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Facilitators' planning practices for PD activities and their alignment to chosen PD goals: A case study on relevance of unpacking PD goals

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For promoting students' mathematics learning and mathematics teachers' learning in teacher professional development (PD), setting clear learning goals and designing activities that align with these goals is crucial. We lift a typical research approach on teachers' planning practices to PD facilitators' planning practices and investigate what facilitators need to achieve alignment between chosen PD goals and the PD activities they design in their planning. The qualitative analysis of three planning documents indicates that the quality of the facilitators' unpacking of the PD goals might be crucial for coherent alignment of the activities to the PD goals.

Keywords: Facilitator preparation, facilitators planning practice, unpacking PD goals, designing content-related PD activity, language-responsive mathematics teaching.

Introduction: Investigating coherence in facilitators' planning practices for PD

Since several years, the practices of facilitators (i.e., mathematics teacher educators working in various forms of practicing teachers' professional development) are empirically investigated, mostly with the overall purpose to inform the design of facilitator preparation programs and their ongoing support (Borko et al., 2014; Lesseig et al., 2017; Karsenty et al., 2023). One issue identified in several studies is that novice facilitators only successively learn to tie their practices to the learning goals that were set for the PD session, this was found for *noticing practices* (Lesseig et al., 2017) and *discussion-leading practices* (Borko et al., 2014; Karsenty et al., 2023). The researchers of these studies draw the consequence that PD facilitators should work on these PD goals more explicitly in the preparation in order to achieve a better coherence between PD goals and noticing/discussion-leading practices. However, little is known so far if the identified loose coherences are effects of spontaneous in-the-moment decision-making (e.g., because atmospheric goals are prioritized before PD goals, Karsenty et al., 2023) or in how far they already occur in the facilitators' *session planning practices* (e.g., because goals were too diffuse, Lesseig et al., 2017). That is why we focus on facilitators' planning practices and pursue the following research question in this paper:

How do facilitators plan PD activities, and what guides their planning practices when they more or less coherently align the design of PD activities to the PD goals they have chosen?

We situate our research in a PD program on language-responsive mathematics teaching (Prediger, 2019), in a facilitator planning activity for the case of dealing with language obstacles in word problems. In order to pursue this research question, we draw upon theoretical constructs and findings from the classroom level about coherence of goals and activities (Seidel et al., 2005; Renkl, 2015) and the underlying teachers' practices (Morris et al., 2009) and explore how to lift them to the PD level while taking into account the higher complexities of the PD goals.

Theoretical background and PD context for the research

Alignment as a quality feature for planning practices

On the classroom level, clarity and coherence of lesson goals have been identified as essential quality feature of classroom instruction that significantly impact students' learning gains (Seidl et al., 2005). For effective teaching, this means, that setting clearly specified learning goals and designing classroom activities aligned to these learning goals are important jobs for which teachers should be prepared. As Morris et al. (2009) have pointed out, "clarity about learning goals requires analysing and unpacking learning goals into their constituent parts" (p. 493), based on this, they suggest to include the practice of unpacking learning goals consequently into teacher preparation courses.

In this paper, we intend to lift these considerations about coherently aligned planning practices to *the PD level*. This lifting strategy is justified by findings that not only student learning, but also adult learning can most effectively be promoted by activities that are systematically *focused* to clearly specified learning goals (even if these goals are more complex), whereas ineffective instruction is often shaped by missing focus (Renkl, 2015). Whereas we can assume that for PD programs, the clarity and coherence of PD goals can substantially shape teachers' professional learning opportunities, qualitative studies show that facilitators can struggle to create coherence (Borko et al., 2014; Karsenty et al., 2022). In analogy to the research on teachers by Morris et al. (2009), we therefore study two essential *facilitators' practices for planning a PD session*: (1) setting PD goals and (2) designing PD activities aligned to these chosen PD goals. We investigate in how far they benefit from a (3) practice of systematically unpacking the PD goals to achieve coherence between chosen goals and designed PD activities, like shown by Morris et al. (2009) for teachers.

Unpacking teacher jobs to specify the PD goals: The case of dealing with language obstacles

Unpacking PD goals for teacher learning can be more complex than unpacking mathematical learning goals for students, in particular when the overall PD goal is not the mathematics, but enhancing multifaceted teacher expertise with its underlying pedagogical content aspects (Prediger, 2019). Bass & Ball (2004) suggested to conduct a job analysis to specify what teachers should learn so that it can be explicitly addressed in targeted ways.

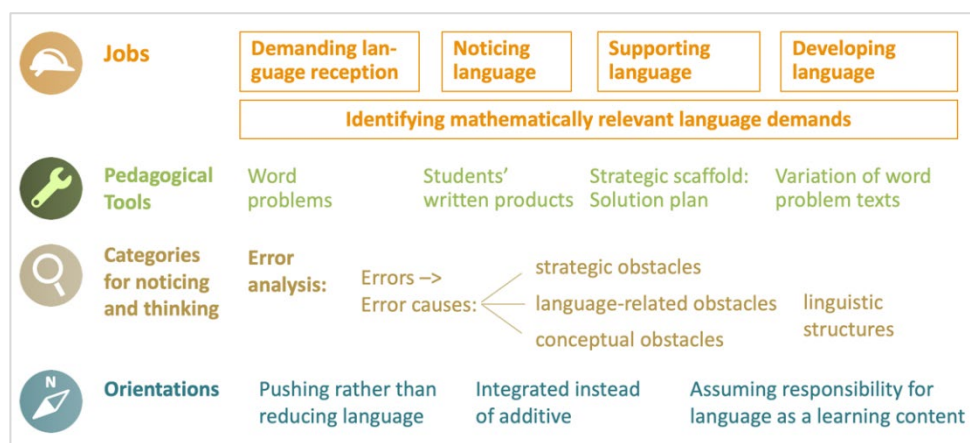


Figure 1: Unpacked PD goals for dealing with language obstacles in word problems

In the PD program chosen for this paper, the overall PD goal is to promote teachers' expertise for language-responsive mathematics teaching. This PD goal was decomposed into *five teacher jobs* (i.e., recurrent demands of teaching): *demanding* students' language production and reception, *identifying* mathematically relevant language demands, *noticing* students' assets and obstacles, *supporting* students in overcoming the obstacles, and by this, successively *developing* students' language proficiencies. These five jobs can be mastered by varying teaching practices with different *pedagogical tools* (e.g., sentence starters as scaffolds for supporting language), and underlying pedagogical content *categories* for perceiving and thinking, and *orientations* that implicitly or explicitly guide teachers' decisions (Prediger, 2019).

In a particular PD session, not the whole landscape of all jobs with the intended practices (and their tools, categories, and orientations) are usually addressed, but only parts of it. For example, Figure 1 sketches what might be involved when teachers address the jobs of language-responsive teaching for the particular case of dealing with language obstacles in word problems. When facilitators are supposed to plan their PD, we ask them to *set their PD goals*, i.e., to choose PD goals as a subset of all possible jobs and constituents, and substantiate them for the particular case. On this base, they can design their PD activities (with particular representations of practice such as students' written products, videos, activity structures, focus questions and a plan for the intended outcome of the activity). We call the designed PD activity coherently aligned with the chosen PD goals, when simulating the chosen jobs is explicit part of the PD activity and the relevant underlying constituents become focused, e.g., by a categorial scheme to be used for noticing. When analysing the facilitators' PD practices, it is therefore crucial not to compare their PD activities to the original intention of the PD program designer, but to the unpacked PD goals they have chosen themselves for their own teachers.

Research context and methods for analysing facilitators' planning practices

Research context: Large-scale teacher PD program with facilitator preparation program

The current study is conducted within an ongoing large-scale teacher PD program in which both authors design and investigate facilitator professional development (FPD) to prepare 19 facilitators to conduct an 18-month teacher PD program. The facilitators were experienced with other mathematics education PD programs, but 17 of 19 were new to the PD content in view, language-responsive mathematics teaching in the sketched five jobs and its underlying constituent parts (Prediger, 2019). The FPD program run over two years (in total, 46 hours), after six months, the first PD session started, so that the facilitators had their own PD simultaneously with a mini-successions within the FPD.

In order to enhance the facilitators' abilities to set PD goals, to plan PD activities aligned to these goals and to conduct the PD discussion, a PD content map with the decomposed teacher jobs and unpacked underlying constituents (similar to Figure 2) was explicated and repeatedly used for setting PD goals, noticing teachers' ideas and challenges and simulating reactions. In all FPD materials, activities for the classroom level, PD level, and FPD level were always explicitly distinguished by standardized colour codes. The alignment to the PD goals was always discussed, in particular with respect to the difference between pedagogical tools that can easily be handed over to teachers, but only work when also the underlying categories for noticing and thinking and orientations are mentally constructed by the teachers, for which teachers need learning opportunities.

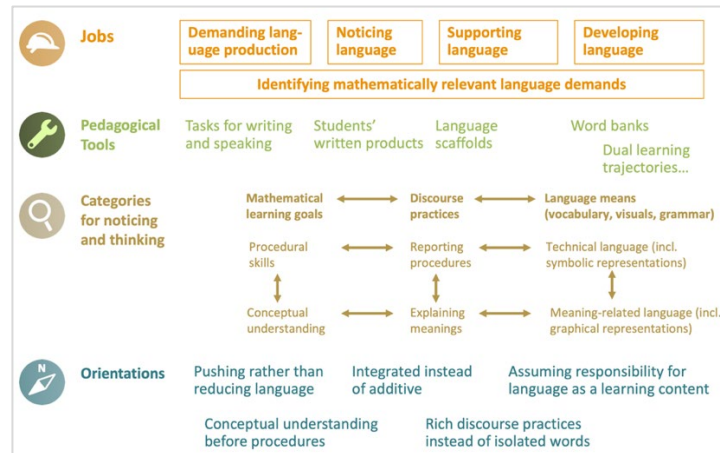


Figure 2: Map of PD content elements for language-responsive mathematics teaching (Prediger, 2019)

Method of data collection on facilitators' planning practices

After 9 months of FPD, and after 3 months of conducting highly specified PD sessions designed by the program leaders, the facilitators were invited to plan their own next PD session in their co-facilitation pairs for the teacher group they work with. This planning activity required a transfer of the general PD content map from previous cases in which students' language production with epistemic purpose was foregrounded (Figure 2), to the particular topic of language reception in word problems. This transfer was supported by a professional journal paper on this topic. A possible adaptation of the PD content map for the particular topic is suggested in Figure 1.

In order to capture the facilitators' planning practices and the underlying reasoning, we asked them to document their planning and explain their decisions around one core PD activity with potential inputs and systematization phases of about one hour, scaffolded by four questions (later the columns in Table 1): 1. What are your goals for this PD activity (adapted from our PD content map)? 2. What design do you choose for your PD activity? 3. How do you design the questions, what will you ask your teachers to do? (4) What answers or outcomes do you intend to get in the end? The written planning documents form the data corpus of the current study. In this paper, we selected documents from focus facilitator pairs that highlight different practices in setting PD goals by more or less unpacking PD goals and designing PD activities. The criterion for case selection was their potential to illustrate interesting phenomena about the content-guided planning practices by our facilitators.

Methods of data analysis

To pursue the research question, we qualitatively analysed the written planning documents (see examples below in Table 1), in *Step 1* by coding (a) the explicitly selected PD goals (decomposed into jobs and eventually unpacked with respect to underlying PD content elements such as pedagogical tools, categories, orientations; see Figure 1) and (b) which of the PD content elements were really addressed in the designed PD activity, this was operationalized by their occurrence in the anticipated teachers' reasoning and discussions (in line or not with the chosen PD goals), and (c) for which of these PD content elements the facilitators provided explicit learning opportunities and scaffolds within the PD activity. In *Step 2*, the comparison of set PD goals and addressed and supported PD content elements allow us to evaluate in how far the facilitators PD activity design was aligned to

their chosen PD goals (operationalized by analogical occurrences in different columns). In *Step 3*, we summarized teachers' planning documents to print an extract, for the empirical insight here. Examples for the coding procedures can be found in Table 1.

Table 1: Extracts of three facilitator pairs' planning documents on PD activities with color codes for addressed PD content elements (jobs, pedagogical tools, categories, orientations, crossed-out: PD content element chosen as PD goal, but not addressed in activity design, bold: additional elements not in goals)

	1. General goals of PD activity	2. Design of PD activity phase (often unpacked goals of activity)	3. Designed questions in PD activity	4. Intended answers / outcomes at the end of PD
Pair A	Demanding, noticing, supporting and developing language Assuming responsibility for students' language learning	Clarify connection between language-related and conceptual obstacles as error causes, to motivate the need of preventing different causes of errors. Provide theoretical input on approaches to help students deal with language and strategic obstacles, where strategic scaffolding and variation can support students in dealing with the word problems.	(1) Apply the strategic scaffold to solve this penguin word problem as an example. (2) Vary the penguin word problem slightly , so that a different solution (pathway) must be used. Use the material for the visual presentation of several variations and solutions.	Various solutions are presented. Participants train themselves to use the strategic scaffold and the problem variation from the student's point of view. The teachers see the benefits to student success in overcoming obstacles in word problems. So, they will incorporate them into their planning in the future.
Pair B	Participants should: - identify the relevant language demands (job) in three given texts. - take an integrated view on language and conceptual challenges (orientation) . - support the relevant linguistic structures (job) , without simplifying the texts (orientation: offensive approach). - provide support by strategic scaffolds and variation (tools) .	Individual work: Anticipating language and conceptual obstacles for three different word problems. (Short discussion to check whether the focus is on the mathematically relevant linguistic structures.) Group work: Creating subtasks for the word problems to support the relevant conceptual and linguistic structures by using the principles (suitable strategic scaffolds and variation).	(1) Where are the obstacles (language, conceptual, strategic) for dealing with this word problem? (2) What language and conceptual challenges you expect for your students in these word problems? (3) Outline a task/series of tasks to sensitize your learners for the relevant linguistic and conceptual structures. Use suitable strategic scaffolds, the principle of variation etc. to do this.	- Focus on linguistic structures which are relevant for conceptual understanding. - Support of key structures (conceptual and language-related). - Use of principles (strategic scaffolds, variation).
Pair C	Supporting, noticing and developing language Identifying and analysing error patterns and causes [unpacked noticing]	We use student documents on word problems from the given background literature for making participants analyse . Goal: Identification of error causes and good error analysis are first steps to promote students' ability to deal with obstacles. Right choice according to error causes is crucial.	Analyse the causes of errors in the following word problems and describe a possible procedure for discussing the error with the students.	Here we hope for a similar insight as was formulated in the paper. Basic aspects in the area of error analysis should be recognized and partially applied . In addition, it should also be internalized that there are several possibilities (depending on the error cause) to correct it with the students.

Empirical insights: Three cases of planning practices and different alignment

Table 1 reveals the summarized planning documents of the three focus pairs of facilitators, Pair A, B and C, for each of the planning questions. The colours refer to the constituents in Figure 1 and 2.

Case of planning practices of Pair A: No alignment between unpacked PD goals and PD activity

Column 1 of Table 1 reveals that Pair A (presented in the first row) has developed the routine to consider (at least four out of five) jobs as the overall PD goal, and add the overall orientation “assuming responsibility for students’ language learning”. Only in the moment that they plan the overall design of the PD activity, they restrict themselves to the jobs of noticing and supporting language, and go deeper into the professional journal paper that provides for them a powerful unpacking of the jobs noticing and supporting which is correctly reproduced (Column 2, similar to Figure 1). While staying near to the journal paper, they address both, the pedagogical tools for teachers (strategic scaffolds and variation) and the underlying PD elements that still need to be unpacked for mastering the intended jobs: the integrated view of language and conceptual challenges (“connection between language-related and conceptual obstacles”) and the relevant categories for distinguishing the different backgrounds of student errors, strategic and language-related obstacles. Interestingly, this reproduced unpacking only scarcely informs the concrete questions these facilitators plan to ask in the activity (Column 3) and the outcomes they expect from it (Column 4): they exclusively plan a self-experiment on a typical student classroom task, but no simulation of the teacher jobs of noticing students’ errors and analysing their backgrounds, or supporting the students (Column 3). This is also reflected in the intended outcome of the PD for the teachers (Column 4), which highlights the orientation of responsibility for students’ language learning, but only drawn from the self-experiment of solving the word problem with the scaffold, without genuine teacher activities. *In total*, Pair A does not achieve alignment of their PD activity to the decomposed jobs (only one job is implicitly addressed, but from students’ point of view) nor to the unpacked underlying categories for noticing by error analysis.

Case of planning practices of Pair B: Supported alignment to systematically unpacked PD goals

In the planning document of Pair B (summarized in the second row in Table 1), we see a very elaborated setting of PD goals, both in general (Column 1) and in the concrete activity (Column 2), which also includes the explicit addressing of the meta constructs from the PD content map (“jobs”, “orientations”, “categories”, “tools”). The learning goal is not only decomposed into jobs (identifying, supporting), but also unpacked into the underlying PD elements, as the tools (“strategic scaffold” and “variation”), the categories (“language and conceptual challenges”; “relevant linguistic structures”) and possible relevant orientations (“integrated view” and “offensive approach”), which are substantially connected to each other in the articulation of goals. The highly unpacked specification of the learning goals down to the elements to be learned is also reflected in their questions articulated for the PD activity (Column 3) and the intended outcome (Column 4). The facilitators succeed in planning a meaningful learning sequence (from task 1 to 3 in Column 3) for teachers along the three jobs: (1) identifying, (2) noticing and (3) supporting, with adequate underlying categories (“challenges (language, conceptual, strategic)”, “relevant linguistic structures”) and tools (“suitable strategic scaffolds, the principle of variation”) to enable teachers to master the jobs. *Summing up*, Pair B’s planning document shows a highly coherent alignment between PD learning goal and planned activities which

are unpacked into exactly the same categories and orientations as for the other two jobs identifying and supporting. In addition, through focused cognitive activation as a learning graduation, these two facilitators empower their teachers to learn how to master the jobs and their challenges.

Case of planning practices of Pair C: Selective alignment yet without sufficient support

In the planning document of Pair C (summarized in the third row in Table 1), we can see just by the orange colouring throughout all columns that the facilitators focused on a specific aspect from the PD content map, namely error causes as a category for identifying, noticing and deciding about approaches to develop students' abilities (in column 1: "identifying and analysing error causes"; in column 2: "identification of error causes"; in column 3: "Analyse the causes of errors"; in column 4: "depending on the error cause") and has coherently planned and designed the PD activity along this choice. If we look more closely at the general planning, we see that in addition to the specific category they choose three jobs as PD learning goal. In the more concretized activity goal (in column 2), identifying is also addressed as another job. In the question phrased in column 3, all the three jobs occur, but they do not necessarily become learnable for teachers in this way because they are all clustered into one task instead of into a meaningful learning sequence. In addition to this, providing relevant PD content elements (such as the pedagogical tools for developing language, the strategic scaffolds and formulation variation) would have been an asset to enhance the learning process of the teachers that is not mentioned, here. Addressing the pedagogical tools within the activity would indeed be important, because looking at column 4, it becomes clear that they are demanding a relatively high performance from their teachers (like linking the not supported/provided pedagogical tools into relevant categories: "there are several possibilities depending on the error cause"), which may be difficult to achieve without adequate learning opportunity for "how to unpack" within the activity itself. *Summing up*, Pair C decomposes the PD goals not just in PD jobs, but also into one specific underlying PD content element (category "error causes"), even if the unpacking considers less all underlying PD content elements (Figure 3) and their own expectations (Table 1, Column 4). A next step in these facilitators' professional growth would be to plan more sequenced activities with more supports.

Discussion and conclusion

In our analysis, all three pairs of facilitators have chosen nearly the same PD goals for their teacher groups: identifying, noticing, and supporting or developing language. However, we see that they succeeded differently in further unpacking these jobs into more detailed PD content elements (like the teachers in Morris et al., 2009). Whereas some facilitators (Pair A and further pairs in the larger data corpus) only plan activities on the student level, others work through various teacher jobs and thereby provide learning opportunities nearer to teachers' practices. The case of Pair C (and others in the whole data corpus) indicates that the decomposition into selected jobs can be of help to find a more suitable sequence of PD activities. However, for supporting the teachers to master the jobs during the PD activity, it seems to be necessary to unpack more in detail than Pair C what exactly the teachers have to learn, as the support for underlying PD content elements depends on this unpacking (Ball & Bass, 2004). We *generated this hypothesis* in line with Morris et al. (2009) and underpin it by the contrast of Pair C and B, as only Pair B who unpacked the underlying PD content elements in detail were able to provide sufficient support for their participating teachers.

Even if this small-scale case study works with very limited data (written planning documents are much less rich than, e.g., oral planning discourses), it can provide first humble indications that the challenges of novice facilitators found in *noticing practices* (Lesseig et al., 2017) and *discussion-leading practices* (Borko et al., 2014; Karsenty et al., 2023) can already root in facilitators' *session planning practices*: Like for noticing and discussion-leading, too diffuse goals are insufficient for a targeted planning of PD activities. This calls for making potential PD goals as explicit as possible, and therefore to treat the PD content map as a tool that supports facilitators compiling robust plans.

These insights allow for further fine-tuning of FPD programs, particularly the FPD activities to address unpacking of PD goals not just into jobs, but particularly into underlying PD content elements (Lesseig et al., 2017, Borko et al., 2014), including the reflection about alignment of intended goals, the addressed ones in designed PD activities and the expectations of the outcome of the PD activity.

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