video analysis in the case study: how do students deal with self-organised learning? This question can be split into the following sub-questions:

- Which multi-modal utterances feature the videotaped students' interactions with one another and with their teachers?
- Which iconological meaning is documented in the videotaped interactions?
- Which collective frameworks of orientation guide the students' classroom interactions?

The videos analysed for this study (section 4) were recorded by Design-based researchers during one of the groupwork days at the pilot school towards the end of the first school term in 2014. They used multiple cameras at the same time. Three different teachers were present and the majority of students of two classes, with only a few of them taking the opportunity to opt out of the video research. While the use of recording technology may have some impact, on the educational setting, the assumption is that participants will soon forget about the presence of the camera once it has been introduced and they will then continue with their regular behaviour. However, some studies indicate that in educational research, learners remain awa-

re that they are being recorded (e. g. Vossoughi & Escudé, 2016, 43). This could be confirmed during the collection process. According to feedback from the teachers, the students demonstrated 'common behaviour', but nevertheless, the video tapes also reveal that students occasionally include the camera in their interactions. This may serve as a marker for the students' awareness of them being recorded.

The collection of video data allows for a reconstruction of collective frameworks including both the non-verbal and verbal dimension of interactions. Hence, the formulating interpretation of video sequences aims at an interpretative (in German: "sinnverstehend") account of first, the non-verbal (iconic) dimension of interactions including body movements, and, second, the discourses (texts) amongst the people recorded. The iconic interpretation is primarily done by analysing the formal composition of recorded images. In a separate analysis, the discourse organisation of interactions is transcribed as a sequence. Italics are used to distinguish the formulating interpretation of the scenes (section 4). However, the formulating interpretation also includes scenic descriptions of the setting on the iconographic level, created by using textual and narrative prior knowledge. This makes it easier to phrase, read and understand the formulating interpretation, but carries a higher risk that the normative premises of the school setting are taken for granted. These should be put into 'brackets', as Bohnsack suggests. The problem in doing a 'pure' pre-iconographic description (that is, excluding in-order-to-motives) of videotaped scenes is that there is no well-established and easy-to-read form of language to put what is seen into words. To prevent confusion, in what follows underlining is used to separate the pre-iconographic descriptions from the iconographic interpretation (cf. Lamprecht, 2015, 102). In the reflective interpretation, the discursive and iconic dimensions are brought together, satisfying the simultaneous structure of social reality. The implicit frame of orientation is first explicated on the basis of single scenes. During the next step, a comparative analysis of these and other scenes is added to identify homologous ways of dealing with different topics, which in turn reveal similar frameworks of orientation.

4.0 Empirical findings: Reconstruction of students' frames of orientation in dealing with the SOL design at the pilot school

The analysis of video data resulted in the reconstruction of a subversive and a confirming framework of orientation that guide the actions of two types of students. The recon-

struction is illustrated using two scenes as examples.

4.1 Scene: Presentation of self on front and back stage (Camera 3, 00.54.29 – 00.58.32)

In a group workspace separated by glass walls and accessible through a door, the students make use of the open space provided for self-organised learning by subversively infiltrating the formal educational requirements. They do not fundamentally challenge the validity of school-based Standard, but they try to utilise the space for independent peer activities in a playful way.

Formulating interpretation

After working on her worksheet, SOFIE[2] packs her items and then walks past LINA and another classmate to the door. Just at this moment, KASIM comes in and positions himself in front of the door which he closes immediately. Looking at him, SOFIE stops. As AKIF, another classmate, is visible from the outside, KASIM steps aside, whereupon he also enters. Immediately, all three begin a verbal negotiation about who plays with whom a rock-paper-scissors game. This negotiation is also carried out using mutual finger pointing to the upper body or arm. SOFIE holds KASIM by his upper arm and emphasises that it is he she wants to play with. Right at the beginning of this negotiation LINA, who is still sitting at the table and watching the three of them, points out that what is happening in the room is being recorded by sound and video. KASIM shouts 'Hi' in the direction of the camera, as the game negotiation continues. After the first round of the game, Mrs. LANGE approaches the room, visible through the glass wall. She pushes against the door with her right arm while KASIM leans against it on the other side, using his arm and upper body weight while moving aside in several quick, small steps. Her glance is directed to the opposite side of the room. Only after she has entered does she turn towards KASIM and reminds him of an 'agreement'. After a five-minute break, he was asked to explain to her the meaning of a non-binding offer in contract law. When Mrs. LANGE invites corrections to his answer, AKIF moves towards the door, attracting Mrs. LANGE's attention. Out of Mrs. LANGE's sight, KASIM looks at SOFIE, holds her by the arm and reminds her of the next round in the game. SOFIE turns from KASIM to her teacher and exclaims: 'Mrs. LANGE, help me!' KASIM loosens his grip and Mrs. LANGE turns to the students at the table, addressing the disorder through the game. Barely out of sight of the teacher, SOFIE, KASIM and AKIF leave the room together and close the door with a bang. Mrs. LANG, chan-

[2] All references to persons or places are anonymized.

ging her expression into a grin, recalls that at some point LINA had pinched ARIAN. LINA rocks back and forth, saying 'if he's cheeky.' After a few seconds of silence, Mrs. LANGE exhales audibly and then starts questioning the two remaining students about the term 'non-binding offer'.[3]

Figure 1: Scene A – picture 1

Figure 2: Scene A – picture 2

Figure 3: Scene A – picture 3

Figure 4: Scene A – picture 4

Figure 5: Scene A – picture 5

[3] If preconceptions about what a certain action means in a social world were not 'bracketed', this paragraph would look very different. One might perhaps describe the scene as Mrs. LANGE's attempt to get students to work who would rather play. Short and easy to understand. However, this type of description would remain trapped in common sense interpretation and speculation about motives. All this would prevent access to the iconic and pre-iconological meaning that is important for the reconstruction of the modus operandi of the stu-dents processing the SOL intervention. Based on the formulating interpretation, that access will be given in the reflective interpretation contained in the paragraph that follows.

[4] With reference to Goffman (1959), it can be said that knowledge about the public nature of social behaviour leads to everyday life consideration of presentation. He deploys the metaphor of theatrical production, distin-guishing between 'front stage' behaviour, which reflects the internalised norms and expectations of the specific social setting, and 'back stage' behaviour, which reflects the absence of formal norms and the adoption of a different set of rules and customs shared with those who are at the back of the stage. The metaphor is used in this paper to distinguish behaviour related to (formal) school expectations ('front stage') and behaviour related to peer culture that happens 'back stage'.

Reflective interpretation

This scene documents how students master the formal rules of the school and act as if they were following them under the supervision of their teachers[4] , while at the same time trying to expand the space for independent peer activities 'at the back of the stage'. A special feature of this social situation is that front and back stage share some similarities. In both instances, students are concerned with the protection of space and self-presentation. Self-interest is defended against other interests. To achieve what is their own interest, the peer culture permits actions such as pushing, holding on to a person, and, perhaps, pinching, none of which are allowed on the 'front stage' of official school rules.

In several cases, students attempt to apply the strategies of peer culture at the front of the stage. However, where students test these strategies, they try to avoid direct

confrontation. When, for example, KAZIM uses his arm and upper body weight as a counter measure to the door as Mrs. LANGE steps in, he retreats with rapid small steps. His behaviour therefore appears ambiguous: showing simultaneously resistance and retreat in dealing with the entrance of his teacher. Along the same lines, Mrs. Lange opens the door against the resistance of KAZIM, whom she does not have in her field of vision, thus making herself 'blind' to a behaiour that is unacceptable on the front stage. In this way she signals that she will not pursue KAZIM's violation of the rules, something that is confirmed later in the sequence. Her behaviour is equally ambiguous: she overcomes the apparent resistance and claims her right to enter. Through her performance, particularly by looking in particular directions, she also leaves the breach of rules uncommented upon. This could be interpreted as implicit approval of KAZIM's behaviour. Similarly, Mrs. Lange, again in a non-verbal way, signals approval of LINA having pinched another peer by smiling in her direction, even though pinching is also a clear breach of school rules. Lina's moving backwards and forwards may be interpreted as a physical expression of an internal vacillation over whether to approve or reject the pinching of a peer on the basis of her own standards.

Subversive ways of extending the space for autonomous behaviour against peers also include strategies that instrumentalise the front stage. LINA uses this strategy when she broaches the issue of KAZIM holding on to her. She presents herself as a victim of peer activity to Mrs. Lange, as this behaviour is acceptable back stage, but not at the front of the stage. Her approach is not objected by KAZIM, and he lets go of her almost immediately. Here, too, Mrs. LANGE does not intervene, instead moving her line of sight towards LINA and her neighbour. This could also be interpreted as abandoning SOFIE and KASIM.

As soon as she averts her gaze from them, Mrs. LANGE opens up a new back stage field behind her back for KAZIM and SOFIE. Immediately, the two students take advantage of that opportunity and leave the room together with ARIK, thus escaping a situation wherein their teacher had tried to restore the intended learning activities, without having to express direct opposition to her. This situation serves as one of many examples where physical presence, in combination with attention paid, has a high impact on the students' actions. The impact declines, however, as soon as physical presence diminishes or, as in this case, the teacher looks away. Even where students clearly prefer peer activities over formal learning or group work, this

behaviour demonstrates how academic requirements are fundamentally accepted and compliance is enacted on the front stage, at least insofar as to camouflage attempts to ex-pand non-permitted peer activities. Consequently, when Mrs. LANGE meets KAZIM again at a different spot in the learning space about 30 minutes later, he gets involved in a follow-up discussion with her about non-binding offers, even beyond the beginning of the official school break (Camera 4, 01.28.03ff.).

Furthermore, the prepared learning material has a strong impact on the behaviour of both teachers and students. The first picture in the scene shows SOFIE taking one of her worksheets and filling something in. In doing so, her posture simultaneously expresses attention to the paper and whatever she is writing; on the other hand, the posture also shows that she raises herself above the sheet by kneeling on the chair, instead of sitting down like her neighbours. The left leg, which cannot be seen in the picture, seems to stand on the ground, giving the impression that she would be able to jump up from her position at any time. Her body posture, therefore, appears ambiguous, manifesting attention and distance at the same time. For this purpose, her back is bent forward. This interpretation of the simultaneity in the picture is supported by an analysis of the sequential nature of the scene: when LINA enters the room, she goes straight to her bag and makes a very focused entry so that the whole process barely takes four seconds. This is time enough to find the right spot for the note, but not enough time to familiarise herself with the material and the context of the note. That leaves the impression that she just records any information, paying the minimum attention needed to the material. Apart from this, her behaviour documents a swift self-separation from the material.

4.2 Scene: Parallelisation and cross-over of activities (Camera 5, 01:23:50 – 01:28:01)

With this camera shot, several social groups are recorded. Each of these groups mainly acts separately and intersects only occasionally, despite their close proximity. The entire sequence lasts about 5 minutes. Except AMINA, all those videotaped remain visible in front of the camera throughout the time.

Formulating interpretation

As the scene consists of multiple groups and their simultaneous activities, the formulating interpretation starts with the reconstruction of the planimetric composition. This

utilises and gives access to the self-referentiality of iconic reality in order to interpret the immanent meaning of a social situation. For this purpose, three high-contrast photograms of the video sequence were selected, each of them taken at a moment in which the density of interactions culminated. The first picture presents four separate groups of two or three members, which can be distinguished from one another by the planimetric structure of rectangles and one triangle. On the left side of the picture, a rectangle and a triangle overlap. This has to do with the plane character of videographed images. In three-dimensional space, both groups are close together, but there is a distance between them that is difficult to see on a 2D image. It can be recognised that the physical closeness of the groups is in contrast to the lack of visual contact between the groups. Visual contact, however, is well aligned within each group: Towards the white board in the first group on the left, to where the girl pokes her finger at the teacher at the group standing in a triangle, towards the laptop screen in the group to the far right, and, though difficult to tell, possibly towards the material being used by the two students sitting at the table. On the iconic level, the single groups are referring to themselves. This is also the case in the second picture, where there have been some changes in the formation of the groups but the boundaries between groups are still clearly recognisable. The third picture captures the moment immediately after a student has lost his balance while arguing with the girl who has moved to the foreground. He falls to the floor along with some material from the table. The changed constellation is clearly recognisable. On the physical level, there is a clear alignment with the way the student stood before the fall. Thus, the separation between the groups dissolves.

Figure 6: Scene B – picture 1

Figure 7: Scene B – picture 2

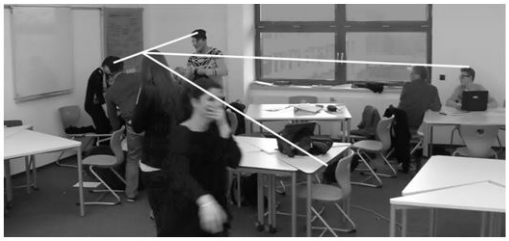

Figure 8: Scene B – picture 3

With the formulating interpretation of the formal structure of the selected photograms, the self-referentiality of the iconic and its simultaneous nature can be used to gain

access to the immanent meaning of the scene. This analysis will be complemented by a sequence analysis of the verbally and non-verbally organised discourses among the videographed persons. Due to the limited scope of the paper, this will be done selectively.

Picture 1 refers to a sequence in which AMINA and SAMI discuss weight gain and wedding preparations. This discussion is carried out on a verbal level but also includes extensive mutual poking and pushing back and forth. Just as AMINA pushes SAMI away, Mr. ROSE appears, looks at both of them, and then approaches SAMI, who in response moves about half a step backward. With Mr. ROSE standing in front of the chair and between the two students, AMI-NA begins to poke her right finger into the upper part of Mr. ROSE's belly, laughing loudly. On the second poke Mr. ROSE moves his abdomen and hips out of the way, but keeps his feet and his head roughly in their original position. He first looks down at AMINA'S finger and then fixes on her eyes. AMINA, who has since withdrawn her hand, then lowers her head and looks at the floor in front of him. Meanwhile, NADINE and ERKAN are carrying on their discussion at the whiteboard on how to use a particular formula, just as they have since the beginning of this sequence.

Picture 2 shows AMINA and SAMI on the extreme left, resuming their discussion of wedding conditions. Their conversation had been stopped for only as long as Mr. ROSE stood directly next to them. In the second section, moving from the left of the picture, NADINE shows individual aspects of different sheets of her material. Afterwards, ERKAN photographs her writ-ing from the whiteboard and explains that he has to look at this at home three times before he is finished. In the picture section on the far right, a conversation is going on that is not audible on the recording.

Picture 3 is a still picture taken immediately after AMINA pushed ERKAN aside during an argument, with the result that he fell down, knocking over the material lying on the table. Following the sound of the crash, AMINA walks quickly out of the way, leaving the spot, while everyone else in the scene looks to where ERKAN had been standing.

Reflective interpretation

The scene is characterised by a parallelisation of individual groups which are close to each other and yet functionally distinct, according to a group-inherent logic. Only a few events (picture 3 is an example) lead to a situation in which the individual groups realign to a shared crossing point.

This finding, based on insight at the level of the reconstruction of the formal image plane, is confirmed by an analysis of the sequences conducted during the stage of reflective interpretation. It reveals that interchanged storylines can be resumed even when there is a shift between group members and a succession of peer activities and school-related activities.

In scene 1, for example, AMINA shows behaviour similar to that of some students in the previous scene: She, too, uses behaviour that originates in peer culture in an interaction with her teacher. In contrast to her interactions with peers, her poking of Mr. ROSE is accompanied by an audible laugh. This can be regarded as an ironic element in her behaviour. By replying to such laughter, Mr. ROSE could acquiesce in the ironic nature of the situation, as other teachers have done in similar videotaped situations. Instead, he moves that part of his body that AMINA is approaching out of the way, while defending his current position with the rest of his body. With this move he expresses, on the one hand, that he wants to avoid being poked, and on the other hand, that he does not want to be denied any space in the classroom. His body movement is in line with his facial expression which does not contain any ambivalent consent to the poking. It therefore appears as aimed at the restoration of school order. AMINA does not oppose this invitation to follow the school rules. However, the alignment with school behaviour is lifted as soon as Mr. ROSE leaves the immediate physical proximity of AMINA and SAMI.

Due to the multimodal nature of the video data, it is safe to say that NADINE and ERKAN are not able to visually perceive the noisy exchange of the trio but can easily hear it. Their behaviour does not respond to the wrangling going on next to them, and they continue their discussion of a formula. NADINE leads this conversation and ERKAN takes on the role of the learner, taking in information and photographing her white board notes. The distance between the two is noticeably larger than in the case of students involved in playful peer activities. The distance between them is comparable with the distance that Mr. ROSE tries to keep from AMINA (pictures 1 and 2).

In addition to that, NADINE's actions are characterised by a strong attachment to the school's material. This attachment is maintained, even when her course of actions includes periods in which she is in exchange with AMINA, SAMI and ERKAN, apparently about topics of peer culture. She continues to work with the material and can do this comfortably, in much the same way as AMINA and SAMI can continue peer-cultural activities despite interventions by the teacher.

4.3 Subversive and confirming types of orientation

The comparative analysis of how interaction is organised, and of the scenic choreography with reference to the formal composition of recorded images, lead to the empirical reconstruction of two multidimensional modi operandi of how students deal with their learning environment: subversive and confirming orientation. These two types of students vary significantly in their interaction with teachers, other peers and learning material. In what follows, these two frameworks (including their sub-frameworks) are introduced before the findings are summarised. This leads to a discussion of the relevance of these finding for the DBR process.

Firstly, students in a subversive orientation try to expand the boundaries of peer activities within the school setting while apparently maintaining the intended school order whenever under direct supervision of the teachers ('front stage behaviour'). This includes attempts to conceal peer activities from public observation but not from the cameras. This orientation is particularly apparent on the bodily level. With ambiguous behaviour, students can simultaneously express alignment to the rules of the school and opposition to those rules in order to expand peer activities. This is evident in their interactions with peers and teachers, as well as in their handling of the SOL material. Contradictions and ambivalences like these can be understood as examples of Imdahl's 'complexity of transcontrariness' in the iconic presentation of self. A significant feature of this orientation is the conscious avoidance of direct confrontation with the teachers and their expectations. The sphere of peer activities is expanded to the front stage only in an ambiguous way, or unambiguously when unobserved. In this respect, the design of the SOL space, which is intended to create learning zones, allows a back stage space for activities not intended by the teachers. In fact, the cameras revealed spots where no teacher was present during the whole group work period. Furthermore, groups of students playing games such as rock-paper-scissors or hide-and-seek, roam from one area to the next, keeping out of the teachers' sight. The behaviour of these students is not framed by what teachers say beyond the range of their direct presence or field of view. In contrast to that, the learning material, worksheets etc. do frame their behaviour, independent of the teacher's whereabouts. However, the video data clearly revealed ambiguous forms of dealing with the material. While students in a subversive orientation do make entries on their sheets, they do so for very short periods of time only, and their body language simultaneously expresses disassociation from the ma-

terial. During the analysis of the video data, it appeared that some of this behaviour involved copying results from others. In this, students showed social behaviour that is accepted in the peer culture, applying communicative skills, conflict resolution skills, and so forth. This is to say, formal school expectations are accepted at the front of the stage, but not internalised. Where compliance to the rules is enforced, students in this orientation spend their time avoiding direct confrontation. However, whenever possible, they choose to revert to peer culture.

In the scenes selected for this paper, the subversive orientation has been exemplified by students involved with peer activities characterised by a high level of noisy social interactions and a significant degree of physical contact. In other scenes in the video corpus, another form of this orientation was observed. In this, students act in the same modus operandi but carry out a different set of peer activities. In many cases, they were relaxing, enjoying the unhurried atmosphere of sitting around, sometimes showing little verbal exchange with peers. Despite these differences on the surface, both subgroups are guided by a similar orientation. In some scenes, for example, students signalled the need for help, complaining about the poor quality of the task sheets. Some teachers would then approach and discuss the task, but this also served as a recreational pastime when students turned these discussions towards small talk about leisure activities, sometimes also mentioning where they had seen their teachers over the weekend. Much like the subtype of students preferring exchange of physical contact, this subtype also invades the sphere of learning and mentoring with peer activities in a playful manner.

Secondly, students in a confirming orientation do not challenge the boundaries set for intended school activities and peer activities. This group of students still demonstrates peer activities at school, but these activities are performed within the set boundaries, e. g. during the official breaks, or in a way that does not contradict their pursuit of the formal learning objectives. In contrast to others, the behaviour of these students is much more closely attached to the material they are supposed to be working with. They take on a superior teaching role in relation to some of their fellow students, due to their better ability when it comes to working with the task sheets. In several scenes, this type of student holds on to learning material-related activities, even in places where noisy games are taking place right beside them – as documented for example in NADINE's viewing direction during AMINA's squabble with her teacher in scene 2. When these (formal) learning activities are in-

terrupted, they will be resumed later on own initiative. Behaviour like this documents a form of internalising school expectation that is significantly different from students in a subversive orientation. Because of their quiet voices it is hard to identify what these students are talking about on the videos. Only fragments of these conversations are audible. The analysis of this type must rely even more on the iconic dimension of the video data than the first type, for which the organisation of discourses was easier to understand.

Without going into too much detail on the tacit frames that orient the teachers' behaviour, the two main types of student behaviour are essentially coproduced by their teachers, as teachers are crucial participants in the open space created for the SOL design. Student actions are framed by the teachers, especially when teachers are nearby and what they say and do conforms. However, in many critical scenes, the teachers' body language is ambiguous, creating space for subversively oriented students to expand autonomous activities. It is very common that when students make calls for additional support, teachers tend to respond. However, sometimes the teachers rejected this call and instead referred the request to fellow students of the 'expert group' for an answer. Sometimes they also address groups, but they predominantly address single students or pairs, thus avoiding relating to those very social units that are supposed to be established at this stage of the group jigsaw.

To sum up, the opportunity to view simultaneous and sequential aspects of the videotaped activities reveals not only the interrelationships between language-based discourse (which can be analysed sequentially) and what has been shown on a bodily level (which can be reconstructed simultaneously), but also the contradictions and ambivalences that come with it. In their bodily dimension, students can conform to and oppose the school norms at the same time. Ambivalences like that show how fragile or uncertain a practice is. It means that behaviour may change and is therefore of educational concern. How this understanding was used within the DBR project is discussed in the following subsection.

4.4 Video-based insights about the SOL intervention and its relevance for the DBR process

The insights created through the reconstructional analysis of video data led firstly to a revision of the initial hypotheses proposed within the DBR project at the school. At an early stage in the clarification process, a group of students that had been perceived as not following the teachers' le-

arning tasks had been labelled 'wild boys'. After the frameworks of orientation were reconstructed, it became clear that categorisation into simple gender stereotypes were not appropriate for describing the logic of action in the field. This is not to deny gender differences, yet the conventional labels of 'wild boys' and 'shy girls' are dismissed. The analysis revealed how in a subversive orientation both male and female students perform ambiguous violations of norms in relation to teachers. At the same time, students of this type also portray themselves as victims of assaults rooted in peer culture. Actions, different as they are on the surface, are oriented by the same modus operandi of expanding autonomous peer activities. In this more differentiated view of classroom practices, students addressing their teachers with complaints about 'distracting and noisy classmates', for example, can also be framed in a subversive orientation of the second subtype. External reasons for slow progress on the learning task may be turned into instruments for self-presentation as a 'victim', allowing the formal school environment to be flooded with 'legitimate' reasons for avoiding the intended output. This view is supported by empirical evidence of learning interactions which continue alongside noisy games, just as the video data confirmed the high degree of parallelisation of activities.

Secondly, the importance of the study material (work sheets etc.) used in the SOL intervention was highlighted. In this regard, video data has been used to identify whether students are working on the sheets, how long they work on them, what their body language says in relation to them, etc. For assessing the quality of learning material or the quality of answers given by the students, video analysis has a limited capacity. Research approaches such as content analysis of tasks and students' work, or interviews about learning and teaching processes, are more efficient in evaluating study material than video analysis alone. With regard to this, an additional review of the study material was conducted. This review showed that the material employed is probably breaking down the learning processes into very small steps which leave little space for independent decision making. This runs contrary to the intended self-organised learning. Based on these considerations, an extended research hypothesis was formulated during the reflections in the DBR-process. On one hand, the learning space is architecturally designed to support self-organised learning. On the other, the openness of the room is not reflected in the way the learning is organised as the material seems to be rather narrow guiding. These additional insights allows the behaviour of subversively oriented students to be reframed as an escape from tight

control. Another issue that was raised concerning the material – but could not be fully answered using video data – addressed the productivity of group work in the jigsaw design. According to another hypothesis developed during the redesign process, copying what single students have worked out on their own, may even be the simplest way of getting to the goal (the credits) from the students' point of view. This hypothesis is supported by the video analysis in so far as students in a confirming orientation work on material independently, or act as experts in relation to other single classmates. Considering that intensified exchange among expert students returning to their core group is to be expected at the stage of the recorded jigsaw group, the videotaped intensity of interactions related to the group tasks is disappointingly low.

Thirdly, in accordance with the DBR approach, the teachers at the pilot school should participate in the video analysis. To this end, the researchers did not just present the above-mentioned results, but also brought some sequences of the video corpus to project meetings, where the data was analysed jointly with the teachers. This was guided by a short manual on the process of video analysis created by the DBR researchers. Nevertheless, the analyses conducted with and by the teachers were not meant to meet scientific standards, but to serve the design process. Through this, the teachers reconsidered their views on what was happening in class. Thus, video analyses were also used as a mechanism for teacher training.

Fourthly, the teachers became more considerate of their students' behaviour, and of their own role, based on the insights they gained from working with the video data. For example, in an exchange with the DBR researchers the teachers said they were aware that they were acting as 'policemen' and that they would like to stop doing so. This indicates that the participating teachers are in an active process of shifting to a new type of role. Hence, role insecurities were identified as possible explanations for the recorded ambiguity in some teachers' behaviour. This is apparent in situations where students ask for help and teachers tend answer them in their role of 'professional expert', thereby preventing students from finding answers for themselves. This is contrary to the intended role of teachers as learning mentors. Furthermore, the teachers participating also began to consider the effect of their physical presence, realising that those students initially labelled as 'wild boys' also avoid direct confrontation when in their subversive orientation.

Finally, the teachers used the reflections during the joint video analysis to identify possibilities of changing the de-

sign of their SOL model. It was agreed to have more teachers present at the group work phases and to introduce a new set of penalties. These measures address significant issues like rule enforcement and leveraging the impact of teachers' presence. However, the DBR researchers imagined alternatives to these measures such as a reconfiguration of the study material based on gamification principles, and a reorganisation of pupil-teacher interaction based on clarified responsibilities in the learning process, preventing frustration of the parties involved. But, in the end, it is the practitioners who decide what is practiced. Problems arising from the use of video analysis in DBR will be further reflected upon in the following section.

5.0 Methodological discussion on using video-data in DBR

To draw conclusions on how video analyses can be used for enhancing design development and theory generation, DBR can be seen as a mutual process between practitioners and researchers. Videos can be regarded as a new medium in this process. For DBR, we find it relevant that practitioners and researchers apply different standards to the analysis of videos. In the case study, it was shown how scientific standards can be met in the process of generating insights from video data by applying the documentary method. Yet, for research results like this to be fruitful in DBR, they must not just be recognised by the researchers but also by the practitioners participating in the design process. From experience in the case study we learned that it can be difficult for teachers to receive research outcomes that are counter intuitive to earlier views. The video analysis, for example, revealed implementation difficulties with the SOL design to be caused by patterns of action among the students that are partly a response to strategies used by the teachers. Since video data are not in themselves 'objective', impressions of the material can be biased. In order to learn from video, the analysis must be put into a reflective context. In the case study, the teachers participating in the DBR project were invited to join the analysis process. Through this, they could integrate their perspectives on the video sequences. In our experience, educating teachers to gain sound insights from video data may be one way of making better use of video data. Integrating them into the analysis process also supports teachers to consider findings that might initially be rejected. In addition to that, we also realised that having common ground on the insights does not automatically lead to similar ideas on what should be done about redesign. Decisions on what needs to change in a given design depend on the normative aspirations of the actors. Generally speaking, actors

in DBR do not fully share the same norms and objectives. For the design of educational interventions, video analyses are, much like other forms of data analysis, just input for a complex, discursive decision-making process, which will eventually lead to the implementation of a specific didactical intervention.

In this context, the study in hand revealed a number of the benefits and limitations of video analysis for DBR. Regarding the benefits, video material can be useful for a new icon-based understanding of classroom practices. For this purpose, it may be used in different phases of the DBR process, in particular for problem analysis and evaluation of designs. A joint analysis of recorded videos also supports the discussion among practitioners and researchers of different interpretations of events in the classroom. Compared to classroom observations, this provides some advantages, because the number of observers is not limited and the same event can be looked at again when needed for deeper understanding. Furthermore, it has been shown how videos can give access to student behaviour that is usually hidden from researchers and teachers. At the same time, video analyses have relevant limitations. For example, for video data recorded with cameras designed for home use, the sound quality is usually poor. In this case, only shouts and fragments of conversations in quiet moments are audible. This is one of the reasons that the reconstruction of the video material primarily referred to the non-verbal level. Since education is much more than the recordable interaction, a solid analysis always requires more than video. In this case, the video analysis was complemented for example by a content analysis of material and by interviews that drew on how the participants themselves made sense of the invisible processes.

Since the recording technology is already quite easily available, we believe that video analysis will find a substantial role within DBR alongside more traditional means of data collection and analysis, where the work with video also includes their iconic nature and appropriate research methodologies are applied on a routine basis.

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