

How to elaborate what teachers should learn?

Five steps for content specification of professional development programs, exemplified by “moves supporting participation in classroom discussions”

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Abstract This paper aims at widening the discussion on the research-based design of professional development (PD) programs: from the prevailing “how-questions” (with their focus on the pedagogy and didactical principles for PD) to the “what-questions.” What-questions focus on the specification of the content in the PD program that should surmount deficit-oriented views on teachers’ perspectives. The presentation of a five-step program for the theoretically and empirically grounded process of content specification of a PD program is exemplified by the content “moves supporting participation in classroom discussions.”

Professional development of mathematics teachers is a topic of growing interest in the mathematics education research community (cf. e.g., Sfard 2005; Sullivan and Wood 2008; Gellert et al. 2013). In analogy with any instructional design for students, the design of professional development (henceforth PD) programs requires a theoretical and empirical base. This need for research-based designs has fueled a growing body of empirical investigations into pedagogical features for PD programs focusing on their effectiveness. In that way, important pedagogical principles can be specified for the design of PD programs (for an overview see Lipowsky 2010; Clarke and Hollingworth 2002; Tirosh and Wood 2008).

However, these studies rarely consider the ‘what-question’, that is, asking *what* content is most crucial for which PD programs and especially from which perspectives it should be addressed, i.e. “restructured” for the purposes of the PD. For example, in their survey on the state of teacher education at ICME 2004, Adler et al. (2005) do not name the specification and restructuring of content as a major issue of research, and especially remarkable is the fact that it is not even on their list of missing issues. Also in their handbook article on research methods in teacher education, Gellert et al. (2013) do not mention content specification and restructuring as an issue of methodological reflection.

Considering the variety and sometimes arbitrariness of possible contents for PD programs, we start from the assumption that selecting and restructuring crucial competences calls for its theoretical and empirical foundation. As emphasized for mathematical content by van den Heuvel-Panhuizen (2005), the empirical foundation is not restricted to proving effectiveness for students’ learning in experimental interventions, but also other forms of empirical insights come into question which support the selection of contents.

Thus, this paper firstly suggests that systematic use of empirical findings (e.g., on classroom interaction) should not be used to identify suitable and worthwhile kinds of content. More importantly, this content requires a so-called restructuring (Prediger 2005) for the purposes of PD that takes into account not just the theoretical foundation and empirical investigations, but also relevant perceptions and conceptions of teachers. These necessities are combined in our five-step approach for content specification in research-based design of PD programs.

After discussing alternative strategies for addressing the what-question in Section 1.1, we argue that taking into account teachers' perspectives is required for restructuring the identified content and explain what restructuring means in this context (Section 1.2), before we present the five-step approach (Section 1.3).

In Section 2, the five-step approach is illustrated for an exemplary content area, teachers' moves that support students' participation in classroom discussions. Drawing on data from the ongoing empirical research project INTERPASS, we show the practical and theoretical potential of the presented approach. This exemplary content "moves supporting participation" (henceforth: MSP) is especially challenging in research and practice as it does not primarily address cognitive issues but subtle interactive phenomena. We therefore investigate it in an interdisciplinary team (with two mathematics educators and two linguists). Section 3 briefly discusses further strands and issues.

1. The what-question: Strategies for systematic content specification in professional development programs

By the notion 'content specification' Hußmann and Prediger (submitted) refer not only to the process of identifying relevant learning content and embedding (grounding) it theoretically, but mainly of restructuring it with respect to useful metaphors and models, overarching ideas, and disturbing conceptions (Klafki 1958; van den Heuvel-Panhuizen 2005), as well as with respect to learners' perspectives (Duit et al. 2012). Hence, content is not considered to be clearly given, but requires to be constituted in a specific way. Whereas Hußmann and Prediger (submitted) discuss examples of school mathematics with students as learners, this paper refers to professional development and teachers as professionals and learners. The same steps would be needed for initial preservice teacher education, with slightly different outcomes.

Although the literature on content for teacher education is mainly focused on prospective rather than practicing teachers (cf. Sullivan and Wood 2008), we are able to systematize existing approaches into five currently found strategies for specifying content for practicing teachers, taking up the professional demands in classrooms. We briefly discuss their strengths and weaknesses (in Section 1.1) before presenting our approach (in Sections 1.2 and 1.3).

1.1 Typical strategies for specifying content for PD programs

For analytical reasons, we briefly present five "pure" strategies, although in most cases mixtures of these strategies are applied more or less explicitly. Especially the first two rarely appear in theoretical discourses. However, they do appear in practice.

Strategy 1: Arbitrary content choice by personal interest of facilitators

A practical experience is that rather than specifying the content for PD programs in a systematic way according to mutually approved criteria, many institutions select the content composition more or less by chance, thus simply relying on the facilitators' personal interest. Although of course substantial offers *can* appear within this strategy, there is a definite risk of arbitrariness in that it neither accounts for teachers' interests nor for the relevance of content for teaching in a certain sense.

Due to the lack of criteria rationally derived and agreed upon, the relevance of the PD program cannot be secured.

Strategy 2: Full freedom for teachers in bottom-up strategies

As opposed to Strategy 1 which is based on facilitators' interests, radical focus on teachers' subjective interests and concerns is adopted by bottom-up strategies. Some variants of action research (Krainer 2005; Crawford and Adler 1996), in which the participants of PD projects define and shape their questions in a completely unguided procedure, are a case in point. On the one hand, this approach is characterized by a lack of constraints and thus high involvement and orientation along the participants' interests. On the other hand, the sacrifice of criteria to personal interests implies a high risk of shaping content in unproductive ways, and therefore the risk of wasting teachers' time.

Strategy 3: Top-down theoretical and experienced-based strategies

The strategy which is presumably most often applied is the top-down specification of content, informed by and derived from theoretical constructs, from long-term practical experiences of scholars and practitioners, or from actual policy issues. This is for example the case in many reform contexts, when standards for classrooms and students are the starting point for PD programs. In pursuit of these strategies, many theoretical constructs for different professional demands have been developed and successfully used (e.g., Shulman 1986; for an overview on contributions to the what-question with a strong focus on mathematical knowledge rather than didactical knowledge and competences, cf. Sullivan and Wood 2008; Neubrand et al. 2009).

Whereas Strategy 3 often sets the general frame for content *selection*, the more detailed specification (i.e., restructuring and processing) requires further strategies, as Strategy 3 bears the risk of not being sufficiently grounded in practical or empirical bases for deriving concrete demands. That is why it is often combined with Strategy 4 or 5.

Strategy 4: Specifying professional demands by job analysis or research on quality instruction

As mentioned above, in order to pursue the theoretically set general frame identified in Strategy 3, a more detailed restructuring of the content, along the lines of the concrete professional demands, is necessary. It can be conducted for example by a so-called job analysis or empirical research on quality classrooms. In both cases, a variant of classroom research is the empirical base for specifying the professional demands.

Bass and Ball (2004) mainly base their job analysis on qualitative analyses of classroom practices for deriving what a teacher needs to do and know. The criteria for the specification are here derived from the theoretical frame and the situational phenomena reconstructed in the classroom.

Assuming that teachers should learn to teach effectively, empirical research on quality classrooms investigates how to shape this content in detail. For this purpose, those classroom practices which are most effective for students' learning are specified empirically and normative lists of desirable classroom practices that teachers should master are derived (e.g. Helmke 2010; Hattie 2009). Hence, the criteria in this case depend on the effectiveness of enhancing students' knowledge in the way it is operationalized by the underlying students' assessment.

Strategy 5: Deficit analysis by assessments on teachers' professional knowledge

In the last decade, more and more studies have been conducted assessing the state of teachers' professional knowledge (e.g., Baumert et al. 2010; Blömeke et al. 2011 and Walsh 2003 on teachers' understanding of interactional processes; see Andrews 2008 for an overview of research on teachers' language awareness). When starting the content specification by Strategy 3 or 4, the teacher assessment can refine the scope by allowing empirical verification of teachers' typical strengths and weaknesses, according to the criterion of students' learning effectiveness. Especially the deficit analysis can then inform the decisions about content for further PD programs.

The criteria for the strategy of content specification based on this kind of research are then mainly determined by the operationalization of teachers' professional knowledge in the underlying teacher assessment.

Starting from the assumption that the content of PD programs *should be selected in a transparent deduction* and should be *shaped* in a research-based way, the strategies 3 to 5 seem to have some relevance, but should be combined in a systematic way. Some researchers have emphasized the cooperative process of teachers and researchers for specifying the content synergetically by combining top-down and bottom-up (Penuel et al. 2011). We present an approach that is applicable also in school systems where the researcher is not always the teacher educator himself (such as in larger German federal states). In these cases, scaling up requires work with facilitators and less-spontaneous decisions.

1.2 Restructuring professional demands by taking into account teachers' professional visions

Within the framework of the strategies 3 to 5, necessary professional demands can be identified in a theoretically and empirically sound way (see below), so that the relevant scientific disciplines mathematics and general education research can support the identification of professional demands as relevant topics for PD programs (relevant with respect to specific aims). In the next—and most important—step, these professional demands require a *restructuring* for making them accessible, just as every mathematical topic requires to be restructured for learner-oriented didactical purposes (Prediger 2005).

Traditionally, the didactical restructuring of mathematical topics for students has taken into account the big ideas of the scientific discipline, useful metaphors and models, and genetic problems. Due to the principle of student-centeredness and the perspective that learning always means integration of new knowledge into existing knowledge, including sometimes a conceptual change (Posner et al. 1982), the process of restructuring was refocused to taking into account student conceptions as the necessary starting points for all learning processes (Posner et al. 1982; Dewey 1897). Until the 1990s, these student perspectives were mainly considered in terms of errors and misconceptions. In contrast, the contemporary program Educational Reconstruction (Duit et al. 2012; Kattmann et al. 1998) emphasizes that learners' perspectives comprise more than deficits as identified in assessments: mainly qualitative research investigates learners' perspectives and their

ways of making individual sense of academic conceptions in their own right in order to identify a promising starting point for fruitful learning processes:

“It is a key assumption of the model [of Educational Reconstruction] that the curriculum developers’ awareness of the students’ point of view may substantially influence the reconstruction of the particular [...] content. [...] intimate knowledge of students’ conceptions may provide a more adequate understanding of the [...] content by the curriculum developers.” (Duit et al. 2012, p. 19)

Recently, this program Educational Reconstruction has been transferred from school subject matter to teacher education (Komorek et al. 2013). Since also teachers hold certain conceptions and perceptions that need to be explicitly tied with the target demand in this non-deficit perspective (cf. Chapman 2014), this suggests a research program that focuses on teachers’ subjective theories, not only in terms of general beliefs, but referring to the quite specific demands and subject matter content. By relating teachers’ subjective theories on a particular content area with the target theories, the pathways to the content for PD courses can be synthesized.

We follow Komorek et al. (2013) in their idea to take teachers’ perspectives into account, but without conceptualizing them as ‘subjective theories,’ as we are not necessarily interested in *individual* conceptions or theories of teachers, but rather in their *professional* perspectives which are shared in the professional community, specifically the professional orientations and perceptions with respect to their practices in classroom communication.

Therefore, we draw upon the construct ‘teachers’ professional vision’ that Sherin (2007) brought into teacher education research by referring to the anthropologist Goodwin (1994). According to Goodwin (1994, p. 606), professional visions are “socially organized ways of seeing and understanding events that are answerable to the distinctive interests of a particular social group.” Sherin (2007) specifies this construct by the following:

“For teachers, professional vision involves the ability to make sense of what is happening in their classrooms. [...] As a teacher observes a classroom, he or she is constantly reasoning about what is seen, and this drives where and how the teacher will look in the future. ... [...] describe professional vision as consisting of two distinct subprocesses: (a) selective attention, and (b) knowledge-based reasoning.” (Sherin 2007, p. 23)

As a consequence, teachers’ professional visions on specific topics should be empirically explored, in our case with respect to the professional vision on teacher–class interaction. It is assumed that these visions underlie the strategies and moves adopted in classrooms and help in understanding the background of mismatches between professional demands specified in research and teachers’ everyday strategies.

1.3 Identifying five steps towards research-based content specification for PD

Summing up the two preceding sections, the research-based content specification and restructuring should take into account theoretical frameworks, concrete professional demands as specified in classroom studies, and teachers’ perspectives, here in terms of professional visions.

In our approach to research-based content specification for PD programs, we draw upon the necessity to refer to theory and practical experiences (Strategy 3) in our Step 1, but also to the need of empirically specifying concrete professional demands as sketched in the approach of job analysis of Strategy 4 in our Step 2. Having identified a general theoretical frame and the necessary target competences and knowledge, we start a process of educational reconstruction by empirically ex-

ploring the teachers' perspectives (Step 3) and then confronting them with the normative perspectives for restructuring the pathway to the content (Step 4). The design of the concrete program and its activities, pedagogy, and methods can start only when these steps of profound content specification are completed:

- Step 1. Theoretical embedding: Why and how is the content relevant?
- Step 2. Empirically based specification of the concrete professional demands
- Step 3. Empirical exploration of teachers' perspectives
- Step 4. Synthesizing seeming antinomies in different perspectives for restructuring the content of the PD program
- Step 5. Iterative design of a concrete PD program

2. Illustrating the five steps for the exemplary content “moves supporting participation” (MSP)

In the following, we will illustrate this approach for a specifically difficult content area: teacher's moves that support participation in teacher–class interactions. Of course, the exemplary insights into the underlying empirical research and their consequences for the PD programs can only be briefly sketched. As Step 5 is still in progress in the ongoing project, it is here only treated as an outlook.

Before starting to embed the PD's topic in the theoretical and empirical background, we need to emphasize that the selection of, for example, the field of classroom interaction in itself cannot be derived empirically: any study's issue to a certain degree follows the researchers' interests and specific knowledge domains. Once the field is set, however, the more concrete specification for the purposes of the PD program can be empirically derived, as will be shown.

2.1 Step 1: Theoretical embedding – Why and how is the content relevant?

Our starting point is the fact that acquisition of mathematical knowledge often takes place in classroom interaction (Krummheuer 2011), and classroom interaction is mainly constituted linguistically (Hasan 2011; Sfard 2008; Barwell et al. 2005; Bauersfeld 1995; Pimm 1987). In view of this fact it becomes understandable that the degree of linguistic competence on the part of the students is one of the factors responsible for learning achievement in the different domains; the lack of adequate linguistic competences in production and comprehension prevents students from fully and effectively participating in teacher–class interaction aimed at the acquisition of mathematical knowledge (Jablonka and Gellert 2011). Since student participation in teacher–class interaction means participation in specifically institutional verbal exchanges, it also becomes understandable that these communications at the same time provide a field of specific verbal practice necessary for language acquisition. In addition, student participation in itself is linguistically constituted: teachers' verbal utterances trigger, encourage, discourage, “delete” students' verbal contributions, and allocate evaluations accordingly (Jablonka and Gellert 2011; O'Connor and Michaels 1993).

The linguistic requirements and thus the specific acquisitional tasks in secondary school can roughly be summarized by the umbrella-term ‘academic language’ (Gogolin 2009; Snow and Uccelli 2009). This holds for the special situation of multilingual students not mastering the language of instruction sufficiently (Cummins 1979; Barwell 2009), but also for students using their first

language in class but who are nevertheless confronted with unfamiliar communicative tasks. The institutionally expected practices in classrooms include a broad repertoire of syntactical and lexical choices (Maas 2008) and also the use of discourse genres required in formal interaction for the purposes of teaching and learning (Morek and Heller 2012).

According to our empirical observations in the video study INTERPASS (Erath et al. 2014; see below), among the genres prevailing in mathematics and German lessons in grade 5 are explanations and—to a lesser degree—argumentations. Compared with narratives, these genres require a higher degree of syntactic and lexical density and complexity (Quasthoff 2012) as well as a deeper processing of subject knowledge. Students' active involvement in these discourse activities, co-constructed by teacher and student(s), thus provides the microstructural learning context (Rex and Green 2007) on the one hand and an acquisitional context for language and discourse skills (Becker-Mrotzek 2009) on the other hand.

The linguistically relevant theoretical background in a more specific sense then refers to the acquisitional mechanisms of discourse skills. Interactive mechanisms of the acquisition of discourse skills originally have been investigated mainly with respect to narrative genres and familial acquisition contexts for young children (Blum-Kulka and Snow 1992; McCabe and Peterson 1991; Civil 2006). The mechanisms of narrative development have subsequently been empirically investigated and theoretically explicated with respect to children up to the age of 14 years and also with regard to classrooms as acquisitional contexts (Hausendorf and Quasthoff 1996; Quasthoff 1997; Becker-Mrotzek and Quasthoff 1998). The interactive mechanism of the **D**iscourse **A**cquisition **S**upport **S**ystem DASS (Hausendorf and Quasthoff 1996) was empirically extended and theoretically adapted in recent research with respect to explanations (Morek 2012) and argumentation (Heller 2012). DASS has been extended to mathematics in kindergarten (by Krummheuer 2011) and is now being investigated in grade 5.

This research essentially shows that children acquire discourse skills by taking active part in systematic patterns of adult-child interaction, fine-tuned to the child's level of competence (Quasthoff in press). The pattern 'demanding and supporting' involves the child as a communicative partner responsible for a mutual discourse task at hand (e.g., explaining a rule, giving a reason), supported only to the degree that he or she fails to produce relevant steps in the elaboration of the explanation or argumentation. There are, however, different patterns of adults' communicative dealing with children outside of school that have different potentials with respect to the child's acquisitional process (Quasthoff and Krah 2012).

Based upon the theory of DASS, the ongoing research in INTERPASS investigates the specific discourse-acquisitional opportunities of teacher-student interaction in classrooms and their immediate and longer-lasting effects in terms of students' participation and discourse practices (Erath et al. 2014; Heller 2015). Results so far show that teachers

- in their questions, often do not explicate their expectations with respect to the linguistic format and the precise content of students' contributions,
- often do not make it transparent for the students why they accept some answers and reject others.

When confronted with relevant video clips, group discussions with teachers show in addition that teachers are typically not aware of (not) providing a language learning opportunity for their students in conducting classroom discourse (see below).

These characteristics are decisive for the effectiveness of teacher–class interaction as an acquisitional context for students’ acquisition of academic language, since—as opposed to everyday interaction—the knowledge students need in order to participate successfully in classroom interaction is not common “members” knowledge (Quasthoff in press) assumed to be shared by the participants, but subject and institutional knowledge not yet available to many students (Jablonka and Gellert 2011; Setati and Adler 2000).

To the degree that also subject learning requires students’ active involvement (Gibbs 1992), and feedback given to their contributions and activities (Hattie and Timberley 2007), opportunities with respect to subject and linguistic learning are thus currently not provided to the full extent of their potentials in teacher–student interaction. With respect to the goal of enhancing linguistic and subject learning at the same time by structuring teacher–student interaction accordingly, the content of how to use moves that support students’ participation is highly relevant for PD programs.

Summing up, the state of research on teacher–class interaction as an acquisitional context allows the selection of MSPs as a relevant topic for PD courses which has to be further specified: just as for every mathematical topic, this didactical topic must be considered within its theoretical embedding. Here, we show in which way interaction and participation appear as major fundamental constructs which require more attention of teachers. This allows the restructuring of the content.

2.2 Step 2: Empirically based specification of the concrete professional demands

For specifying the concrete professional demands within the selected general topic, we rely on selected results of the micro-analytic classroom study INTERPASS-classroom (Erath et al. 2014) that focuses on the interactive practices teachers adopt to deal with students’ contributions (Heller 2015). We briefly outline the background of the video study (Section 2.2.1) before presenting selected results from which professional demands can be derived (Section 2.2.2).

2.2.1 Background and methodology of the video study INTERPASS-classroom

The assumption is that the way in which teachers take up students’ contributions is—among others—consequential for if and how students can participate in the classroom discourse community. This participation in the ongoing discourse constrains the students’ opportunities for both mathematics learning and developing discursive competences (see Section 2.1).

The data corpus comprises videos of 60 mathematics and 60 German language lessons in five classes (with $n=147$ students and ten teachers). In order to cover a wide range of different conditions influencing classroom discussions, the five urban area schools were sampled systematically with regard to school type (grammar and comprehensive schools) and students’ socio-economic and multilingual background. In order to analyze how teachers’ moves can support or hinder students’ participation in teacher–class interaction, the first eight mathematics and German lessons were videotaped immediately after students’ transition to secondary school (grade 5). About six months later, four additional lessons were recorded.

Methods of microstructural sociolinguistic approaches and applied conversation analysis are used to investigate the dynamics of teacher–student interactions in whole-class discussions. Students’ and teachers’ turns are thus not examined as isolated utterances but as actions in their sequential contexts, focusing on genre-oriented discourse units (Wald 1978). What does an action do in relation to the preceding one, and what next action does it project (Schegloff and Sacks 1973)?

Classroom talk typically involves question-answer-evaluation sequences (McHoul 1978; Mehan 1979; Lee 2007), which are considered here in terms of the global format of genres such as explanations or argumentations. In such sequences, students' answers exhibit how they interpret a teacher's questions or prompts, that is, what type of local answer (e.g., stating a result) or global discourse unit (e.g., justifying a statement or explaining a procedure) they understood to be the relevant next action. In the same way, the teacher's subsequent turn displays how a student's answer is assessed with regard to his/her expectations concerning both content and communicative type (for early adaptations in mathematics education cf. Bauersfeld et al. 1985; Cobb and Bauersfeld 1995). According to the analytic principles of Conversation Analysis, from the contextualized video-graphed utterances meanings are reconstructed which are established "audibly and visibly" as mutually shared meanings among the participants. Thus, the analysis never attributes intentions to speakers. This kind of purely descriptive linguistic analysis also refrains from any evaluation of the relevant moves: an assessment in terms of a (less) successful move with respect to students' learning chances can be derived, but from a didactical perspective it could well be that other issues explain and legitimate the move in question.

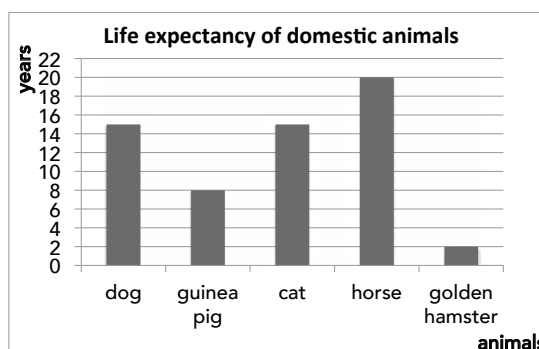
Interesting moments in interactions are those in which a student answer is treated as not (fully) meeting the teacher's expectation. In INTERPASS we investigate what consequences the teacher's subsequent moves have for a student's ongoing participation; and longitudinally what kind of long-term acquisitional contexts these practices create for both mathematics learning and developing discursive competences. In the following we briefly present two different ways of responding to students' contributions in order to illustrate how the sequential analysis of teacher-student interactions can yield results that allow for identifying MSPs as central components of teachers' professional interactive repertoires and relevant content for PD programs. In both cases the teacher displays that the contributions are not accepted, with the first example—by contrast with the second—not giving the kind of feedback that can be used as learning input.

2.2.2 Results for the specification of moves supporting participation

The following two episodes stem from mathematics classrooms. In both excerpts, a student answer does not fully meet the teacher's expectations. The teachers, however, adopt different strategies in dealing with these answers. In Episode 1, a bar chart is projected.

Episode 1. Bar chart (TEA: teacher Mrs. Abt; bea: Bea-Marie; mia: Mia; bet: Bettina)
 (for simplified GAT transcription rules adapted from Selting et al. 2009, cf. Appendix)

- 4 TEA WHAT is this chart about; who starts with DESCRIBING the chart; [pause 2.5 sec] Bea-Marie;
- 5 bea animals are described with the age how old they get uhm
- 6 TEA okay; what can you read off of this chart; have a look at the chart; [pause 10.5 sec] Mia;
- 7 mia one can also uh - think how MANY there are;
- 8 TEA yes; tell me more;



- 9 mia so with regard to the horses (one could maybe up to the twenty) one could also THINK that there could be twenty HORSES or so;
- 10 TEA twenty horses, can that be right; what do the others think;
(...)
- 11 bet no there no,;
- 12 TEA no what is it about then; is it about twenty HORSES?
no; w w what is it about then;
- 13 bet I think it is just about about the AGE of the horses of the animals,
- 14 TEA EXACTLY; fine; let's CONTINUE;

The teacher, Mrs. Abt, asks the students to state the general issue of the chart and to start describing the chart, which is then taken up by Bea-Marie (turn 5). Her second question (turn 6: “what can you read off of this chart”) is ambiguous: it can be understood to ask again for the general topic of the chart or for the specific information that it depicts. Mia’s proposal that the chart is about quantities (turn 7) is ambiguous, too: does the term “quantities” refer to animals or years? When Mia is encouraged to elaborate her idea (turn 8), it becomes clear that she proposes a hypothetical alternative reading of what the chart could be about, namely that it depicts the quantity of animals. Using the subjunctive mood (turn 9: “one *could* think”) with a verb of saying she clearly marks this reading as hypothetical without indicating, however, how she positions herself towards it. She thus follows a possible reading of the teacher’s prompt to provide further possible understandings. Instead of taking up the hypothetical framing of Mia’s contribution, Mrs. Abt repeats one part of Mia’s statement (turn 9: “twenty horses”) and poses a question that is designed as a “reversed polarity question” (Koshik 2005), thus conveying a strong epistemic stance, namely a negative assertion. The teacher’s question does not seek information but in fact challenges the prior assertion which had not been asserted in the first place. Furthermore, by allocating the turn to the whole class she does not provide the opportunity for Mia to clarify her reading herself. Thus Mia’s lack of explicitly marking the possible interpretation to be wrong does not become a topic of talk.

Sequentially, this is clearly a case of rejecting a student’s contribution. In epistemic terms, this rejection does not provide an opportunity for content learning, either for Mia or the other students. Neither the next speaker, Bettina, nor the teacher explicate why their reading is correct and why Mia’s version cannot apply to the chart (e.g., by referring to the title of the chart or to the specification “age”). The student’s experience is thus only rejection, without explicit feedback on why the utterance was not considered as matching the teacher’s.

The second episode stems from a sequence in another math class in grade 5, in which the students were asked to explain the difference between pictograms and bar charts. Beforehand, they had prepared and written down their explanations.

Episode 2. Bar chart and pictogram (nah: Nahema; TEA: teacher Mr. Schroedinger)

- 62 nah the DIFFERENCE is, that one can READ the¹ bar chart faster and more distinctly [*pause 2.5 sec.*]
- 63 TEA WHY?
- 64 nah because of clear because it’s clear(er).

¹ In the German original, Nahema uses an incorrect article: “den” instead of “das” (the neuter is not to be changed in the accusative case).

- 65 TEA the bar chart is you can read [...it] faster; yes that
 why one can do that, you should add that then there in any case; because this and that and that.
 66 nah because it is clearer;
 67 TEA yes,

Nahema's explanation (turn 62) contains a claim: that the bar chart can be read faster. By posing a 'why-question' (turn 63) the teacher, Mr. Schroedinger, *establishes an obligation to give reasons* (Heller 2012). Nahema indeed produces a reason. He also self-repairs a formal aspect (he replaces the conjunction "because of" with "because"), thus displaying uncertainty with regard to the linguistic formatting. In this sequence, the teacher uses the turn 65 to explicate his understanding of Nahema's reason by rephrasing it; in doing so, he also draws the formerly separated parts of the explanation together and formulates a grammatically complete clause. Thus, he does not only *check for understanding* but also *models* the linguistic formatting of a reason. Furthermore, he *meta-discursively explicates* what structural parts the argument contains (turn 65: claim and reason). Again, he models an exemplary phrasing while also confirming Nahema's self-repair (turn 64/66).

In contrast to the first sequence, the teacher halts the progression of the activity when a student's discourse unit does not fully meet his expectations (turn 63 prolongs turn 62). He makes explicit the structural parts of the discourse unit and makes available syntactical and lexical means, thus treating Nahema as being able to revise his contribution but at the same time supporting him to do so. These strategies for applying individualized MSPs are a classroom-typical variant of the pattern 'demanding and supporting' which could be observed in dyadic parent-child interactions as supporting participation and language acquisition (Hausendorf and Quasthoff 1996).

The two exemplary episodes presented here demonstrate different moves for dealing with a student answer not (fully) meeting their expectations: bypassing it by allocating the turn to another student, reformulating or correcting the answer themselves, or initiating a self-repair (Macbeth 2004). Whereas the first two options often go along with an orientation to the content progressivity of the talk (Schegloff 2007, p. 15), the third option assigns more relevance to securing a student's understanding or language acquisition process. Previous research demonstrates that the balance of the two preferences may differ in different classrooms (e.g., Sert 2013; Hosoda and Aline 2013).

In line with other empirical studies, the different ways of reacting are assumed to have different potentials for 'demanding and supporting' both content and discourse learning. In general, it is argued that 'providing opportunities' for speaking and making use of one's linguistic resources is supportive for both first language learning students (Harren 2013) and second language learning students (Swain and Lapkin 1995). With regard to the acquisition of (subject-specific) discourse practices, 'speaking,' however, does not just mean any kind of linguistic activity on the part of the students, but also the production of explanatory, argumentative, and descriptive discourse units that require students to globally structure thematic connections and accordingly to make use of the linguistic resources of academic language.

Fundamental to the pattern 'demanding and supporting' is that communicative demands are maintained (Heller 2012) even when a student does not immediately manage to produce a suitable discourse unit. Remarkably, students themselves sometimes indicate trouble (as in the second episode) and 'invite' the teacher to offer interactive support (Harren 2013; Schmitt 2012). A balance between 'demanding' and 'supporting' is achieved when teachers provide interactional support in the communicative role of a recipient while keeping the student in the role of the speaker responsi-

ble for the accomplishment or the adequate linguistic format. According to our data, the range of supportive moves comprises

- paraphrasing or revoicing (O'Connor and Michaels 1993; Michaels et al. 2013),
- asking for elaborations (Michaels et al. 2013),
- explicating communicative demands (Hausendorf and Quasthoff 1996; Heller 2012),
- providing vocabulary or syntactic structures within the collaborative production of turns (Lerner 1995).

These moves allow learners not only to productively integrate new linguistic resources into their formulation but also to position themselves as competent members of the classroom discourse community.

These empirical findings on professional demands allow specifying the contents of PD programs that enable teachers to increase students' learning opportunities by increasing participation. Teachers need

- to understand that creating interactional opportunities for discourse learning is not bought at the expense of subject learning but can enhance both;
- to recognize the supportive or obstructive potential of different ways of initiating, taking up, and responding to students' contributions;
- to acknowledge the responsibility for clear feedback in order to give a clear orientation of whether and why an utterance matches or mismatches the expectations;
- hence to be able to make situated use of different MSPs such as paraphrasing or revoicing, asking for elaborations, explicating communicative demands, or providing linguistic means.

2.3 Step 3: Empirical exploration of teachers' perspectives

Although research on teacher–class interaction offers clear advice for teachers' MSPs, their enacted strategies in classroom often do not match these criteria. For preparing the PD on MSPs in a way that teachers can integrate the new strategies into their repertoire and their underlying professional vision more successfully, this professional vision must be investigated carefully in order to reconstruct the inner rationality of teachers' strategies.

2.3.1 Background and methodology of the study INTERPASS-group-discussion

For empirically reconstructing teachers' professional visions (i.e., specific patterns of teachers' perceptions, evaluations, and interpretations, cf. Section 1.2) towards interaction and participation, the INTERPASS-classroom study is complemented by the study INTERPASS-group-discussion. In four group discussions with 5–10 teachers each (lasting 95–110 minutes), teachers discussed video-episodes of videographed teacher–class interactions while being relieved from any pressure to actually act (henceforth, 'interactionally relieved teachers'). These teachers were not involved in the INTERPASS-classroom study, but were selected according to their similar professional experience (with respect to school subjects, students' social and linguistic background, school type, and experience in grade 5). So shared professional visions could be assumed (cf. Sherin 2007 and Section 1.2).

Five short video clips which show typical interaction episodes with different types of moves (e.g., Episode 1 in Section 2.2) were selected from INTERPASS-classroom data for stimulating the

discussions. Beyond these video clips (lasting 1–4 minutes), only minimal stimulation was given by the researchers, thus framing the group discussion as an opinion-forming process on the episodes presented without explicit mentioning the research focus.

The resulting video data from the group discussions were transcribed, sequentially analyzed, and arranged with respect to the topics appearing in the discussion. Following Sherin’s (2007) analytic approach for reconstructing professional visions, we analyzed the thematic foci and the teachers’ selective attention to different aspects within their discussions. This empirical analysis allows first insights into typical patterns of how teachers perceive, interpret and evaluate moves which more or less support participation (see Vogler 2015 for details).

2.3.2 First empirical insights into teachers’ perspectives on interactional moves

We illustrate our first results of the ongoing analysis referring to one case which stems from a group discussion with three mathematics and two German language teachers. They comment on a video of Episode 3 “Explaining the procedure of rounding” from a mathematics classroom interaction on how to round 63 to 60 (see Prediger and Erath 2014 for a more extensive transcript and analysis of the episode).

Episode 3. Explaining the procedure of rounding (TEA: teacher Mr. Maler; kos: Kostas; kat: Katja)

- 1 TEA [writes on the blackboard: $63 \approx$] and now, YOU tell me [3.5 sec. break] a NUMBER that could fit on the other side; and OPTIMALLY, you also tell me why or HOW. [...] Kostas.
- 2 kos SIXTY.
- [...]
- 7 TEA hm, LOOK. I’m WRITING it down, Kostas, [completes blackboard entry to: $63 \approx 60$] and now YOU convince us, why the sixty can stand there and why this is CORRECT.
- 8 kos °hhh [articulated clearing his throat] Well, if you are rounding DOWN the sixty-three on TENS; then it comes, it gets, there must be ALWAYS a zero at the end, it MUST be, when you are rounding
- 9 TEA on TENS yes.
- 10 kos and then there, if you take AWAY the three and shift the ZERO to it. So, you could DO that, but actually it’s WRONG. You just have to round down and nea.. nearest number with a ZERO you have to write there.
- [...]
- 12 TEA okay, I think I already UNDERSTOOD SOME parts of what you wanted to explain; so FIRST of all I filtered OUT, you rounded on TENS; what does that mean HERE, if you are rounding on TENS, what ARE the TENS here actually? Can you show that simply once in the front, Kostas? I am not completely sure, if you DID round on tens;
- [...]
- 18 TEA [...] and you already hinted WHY; but does any of you know a RULE, HOW one has to proceed here, and when one here, when the ten stays the SAME? In this case, and the place BEHIND, which is rounded, goes to ZERO? ha; [4.5 sec. break] Katja.
- 19 kat With zero one two three FOUR you are rounding down and with five six seven eight NINE you are rounding (up). [3.5 sec. break]
- 20 TEA did EVERYBODY understand that?
- 21 class [affirms in chorus]

In this Episode 3, the student Kostas simply presents a solution $63 \approx 60$ (turn 2). The teacher establishes an obligation to give reasons and attributes the responsibility exclusively to Kostas (turn 7). Kostas presents a conceptual explanation for rounding to the nearest ‘tens’ by implicitly referring to the mental model of a number line (expressed by “nearest numbers” in turn 10). Although this approach is mathematically correct and rich, his explanation (turn 10) appears not straightforward. The teacher marks a further need of making the explanation more explicit and gives Kostas the opportunity to elaborate it (turn 12). Later (in turn 18), he explicitly navigates towards a procedural

explanation by asking for a rule. Katja's formulation of a rule for manipulating digits (turn 19) is marked as matching the expectations (turn 20).

In the group discussion with teachers, stopping the video after turn 10 was intended to prompt the group discussion teachers' attention to Kostas's contribution. Rather than discussing Kostas's ideas or ways of expressing them, however, the teachers participating in the group discussion are mainly concerned with the fact that the teacher only talks with one student without other students' attention, such as Mr. Neumann:

neu and he takes- he also IGNORES the others.
 his ATTENTION mainly focuses actually more in the direction of the boy

When explicitly asked about Kostas by the researchers, one German language teacher, Mrs. Nachbar, describes Kostas as a 'fit' learner:

nac evidently, Kostas is quite FIT in math and a GOOD student? but Kostas doesn't succeed in EXPLAINING it correctly. and he was urged into this ROLE by the teacher? [...] I could not understand his explanation.

Remarkably, Mrs. Nachbar's evaluation of Kostas's competence refers to the observation that the teacher on the video establishes Kostas in a role of the proponent in turn 7, not to Kostas's answer in turn 8/10. Hence, the source of evaluation is not the student's performance, but the interactive attribution by the teacher. In the same contribution, she evaluates Kostas's utterance as not fulfilling this obligation since his explanation is not understandable for the other students.

One mathematics teacher in the discussion acknowledges Kostas's semantically rich implicit mental model of explaining rounding on the number line (without transcript here) and contrasts it to the formal rule that most children use by rote when manipulating the digits (digits < 5 rounding down and ≥ 5 rounding up). But the other teachers do not follow these thoughts.

After showing the video clip up to transcript turn 12, the group discussion teachers are astonished about Mr. Maler's move. Some are irritated because the style of the feedback is perceived as a face-threatening critique for Kostas (a frequent motive for teachers' selective attention in many sequences of the group discussion). Others do not see a further need of explanation. Again, they are concerned with the rest of the class, such as the mathematics teacher Mrs. Jacobi:

jac somebody RAISES hands. and is totally IGNORED. In my opinion the move only takes place between teacher and student- this one student?
 ...
 when I was a young teacher, this happened to me quite often.
 that for some questions, you rely on the very strong students and say, the rest will work.
 that is what you have to learn to manage, involve all in the discussion.

Four out of five teachers do not invest in a careful analysis of Kostas's ideas. Instead, they focus their attention on the challenge of involving the rest of the class. Thus the teachers mark a recurring challenge in teacher-class interactions: on the one hand, teachers ought to appreciate the possibly good ideas of single students and support them to formulate the ideas properly. On the other hand, it is important to involve the whole class, not only one student.

In the course of the following interaction, they interpret Mr. Maler's reaction (turn 12) to Kostas's explanation (turn 10) against the background of the attributed teacher's goal of the lesson, because the difference between the reaction to Kostas and to Katja would be explainable for them if one does not fit to the teacher's goals, as for Mr. Neumann and Mr. Klein:

neu but he has not phrased it by a RULE. right? well that is what is MISSING. and that is -
kle exactly

neu [...] and Kostas has not given it to him

This assumption is confirmed by the third segment of the video, comprising turn 13–21 in which Mr. Maler explicitly asks for the rule and Katja answers in the expected way.

kle well he has NOT named this rule now. she has DEFINED exactly. what happens with EACH digit? WHEN? THIS actually is the criterion.

The teachers here discuss that Katja’s rule (turn 19) is the appropriate answer to the request of justifying the solution 60, and that this way of justifying is established in this classroom as the socially accepted practice of explaining rounding. Drawing on their professional vision, the teachers deduce easily that this practice is the favored one by the teacher, because it helps in reaching the assumed goal of the lesson. In line with that, they explain why the teacher neglects Kostas’s conceptually more sophisticated approach.

This is a pattern of professional vision that could be reconstructed in various moments of all group discussions and also in other empirical studies (Lee and Takahashi 2011): the teachers evaluate students’ utterances not within their own logic, but with respect to the teacher’s goal for the lesson (“that is what he wanted”). The interactionally relieved teachers consider this alignment of feedback with the lesson’s goal as natural and legitimate. However, they are always concerned to not expose single students to explicit critique due to a certain pedagogical ethos.

2.3.3 Reconstructed motives in teachers’ professional vision and seeming antinomies

With these short insights into complex group discussions, illustrations were given for three often recurring motives that seem to shape teachers’ professional vision on teacher–student interactions, namely (1) avoiding face-threatening reactions (e.g., critique or explicit corrections), (2) keeping track towards the teacher’s epistemic goals, and (3) enabling the whole class to produce contributions. These motives in teachers’ professional vision could be reconstructed in other scenes of our group discussions and are also documented in other empirical classroom studies (see Section 2.2). The teachers’ professional vision explains why many moves that we categorized as non-supportive from the research perspective were judged as adequate in the teachers’ perspective.

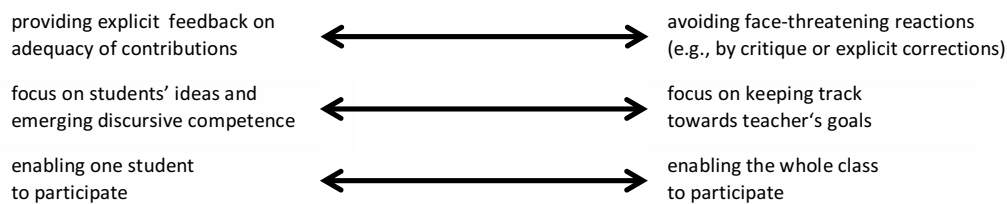


Fig. 1 Seeming antinomies between normative professional demands and teacher’s motives

For some (often novice) teachers, these motives seem to supersede the professional demands totally, which are specified by research (see Section 2.2). For other teachers, they produce three important gaps which are perceived as antinomies (cf. also Thomas and Yoon 2014 for experienced conflicts). These seeming antinomies are sketched in Fig. 1 and discussed in the next section.

2.4 Step 4: Synthesizing seeming antinomies in different perspectives for restructuring the content of the PD program

The empirical investigation into teachers' professional vision showed that it is not enough to convey technical issues (mastering the "right" discourse-techniques for applying MSPs). Rather, it is the teachers' professional vision, shaped by relevant motives, that seems to contradict the motives underlying the MSPs and thus may prevent teachers from applying the MSPs.

Rather than judging the teachers' reconstructed perspectives as wrong and simply trying to overcome them, we thus have to consider them as legitimate starting points which have to be taken into consideration systematically in order to build up new insights. Within the program Educational Reconstruction, confronting the normative and the participants' perspectives is an important step in restructuring the content of teaching-learning arrangements not only in the sense of repairing deficits, but also for the purpose of preparing the content in a way that allows the participants to align it with their own perspectives (cf. Komorek et al. 2013 and Section 1.2) and reorganize their knowledge at the same time.

In our case of MSPs, the analysis of group discussions helped us to identify three relevant motives in teachers' professional vision. We briefly sketch how the seeming antinomies can be synthesized and emphasize that this dialectic synthesis should be the reconstructed content for the PD.

2.4.1 From the seeming antinomy 'providing explicit feedback vs. avoiding face-threatening' to the synthesis 'face-saving feedback and interactional pattern'

Of course, teachers act in a student-friendly way when they try to avoid harming students' integrity by too-explicit critique or corrections. As a consequence, the INTERPASS video study has reconstructed many episodes in which students' mismatching utterances are left more or less uncommented on. On the basis of the group discussions we can connect the observed strategies to the motive of not harming the students' integrity, similarly to other studies. However, many empirical studies with different theoretical backgrounds show that the explicitness of feedback is of major importance for a learning progress (Hattie and Timberley 2007; Gellert 2009).

The synthesis in this seeming antinomy is demonstrated by those moves which give a clear orientation on (meeting) expectations while at the same time being face-saving. One example is given in Episode 2 (in Section 2.2.2) by Mr. Schroedinger who models and explicates what structural parts the argument should contain while at the same time assigning discursive responsibility to Nahema. In more general terms, the interactional pattern 'demanding and supporting' (as introduced in Section 2.1) offers various contextual possibilities for moves that allow for both. The pattern's inherent motive of locally supporting only to the degree of the learner's manifest failure to provide a particular move is face-saving in itself, as it leaves the learner responsible for fulfilling the task at hand and thus attributes competence to him/her. Explicating meanings as well as repairing incomprehensible utterances belong to the basic mechanisms of securing understanding. Mutual understanding of course is a necessary condition of successful talk in classrooms as well as in other communications.

2.4.2 Balancing 'focus on students ideas' and 'keeping track towards teaching goals'

There is no comprehensive synthesis for the antinomy between openness for students' ideas and keeping track toward the teacher's goal of the lesson. Rather, teachers need to reach a balance between both (cf. Krainer and Stern 2004), because solely keeping track of the teaching goals always risks missing the students' lines of thoughts in their own right. On the other hand, a complete openness for students' erratic ideas has a limit in the risk of arbitrariness.

Again Episode 2 seems to sketch a possibility to combine both: Mr. Schroedinger is responsive to Nahema's individual need of support for accomplishing the argumentation. However, he does not stay with it for too long: when Nahema only repeats his short phrase (turn 66), the teacher decides to continue. In this way, he balances a short individual support with the need not to spend too much time on it. In contrast, Episode 3 shows what a teacher can lose when only following his train of thought: Kostas's mathematically rich implicit reference to the number line was lost due to the teacher's focus on the procedural rule. In these kind of cases, a focus on students' ideas could have enhanced the conceptual understanding for the whole class.

2.4.3 Overcoming the seeming antinomy 'participation of one student vs. all students' by a shift from quantity to interactive quality

Teachers' frequent ambition to include many students instead of working with one or only a few students is a legitimate motive, since a classroom with 30 students definitely needs other strategies than the one-to-one interaction in parent-child communication which was in the initial focus of the research on MSPs (cf. Smit et al. 2013).

However, short exchanges with individual students in class communications are not bought at the expense of other students' learning, and the participation of many students in class should not be measured by quantity of involved speakers, but by the discourse and learning quality of the interaction. Empirical analysis of interactions in classrooms (Morek 2012; Heller 2012) suggests that one student having the chance to complete a short unit, or two or three speakers who refer to each other and collectively work on producing an orchestrated discourse unit, raises more opportunities for discourse and content learning than having many students throwing in incomplete sentences without connecting with each other. As a consequence, moves that reconcile both motives are those which include many students in different roles, for example when the whole class is involved in asking for elaborations and explicating communicative demands. Then the interaction can provide learning opportunities for the single student without excluding the others. Hence fostering students to refer to other students' utterances (as emphasized by Cohors-Fresenborg and Kaune 2003, in their conception of discursive quality classrooms) is an important way to work for both aims at the same time.

2.4.4 Looking back

Although the synthesis of the seeming antinomies between perspectives is only briefly sketched here, the examples show how taking the participants' perspectives into consideration can dialectically change the *core* of the content. This has consequences for the last steps.

2.5 Outlook on Step 5: Iterative design of concrete PD programs

In the next step of the ongoing research-based design process, the specified and restructured content is integrated into a concrete video-supported PD program. By establishing a longer-term joint work on videos and transcripts (first from non-familiar classrooms then also from classrooms of the involved teachers, cf. Sherin 2007), we intend to

- sensitize for different moves and their immediate and long-term effects,
- make aware unconscious resources and routines,
- inform and reflect about effects and conditions of success for different moves,
- make explicit typical-seeming antinomies between different perspectives and initiate their integration into fruitful reorganizations of professional acting,
- expand the repertoire of moves by enhancing the understanding of underlying interactionist mechanisms.

First pilot trials with practicing teachers discussing selected video clips and transcripts (Leisen 2010) give hints as to how the MSPs can be made visible in the PD course, how their participation effects in the interaction can be reflected, and how teachers' repertoire of possible moves can be extended. The explicit reflection on the seeming antinomies seems to be crucial for allowing teachers to integrate the new perspectives into their existing professional vision.

For example, the third seeming antinomy between enabling one student to participate and enabling the whole class to participate was discussed by a group of teachers during a PD when watching the video of Kostas. After 10 minutes, both extremes of the antinomy were formulated by the participants. The first author's rephrasing of the conflicting positions as a seeming antinomy and the question how to reconcile the antinomy initiated the collection of further strategies, for example for moments in which one student says something not understandable in the class: continue to involve more students or support the one student to elaborate his utterance? Most preferred by the group were strategies that allow the rest of the class to react to the student; for example, reformulating the student's ideas or giving a visual scaffold at the blackboard to which all can refer. In this way, the student gets support and more students can be involved at the same time. The leading idea then is not "the student has meant," but "how can the other students understand his utterance?" The teacher group experiences these kind of collecting strategies as enormously fruitful.

These experiences are promising and motivate further iterations in the design process. Then, further design experiments will be needed to develop a solid instructional structure. The use of videos from unfamiliar classrooms as well as participants' classrooms have proven to be very instructive (as in other empirical studies, cf. Jungwirth et al. 2001; Sherin 2007; Maher 2008; and others).

3. Outlook for other contents

Research-based designs of PD programs should not only control the effectiveness of their pedagogies, but also adopt a research-based approach for specifying (selecting and constituting) the respective content in a controlled manner. But how to determine what teachers should learn in which way? Classroom research and teaching practices might be suitable starting points for a research-based design, but relating the empirically derived demands to teachers' actual professional perspec-

tives is the essential ingredient that seems to make the difference in enhancing teachers' professional development (Komorek et al. 2013; similarly Chapman 2014 for small groups).

For the exemplary content 'moves supporting participation' we show how the five-step approach allows integrating research-based claims on professional demands and teachers' perspectives dialectically. We argue that both are equally important, in that teachers have to be supported in achieving a synthesis of seeming mutually exclusive motives. Rather than *substituting* one hidden, but actually meaningful, motive of teachers by a new technique, we *reconcile* perspectives and thus help to reorganize the repertoire of teaching practices as well as the underlying perspectives.

Synthesizing different perspectives and motives rather than offering one-sided recommendations might also be a good way of thinking about other teacher challenges, because simple recipes for teaching practices are rarely adequate in any context. In this way, the five-step approach for specifying content might provide an adequate pathway for other PD programs which aim at achieving didactical innovation in the classrooms.

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Appendix

The sequences were transcribed according to the Gesprächsanalytisches Transkriptionssystem 2 (GAT) (Seltling et al. 2009). The transcripts were translated from German to English and simplified for enhancing readability and for avoiding translation:

[<i>comment</i>]	comments, non-verbal utterances or gestures are given in brackets in italics
[...]	signifies omitted parts of the transcript
[breaks 3.5 sec.]	breaks longer than 3 seconds are indicated
EMPHASIS	is referred to complete words instead of syllables
;	signifies falling voice
,	signifies rising voice
.	signifies finally falling voice.