

**Supporting
teacher
reflection**
*in video-coaching
settings*

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SUPPORTING TEACHER REFLECTION IN VIDEO-COACHING SETTINGS

DISSERTATION

to obtain
the degree of doctor at the Universiteit Twente,
on the authority of the rector magnificus,
prof. dr. ir. A. Veldkamp,
on account of the decision of the Doctorate Board
to be publicly defended
on Friday 14 October 2022 at 16.45 hours

by

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This research was supported by a grant from the Dutch Ministry of Education, Culture and Science (BSL2013-06) and conducted in the context of the research school Interuniversity Centre for Educational Research (ICO)

ico

Lay-out: Kern, studiokern.nl

Cover design and lay-out: Kern, studiokern.nl

Printed by: Ipskamp Printing

ISBN: 978-90-365-5455-8

DOI: 10.3990/1.9789036554558

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Chapter 1

Introduction

Abstract

Teaching is a complex task that needs to be supported in order to retain high-quality teachers, especially novices. Two forms of professional development that have the potential to be highly effective together are teacher coaching and the use of classroom video. Unfortunately, while each of these has received considerable attention in educational research over the years, investigation of the combination – teacher video-coaching – is limited. Nonetheless, many schools invest in personnel and equipment to enable video coaching for teacher professional development, in which recorded teaching episodes are used to stimulate reflection. The lack of research is unfortunate because an empirical basis is needed to inform and develop supports for teacher coaches. There is as yet very limited insight on how to support coaches in this type of work. This study was undertaken to address these concerns. Three research objectives were formulated to guide this study, namely, (1) to conceptualize teacher reflection in video-coaching settings, (2) to articulate support to improve teacher reflection in video-coaching settings, (3) to reify (make concrete) the articulated support to improve teacher reflection in video-coaching settings. To achieve them, four sub-studies were undertaken within one educational design research project. This chapter introduces the sub-studies individually, shows how they map onto the different phases of educational design research, and describes how they contribute to achieving the three research objectives.

Positioning the study

Supporting Life-Long Learning through Video Coaching

Learning to teach is a complex task, and according to many, especially daunting early on. Learning to teach is also a life-long process, beginning formally in preservice education, continuing into induction during the early stages of a teaching career, and progressing later on through professional development (Feiman-Nemser, 2001). Novice teachers, who are still learning while teaching, need to sustain effective teaching practices, while also gaining understanding of the school and class context where they are teaching and developing their identities (Feiman-Nemser, 2001). Support is needed during these stages. Teacher coaching has been suggested as a way to support novice teachers' professional development (Dutch Ministry of Education, Culture, & Science, 2022; Podolsky et al., 2016). Teacher coaching is characterized by an "observation and feedback cycle in an ongoing instructional or clinical situation" (Joyce & Showers, 1981, p. 170). Adding classroom video to teacher coaching can allow for close analysis of practice, support teacher discussions, and illustrate situations that are difficult to put into words due to their complexity (cf. Marsh & Mitchell, 2014). However, existing research indicates that learning with video requires facilitation (Gaudin & Chaliès, 2015; Gelfuso & Dennis, 2014). Surprisingly, there is very limited insight into how to support teacher coaches who use video in their own schools (Tekkumru-Kisa & Stein, 2017). This study intends to address this gap.

Characterizing Video Coaching

The roles of coaches within and outside of schools can vary widely within and across states, districts, and schools (Deussen et al., 2007; Mangin & Dunsmore, 2015), and likely between countries. In this study, video coaching is considered as a specific activity in a broader teacher-coaching repertoire, which includes many activities along with video coaching, such as modeling and brokering ideas (Gibbons & Cobb, 2017; Woulfin & Rigby, 2017). Specifically, video coaching is defined as a professional development approach in which teachers or coaches record teaching episodes and engage in video-based one-to-one or group-based discussions in a sustained manner (van der Linden & McKenney, 2020). Sustained implementation means that video coaching ideally consists of multiple cycles of coaching within a school year. Externally, that is, outside schools, coaches are often highly-skilled and part

of the development team or program staff (Kraft & Blazar, 2018), as has been observed in various studies (e.g., Sherin & van Es, 2009). Coaching programs typically include a handful of these high-quality coaches, while systems to train coaches are largely underdeveloped (Kraft & Blazar, 2018). This is problematic, because schools outside of these programs do not have access to this high-quality coaching expertise, and apparently there is limited understanding of how to share important insights from these programs. Conversely, internally, that is, within schools, coaching roles are often fulfilled by teachers (Darling-Hammond et al., 2017), and teacher coaching thus refers to an on-site human resource enacting instructional leadership (Mangin & Dunsmore, 2015).

Teacher coaching is considered both a strategy to support individual teacher development and an approach to support the development of system-wide changes (Mangin & Dunsmore, 2015). As such, coaches (who use video) often find themselves in intermediary positions between individual learning needs and school ambitions and vision, and insights from both can be leveraged to support development (Woulfin & Rigby, 2017). As can be gathered from this, coaches often act as boundary spanners whose roles and practices are influenced by both the school contexts in which they work and the professional development needs of the teachers whom they serve. Unfortunately, coaches often feel unsupported (Gallucci et al., 2010), which is exacerbated by the fact that few studies have reported on ways to structure professional learning for (video) coaches (Tekkumru-Kisa & Stein, 2017; Wenner & Campbell, 2017).

Three Research Objectives

While video coaching appears promising for supporting teacher development, more insight into this phenomenon is needed in order to support coaches who use video in their coaching practice. Fortunately, studies into video-based teacher learning offer some points for departure. In addition to suggesting that learning should be guided by a knowledgeable other (e.g., coach or facilitator), they stress the importance of teacher reflection, and elucidate how coaching with video can help focus this process on teaching and learning (Gaudin & Chaliès, 2015; Gelfuso & Dennis, 2014). Reflection is broadly defined as the “active, persistent and careful consideration of any

belief or supposed form of knowledge in the light of the grounds that support it and the further conclusions to which it tends..." (Dewey, 1933, p. 9). In the next sections, the literature is synthesized to elucidate what is currently known about teacher reflection in video-coaching settings, the supports and the tools for coaches to improve it, and where more research is needed to support video coaches' practices.

Teacher Reflection in Video-Coaching Settings

The scientific literature provides many valuable insights on teacher learning with classroom video and on teacher coaching, although not specifically together. Systematic literature reviews on teacher learning with video have described the way various types of classroom videos (teachers' own or others' videos) can be used (Gaudin & Chaliès, 2015), the affordances of using classroom video for teacher learning (Marsh & Mitchell, 2014), and the use of video for teacher reflection (Tripp & Rich, 2012). Moreover, these reviews have provided insight into the outcomes of video analysis for teacher learning, most notably, teachers' reflective abilities (Marsh & Mitchell, 2014) and professional vision (Gaudin & Chaliès, 2015; Marsh & Mitchell, 2014). In addition, a recent review on teacher coaching illustrated that this approach can have an effect on teacher instruction as well as student outcomes, although effects diminish when programs are scaled up (Kraft et al., 2018). Difficulty building a large capable corps of coaches, as well as inculcating teacher buy-in have been mentioned as possible reasons for these findings. While these reviews provide important insights into the use of classroom video, as well as teacher coaching to support teacher (and student) outcomes, comprehensive reviews on the combination of video and teacher coaching, that is, video coaching, are lacking. This means that there is limited insight into what this approach entails.

In addition, teacher reflection has been a topic of investigation for decades and is widely considered important, but what it is and how it can support teacher learning in video-coaching settings is unclear. Specifically, teacher reflection is regarded a key component of teachers' professional development (Darling-Hammond et al., 2017). Moreover, teacher reflection is widely considered important for developing teachers' practice, as can be gathered from its inclusion in national and regional teaching or qualification standards in Europe, such as the Netherlands (Dutch Ministry of Education, Culture, and Science, 2017), the UK (United Kingdom Department for Education, 2014), and the US, for example the state of California (Commission on Teacher Credentialing, State of California, 2009). While thus regarded as important for both teacher education and teacher professional development, it is an ambiguous concept that can mean different things (Clará, 2015), and the

different conceptions of teacher reflection have made it difficult to compare studies (Van Beveren et al., 2018). In a similar vein, another review reported that the relationship between teacher reflection and action resulting from this reflection (i.e., outcomes) is not always clear (Mena Marcos & Tillema, 2006). Together, these insights indicate that there is limited understanding of what teacher reflection in video-coaching settings entails, and whether and how teacher outcomes can be supported using this approach.

Coaches need understandings of what is meant by teacher reflection in video-coaching settings to be able to apply this approach to their own contexts. The ambiguity concerning teacher reflection is problematic, because insights into the characteristics of productive reflection are needed to guide productive coaching practices. Coaches need to know what aspects of reflection they must pay attention to and for what reason in order to be able to steer reflection in a conversation. This is important, because teachers do not always reflect productively (Gelfuso & Dennis, 2014). This type of knowledge could especially support video coaches in schools, who do not have the support or knowledge that is often present in external coaching programs. Moreover, whether and how video coaching can contribute to teacher outcomes, such as knowledge, instructional practices, and attitudes, has not been established, nor is the role or nature of reflection clear in these settings. This information is needed to help coaches to make informed choices about whether video coaching is suitable for the professional development needs in their own school. Together, this line of reasoning indicates that understanding what teacher reflection in video-coaching settings entails as well as how learning ensues are both needed. Therefore, the first objective of this study is to conceptualize teacher reflection in video-coaching settings.

Support for Improving Teacher Reflection in Video-Coaching Settings

There is some literature on video coaching that is highly relevant to supporting video coaches, specifically focusing on what coaches actually do to foster learning, in terms of their facilitation moves. Studies that reported on facilitation moves have shown the intentional nature of this process (van Es et al., 2014). Moreover, the studies that have reported on facilitation of learning with teachers' own video (i.e., what is considered video coaching in this study) all reported moves for (1) setting up and maintaining a productive learning community and (2) supporting productive discussion based on the video, both of which are grounded in data on facilitator actions (Borko et al., 2014; Coles, 2013; Gröschner et al., 2014; van Es et al., 2014). As such, these studies have provided valuable insights into ways to enact productive coaching moves, along with illustrations of what that looked like in practice. Moreover, some

insights have been so well elaborated that they could serve as a ‘cheat sheet’ during coaching (e.g., the framework by van Es et al., 2014). As such, these studies provide detailed guidance for the actions that a coach could take to support teacher learning with video. However, the research base on how to support coaches’ efforts in video-based professional development remains comparatively thin (Tekkumru-Kisa & Stein, 2017), while there is a pressing need to develop more highly skilled facilitators or coaches, as such coaches are necessary to provide high-quality professional development (Marrongelle et al., 2013).

In particular, coaches need additional support to lead video-coaching initiatives within their own schools. While the research on coaching moves provides an extremely valuable basis for the enactment of coaching sessions, support is also needed to guide coaches’ reasoned decision-making about how to approach developmental challenges within their own schools. Coaches in schools must take into account contextual needs and constraints, at both the school level and the teacher level. Hence, considerations regarding teaching and reflection quality, in light of the school context, seem especially relevant for planning and reflecting on the professional learning opportunities that coaches offer. Literature on learning and instruction could be leveraged to identify promising routes to address these coaching challenges, and thus help coaches to take the lead in developing professional learning opportunities within their own schools. But as yet, articulation of support that can help coaches to design and implement video coaching within their institutions is lacking. Therefore, building on conceptualization how learning through video coaching and reflection occurs (first research objective), the second objective is to articulate support for improving teacher reflection in video-coaching settings.

Tools for Improving Teacher Reflection in Video-Coaching Settings

The literature on teacher reflection (with video) mostly reports the use of instruments to assess teachers’ reflective writing or methods of analysis based on transcribed coaching conversations. Standardized instruments are reported that support the assessment of reflective writing (e.g., Nagro, 2020; Nagro et al., 2017; Ward & Cotter, 2004), but no standardized instruments have been reported that support the assessment of teachers’ reflective talk. In empirical research, the assessment of reflective talk is often approached through qualitative coding (e.g., Lee, 2005), but such an approach is not suitable for practical use by coaches, because of the time it requires. Coaches need the information from an assessment to improve the next conversation. A transcribing and coding approach is not likely to fit within this cycle, especially

if the coach is responsible for the development of a larger teacher community. Instead, coaches need tools that can help them to gain insight into what reflective quality looks like and how to improve it efficiently. Moreover, such tools are needed because teachers have difficulty reflecting productively with video, which needs to be guided (Gaudin & Chaliès, 2015), and because facilitating productive discussions regarding teachers' own videos is also challenging for coaches (Borko et al., 2014). Tools could have the potential to mediate coaches' perceptions of what productive reflection looks like and could provide advice on how to improve it. Tools are especially needed to support the assessment of teacher reflective talk that shows up in real video-coaching practices in schools.

Coaches working in schools, could be supported by tools to formatively assess teacher reflection, but these need to be viable in practice. When viability is concerned, it is important to pay attention to implementation early on, to maximize the chances that the tools being created will yield: added value, be clear to users, feel compatible with core convictions, and remain tolerant of adaptations (McKenney & Reeves, 2019; McKenney et al., in press). Since no such coaching tools are available, there is limited insight into what features need to be included to make such tools viable in practice. Thus, based on the articulation of possible supports to improve teacher reflection in video-coaching contexts (second research objective), reification is needed to explore if and how a tool to improve teacher reflection could be viable in practice. Reification (i.e., the process of making something abstract into something concrete) can thus be understood as a construction process. Therefore, the third objective is to reify the articulated supports in a tool for improving teacher reflection in video-coaching settings.

Shaping the Study

Research Objectives

While the literature provides insights related to teacher coaching as well as teacher learning with video, research is limited on how to design video coaching in schools as a form of professional development, and how to support coaches. This is especially important because video-rich teacher reflection is not automatically productive and needs guidance. Designing support for coaches is challenging, because their work is highly influenced by the context in which it is situated; therefore, support should be flexible and foster

their leadership in providing professional learning opportunities to teachers. Consequently, the aim of this dissertation is to develop theoretical knowledge as well as practical outputs for coaches on how to improve teacher reflection in video-coaching settings. Specifically, the present study has three main objectives:

1. To conceptualize teacher reflection in video-coaching settings;
2. To articulate support for improving teacher reflection in video-coaching settings;
3. To reify the articulated support in a tool for improving teacher reflection in video-coaching settings.

Educational Design Research Approach

Educational design research is characterized by its intention to simultaneously develop theoretical insights along with practical outputs for real-world use (Bakker, 2018; McKenney & Reeves, 2019; Plomp & Nieveen, 2013). This aligns well with the research objectives of this study, and therefore selected as the research approach for this dissertation. Educational design research distinguishes the phases (and underlying core processes) of (1) analysis and exploration, (2) design and construction, and (3) evaluation and reflection, during which explicit attention is paid to implementation and spread (McKenney & Reeves, 2019). These phases may be undertaken in sequential fashion, but this does not have to be the case. During analysis and exploration, the focus is on gaining insight into the existing situation, during design and construction solutions are developed, and during evaluation and reflection solutions are tested. Through each of these implications for theory, design, and implementation are considered (McKenney & Reeves, 2019). To achieve the research objectives, this study foregrounds qualitative methods due to its overall exploratory approach, although mixed methods were also used.

Research Design

This dissertation study consists of four sub-studies (A, B, C, and D), each aligned with one of the main educational design-research processes (analysis, design, construction and evaluation, respectively). Figure 1.1 previews the alignment between the research objectives and the sub-studies. Thereafter, the contribution of individual sub-studies to each research objective is clarified. In the last section of this chapter, the individual sub-studies are described in greater detail.

Figure 1.1

Alignment of the Sub-Studies and the Research Objectives

		SUB-STUDIES			
		Analysis (A)	Design (B)	Construction (C)	Evaluation (D)
RESEARCH OBJECTIVES	Conceptualize (RO1)	Teacher Reflection in Video Coaching Settings			
	Articulate (RO2)		Support for Improving Teacher Reflection in Video Coaching Settings		
	Reify (RO3)			Tools for Improving Teacher Reflection in Video Coaching Settings	

As shown in Figure 1.1, each of the research objectives is supported by at least two sub-studies, while each sub-study also is valuable in its own right. The first research objective – conceptualizing teacher reflection in video-coaching settings – is addressed through sub-studies A, B, and C. Sub-study A contributes to conceptualization of teacher reflection in video-coaching settings by systematically synthesizing empirical research on teacher video-coaching. Sub-study B contributes to the conceptualization of teacher reflection in video-coaching settings by synthesizing literature on teacher reflection, specifically paying attention to the way various perspectives on knowledge development shape reflective processes. Finally, sub-study C contributes to the conceptualization of reflection in video-rich settings by validating the insights on video-rich teacher reflection from sub-study B with teacher reflection experts, and developing understanding of what aspects are important to consider when assessing video-rich reflective conversations.

The second research objective – articulating support for improving teacher reflection in video-coaching settings – is addressed through sub-studies B, C, and D. In these sub-studies, two complementary approaches

to support the improvement of teacher reflection in video-coaching contexts are put forward. Sub-study B describes an approach for structuring video coaching based on insights from instructional design theory. Sub-study C identifies a genuine need for supporting formative assessment of video-rich reflection, as well as important reflection aspects to pay attention to, and sub-study D describes an approach for structuring formative assessment for the improvement of teacher reflection in video-coaching settings and the role of technology in it.

The third research objective – reifying the articulated support in a tool for improving teacher reflection in video-coaching settings – is addressed in sub-studies C and D. Sub-study C operationalizes and evaluates indicators for an instrument assessing video-rich teacher reflection with experts, while in sub-study D, a minimally viable tool to formatively assess video-rich reflective conversations is explored for viability in a proof-of-concept study.

Overview of the dissertation

As described previously, four sub-studies were undertaken to understand and support teacher reflection in video-coaching settings. In this section, brief descriptions of each sub-study and chapter are given. Thereafter, a visual overview of the dissertation is provided in Table 1.

Chapter 2 (Sub-study A), *Video Coaching from Design Features to Student Impacts. A Systematic Literature Review*, reports on a systematic literature review undertaken to gain insight into the phenomenon of video coaching. It uses a logic modelling approach, specifically looking into the observed design features, enactment processes, outcomes for teachers and their students, and their co-occurrences. A total of 59 out of 2362 retrieved journal articles were included based on a 5-step selection process. Data were extracted from the articles and assigned to specific categories using a logic model framework. Next, the data analysis was executed in two parts. First, individual articles were analyzed to identify codes and create a codebook. Second, to answer the research questions, the aggregate occurrences and co-occurrences of conjecture-map concepts within the corpus were investigated. This study has been published in *Review of Educational Research* (van der Linden et al., 2021).

Chapter 3 (Sub-study B), *Uniting Epistemological Perspectives for Contextualized Knowledge Development*, reports a theoretical synthesis in which it was argued that uniting epistemological perspectives during reflec-

tion is beneficial for teachers' contextualized knowledge development. This study elaborates upon an instructional design approach for complex learning in video-coaching settings, and provides a detailed blueprint for designing video-coaching interventions. This study has been published in *Educational Technology Research & Development* (van der Linden & McKenney, 2020).

A brief intermezzo is placed between Chapters 3 and 4. This practitioner-oriented piece entitled, *Design and Enactment of Mobile Video-Coaching* describes the design and enactment of mobile video-coaching. It elaborates on the various functions of technology in mobile video-coaching settings where teacher learning is not bound to a physical location, Written with educational technology coordinators in mind, it provides important considerations for those who wish to undertake and support video-coaching in schools. This article has been published in *TechTrends* (van der Linden et al., 2019).

Chapter 4 (Sub-study C), *Assessing Teachers' Video-Rich Reflective Conversations: Expert Views and an Initial Instrument*, investigates the assessment of teachers' reflective conversations in general, and with regard to instruments having various purposes (summative, formative, or descriptive) through a Delphi-inspired approach. While exploring expert opinions, an initial instrument for assessing video-rich teacher reflection was developed and evaluated on its clarity. In this mixed-methods study, expert views on teacher reflection from research and practice were gathered through open- and closed-ended survey questions and interviews ($n = 27$). Results from each round were used as input for the next round. This study is currently under review.

Chapter 5 (Sub-study D), *Computer-Supported Formative Assessment of Teacher Reflection in Video-Coaching Settings: A Proof-of-Concept Study*, reports on a proof-of-concept-study regarding the viability of a teacher reflection formative assessment tool with participants who have varying insights on coaching teachers ($n = 17$). In this mixed methods study, participants used a prototype of a teacher-reflection formative-assessment tool while thinking aloud. They also responded to interview and survey questions before and afterwards. A use log was recorded while they engaged with the tool. This study is currently under review.

Chapter 6 summarizes and synthesizes the findings of the sub-studies that are presented in chapters 2, 3, 4, and 5. In so doing, it comments on the results for each of the research objectives. Thereafter, reflections, limitations, recommendations, and contributions are presented.

Table 1

Overview of the Dissertation

Chapter	Focus	Sub-study	Methods	Data sources	n
1	Introduction				
2	Analysis	A	Systematic review	Journal articles	59
3	Design	B	Theoretical synthesis	Journal articles	n/a
Intermezzo	Practitioners				
4	Construction	C	Delphi-inspired	Questionnaires, interviews	27*
5	Evaluation	D	Proof-of-concept	Questionnaires, interviews, use log, think-alouds	17*
6	Conclusion				

* 13 respondents participated in both studies

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Chapter 2

Analysis

This chapter is based on:

van der Linden, S., van der Meij, J., & McKenney, S. (2022). Teacher Video Coaching, From Design Features to Student Impacts: A Systematic Literature Review. *Review of Educational Research*. 92(1), 114-165.
<https://doi.g/10.3102/00346543211046984>

Abstract

Video and coaching as vehicles for teachers' professional development have both received much attention in educational research. The combination of the two, video coaching, where teachers watch and discuss videos of their own practice with a coach, seems especially promising, but there is limited insight into how the design leads to desired teacher and student outcomes through mediating enactment processes. This review systematically synthesized the occurrences and co-occurrences of video-coaching design features, enactment processes, teacher outcomes, and student impacts as reported in 59 empirical studies. The literature corpus contained information on design features for all studies, but the video-coaching enactment processes were described in only half of the studies. Altogether, the studies showed that video coaching can support some positive teacher outcomes, such as changes in pedagogical behavior, but evidence was not consistently reported for all types of outcomes. Few studies examined impacts on learners. Taken together, this review revealed important gaps in knowledge, which highlights the importance of paying attention to unpacking teacher learning processes.

Introduction

Video and coaching as vehicles for teacher learning and development have both received much attention in the educational research, as evidenced by the number of literature reviews devoted to these topics over the past decade (Gaudin & Chaliès, 2015; Kraft et al., 2018; Marsh & Mitchell, 2014; Tripp & Rich, 2012). With regard to the use of video, these reviews have contributed to understandings of the affordances of using video recordings for teacher learning (Marsh & Mitchell, 2014), how video can be used to support teacher reflection (Tripp & Rich, 2012), and productive approaches to using different types of videos for teacher learning (Gaudin & Chaliès, 2015). In addition, these reviews have provided insight into the outcomes of video analysis for teacher learning, most notably, their reflective abilities (Marsh & Mitchell, 2014) and professional vision (Gaudin & Chaliès, 2015; Marsh & Mitchell, 2014), that is, the ability to notice and interpret salient classroom moments (Sherin, 2001). In addition, video feedback can support the skills professionals need to interact with contact professions (Fukkink et al., 2011).

In a similar vein, coaching has received much attention, especially driven by the No Child Left Behind Act (active from 2002 to 2015) in the United States, and continuing under the Every Student Succeeds Act (active from 2015 onwards), in both of which policymakers and educational leaders emphasized a focus on teacher performance and student learning outcomes (Connor, 2017). Coaching is consistent with research-based ideas about effective teacher professional development, including key features such as a focus on content, active learning, sustained duration, coherence, and collective participation (Desimone & Pak, 2017), and there have been notable efforts to create frameworks for instructional coaching (Kurz et al., 2017). A recent meta-analysis showed that coaching is an effective approach to enhancing teacher instruction and student outcomes, although the effects diminish when programs are scaled up (Kraft et al., 2018). Other meta-analyses from early childhood education also emphasized the importance of adding a coaching element, for instance, to enhance pedagogical quality (Egert et al., 2018), and coaching was associated with the quality of educator—child interactions and educators' provision of educational materials (Markussen-Brown et al., 2017). The combination of video and coaching, which we refer to as video coaching, where in-service teachers watch and discuss videos of their own teaching practices with a coach, seems particularly promising for in-service teacher professional development.

Yet, even though valuable work has been done to enhance understanding

of video and coaching interventions, in particular, by making visible the effects of (a) coaching on teacher instruction and student achievement (Kraft et al., 2018), (b) video feedback on the interaction skills of professionals (Fukkink et al., 2011), (c) and the reported changes in teachers' professional vision as a result of video viewing (Gaudin & Chaliès, 2015), the mechanisms and outcomes of video coaching for in-service teachers have not yet been investigated in a literature review (to our knowledge). The existing reviews mentioned above did not focus specifically on the combination of the two components, but on related interventions or (combined) participant groups, thereby making it difficult to understand the underlying theories of action for video coaching specifically for in-service teachers. Distinguishing between in-service and preservice is important, because the learning needs and opportunities are likely to differ. Moreover, it seems highly plausible that salient differences could be expected between preservice, in-service teachers and other professionals concerning the materials used and how teachers participate. For instance, materials for preservice teachers might align most heavily with national teaching certification frameworks, whereas other frameworks (e.g., new curricula or standards) might be more relevant for already certified in-service teachers.

Knowing how an intervention supports its outcomes is important for multiple reasons. First, it is important to understand how an intervention is enacted for replication purposes. Second, elaborating the inputs, processes, and outcomes supports the building of theoretical understanding of how video coaching can contribute to teacher learning and development. Specifically, there is limited insight into what the designed or planned video coaching interventions are composed of, and how design choices influence outcomes through their enactment. Third, it is important for practitioners, such as coaches, to know what powerful video coaching looks like in practice in order to implement and adjust their practices to steer them in the desired direction. Making this knowledge available to them can help them to shape their practices. In sum, this study extends insights from previous reviews to reach its objective, with the aim of systematically reviewing the design features, enactment processes, teacher outcomes, and student impacts of video coaching interventions for in-service teachers that have been reported in the empirical literature (qualitative, quantitative, and mixed methods). In so doing, it aims to identify specific characteristics of video coaching intervention design and enactment that might predict certain outcomes. Detailed articulation of such hypothesized relationships is valuable for intervention design, and can also serve as the basis for subsequent testing.

Theoretical Framework

Defining Video Coaching

Video coaching is defined as a professional development approach in which teachers or coaches record teaching episodes and engage in video-based one-to-one or group-based discussions in a sustained manner (van der Linden & McKenney, 2020). Clearly, video coaching is composed of two essential features, namely, professional guidance through coaching and the use of video to capture teaching episodes. As for teachers, “coaching is characterized by an observation and feedback cycle in an ongoing instructional or clinical situation” (Joyce & Showers, 1981, p. 170), and the observation and feedback cycle are thought to be active ingredients of effective coaching (Connor, 2017). Coaches can work with teachers individually or in groups (Denton & Hasbrouck, 2009; Hasbrouck & Denton, 2007). “Ongoing” and “sustained” require that the video coaching efforts last more than one cycle, being combined with at least one additional activity, for example, repeated observation plus feedback. A coach provides expert support; this role is often fulfilled by other educators (Darling-Hammond et al., 2017), but it could be fulfilled by people in different educational capacities, such as a mentor, an administrator responsible for teacher development, an instructional coach working inside or outside the school, or a researcher. Finally, coaching can be focused on domain-specific or general pedagogical issues (Connor, 2017).

In the literature on teacher coaching, different varieties of coaching have been described, some of which focus on teacher practices and student learning outcomes, while others focus on implementing schoolwide change processes, and target not only the teachers, but also the school leaders. Some approaches are focused on implementing reform practices with high fidelity, a technical approach (Denton & Hasbrouck, 2009); programs such as My Teaching Partner (Gregory et al., 2017), and Classroom Strategies Coaching (Reddy et al., 2017) seem to belong in this category. In this type of program, the coach has an ‘instructional expert’ role. Other approaches focus on problem solving with the aim of improving student outcomes; in these types of programs, the coach is more of a facilitator, collaborator, and learner, or makes reflection on knowledge and beliefs central to the coaching, where teachers explore the thinking behind their actions, and the coach supports this thinking (Denton & Hasbrouck, 2009).

With regard to the video part of video coaching, video should be understood as video recordings of classroom episodes that depict the classroom

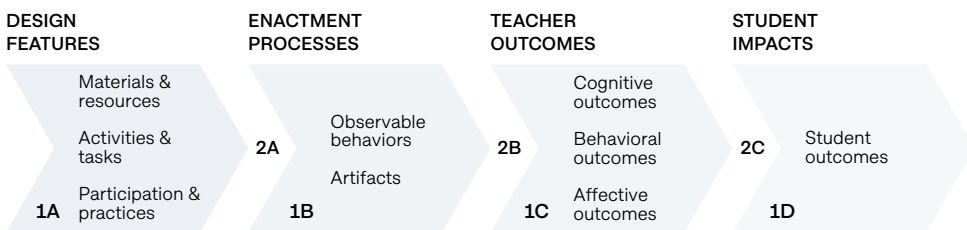
practices of (one of) the teacher(s) being coached, so that the video is aligned with the observational part of teacher coaching. The use of classroom video offers affordances for teacher learning, because these videos are especially useful for analyzing complicated classroom communication, encouraging teacher talk, and supporting the illustration of past events that might be difficult to articulate (Marsh & Mitchell, 2014). Other types of videos, such as video recordings of unknown teachers, could also be included and have shown promising results (e.g., Seago et al., 2004; Seago et al., 2017), but are not essential features of video coaching.

Models of teacher change can support reasoning as to how interventions could support teachers and their students, and associated implications for the design of professional development. Guskey's (2002) model of teacher change describes teacher change as a sequential process, where professional development leads to changes in teachers' practice, which in turn leads to changes in student outcomes, which in turn leads to changes in teachers' beliefs and attitudes. Building on Guskey's work, Clarke and Hollingsworth (2002) proposed the interconnected model of professional growth, which illustrates specific change pathways and the role of reflection in the process. Here, we examine influences present in both models with regard to their implications for video coaching. First, professional development should take into account that change is a gradual and difficult process (Guskey, 2002), and that the anxiety that comes with trying new things can be managed with the support of a skillful coach. In addition, coaching seems especially suitable for tailoring generic program principles to contextual needs. Second, because change in student outcomes can yield change in teacher beliefs, professional development should provide regular feedback on student learning to the teachers (Guskey, 2002), and video coaching could provide opportunities to do this by focusing on student learning (in recording and viewing videos). Third, the idea of growth through reflection and action, as emphasized by Clarke and Hollingsworth (2002), clearly connects with the structure of video coaching, because video coaching requires teachers to enact teaching, record these practices, and look back at these practices with the overall aim of developing further. In addition, this model illustrates the iterative nature of interactions that can lead teacher learning. Finally, professional development should provide continued support and pressure for teachers to implement and maintain new practices (Guskey, 2002). Implementing a coaching cycle more than once could aid teachers in developing their practices, and support through coaching can be tailored as needed. Taken together, this already sheds some light on essential design features of video coaching, but more is needed to gain insight into the mechanisms of this professional development approach.

Modeling Video Coaching Logic

Logic models can be used to plan, develop, and evaluate theories of action for interventions (Greene, 2018), such as teacher video coaching. Logic models are graphic representations of the most important elements of educational programs, and have been used since the 1980s, primarily in the United States (Greene, 2018). These models usually include the inputs (e.g., time, money, resources), activities (e.g., training, experiences), outputs (immediate benefits for the participants), and the short-term and long-term outcomes (learning gains or changes in well-being). Logic models can also be viewed as causal change models, and therefore can act as roadmaps for crafting evaluation focus and questions, as well as for thoughtful development (Greene, 2018). These causal change models are also known as theories of change or program theories, which depict the theoretical foundations of change processes (Jones & Rosenberg, 2018). Conjecture maps (Sandoval, 2014) are specific versions of logic models that emphasize, among other things, observable phenomena during enactment processes, which helps with investigating whether and how a design yields (anticipated) results. In this study, the conjecture map consists of four elements (design features, enactment processes, teacher outcomes, and student impacts), shown in Figure 2.1 and described hereafter.

Figure 2.1
Conjecture Map Framework in Relation to the Research Questions



Note. The letter and number combinations in the figure refer to the different aspects of Research Question 1 and Research Question 2 respectively.

Design Features

The *design features* embody the intended or planned intervention and usually consist of three different components, namely, the materials and resources, the activities and tasks, and the participation and practices (McKenney & Reeves, 2019). First, the *materials and resources* consist of the

inputs that are designed, collected, and/or curated (either in physical or digital format) that are intended for use during the intervention, such as the videos of the classroom practice of the teacher being coached. Second, the *activities and tasks* include the main learning events that participants will engage in (McKenney & Reeves, 2019). In the context of video coaching, one can expect that analyzing past practices will be an essential part of the planned intervention. Third, the *participation and practices* describe intentions for human action during the intervention, which includes the different roles and responsibilities that participants are meant to fulfill, but can also include prescribed norms for discursive practices (McKenney & Reeves, 2019). An example of this design component is the role that the coach fulfills, for example, being a facilitator who is responsible for supporting teacher learning.

Enactment Processes

The *enactment processes* embody the enacted design, that is, the processes that arise when the participants engage with the design (Sandoval, 2014). The enactment processes mediate between the design features and the outcomes of the intervention. These processes fall roughly into two categories, namely observable interactions and artifacts (Sandoval, 2014), or more broadly, observable behaviors and created artifacts. First, observable behaviors are the actions undertaken by the participants when taking part in the intervention that show behaviors that could influence learning outcomes. A behavior to be observed during video coaching enactment is that teachers and coaches engage in reflection on the video recording. Second, artifacts are the products that are created during the intervention, these are important because they can capture the participants' thinking processes (Sandoval, 2014). Teachers might produce annotations to the videos (Rich & Hannafin, 2009), which can be analyzed in order to understand teachers' sensemaking processes.

Teacher Outcomes

The outcomes are the effects of the intervention for the in-service teachers. When designing and developing interventions, the outcomes should be understood as expected or anticipated effects that directly align with the intervention objectives and the indicators used to evaluate the intervention (Greene, 2018). In the context of teacher video coaching, these effects can be broadly understood as three types of outcomes, namely, cognitive, behavioral, and affective outcomes.

First, *cognitive outcomes* within the context of this study refer to changes in teachers' knowledge that occur as a result of video coaching. Teacher knowledge includes both general and subject-specific knowledge of teaching

and learning; Shulman (1986) identified pedagogical knowledge, content knowledge, and pedagogical content knowledge, among others, and his descriptions of these are often referred to (Toom, 2017). Pedagogical knowledge (PK) encompasses general knowledge about teaching, which initially was described as generic principles of classroom organization (Shulman, 1986); later work described additional types of knowledge in this category, such as knowledge of learners and learning, classroom management, instruction and curriculum, assessment and educational goals (Grossman, 1990; Park & Oliver, 2008b). Content knowledge (CK) encompasses knowledge of the subject being taught, including facts and concepts as well as their organization within that specific domain (Grossman, 1990; Park & Oliver, 2008b; Shulman, 1986). Pedagogical content knowledge (PCK) integrates content knowledge and pedagogical knowledge: How to teach a subject to students of different backgrounds and age levels, and what makes certain topics more or less complex (Shulman, 1986). For example, in the context of science education, PCK is composed of the following aspects (among others): knowledge of relevant student understandings, of the curriculum, of instructional strategies and representations for teaching the subject, and of assessments of learning within the subject (Park & Oliver, 2008b). PCK is explicitly regarded as more than just collective knowledge about teaching the subject. It also encompasses constructed knowledge that is developed through analyzing past practices, planning, or through teaching (Carlson & Daehler, 2019; Park & Oliver, 2008b).

Second, *affective outcomes* could also be part of the outcomes of video coaching. In this study, these outcomes are conceptualized as teachers' educational beliefs and attitudes. Teacher beliefs have been defined by different authors, but there is a lack of consistency in the definitions and how similar constructs are researched (Fives & Buehl, 2012). Beliefs have several functions, including the filtering of information and experience, the framing of situations and problems, and the guiding of intention and action (Fives & Buehl, 2012). In this study, the definition by Pajares (1992) is used, which positioned teachers' educational beliefs as a broad term that includes beliefs about the educational system, schooling, students, teaching and learning, the nature of knowledge, and teaching efficacy. Clusters of beliefs around one topic together form a disposition or attitude towards a particular topic that drives action agendas (Pajares, 1992), which can be professional, pedagogical, or educational in nature. Finally, even though knowledge and beliefs are not the same construct, they are interwoven and can be difficult to distinguish empirically, but can exist separately (Fives & Buehl, 2012). For the purposes of this study, beliefs will be investigated separately from knowledge, even though we expect that they might not always be reported as such in individual studies.

Third, *behavioral outcomes* within the context of this study can be

understood as general pedagogical or domain-specific classroom practices. Pedagogical teaching behavior encompasses all classroom practices that are not specifically bound to a subject. These practices, such as classroom management behavior, providing a safe learning climate, providing clear instruction, teaching learning strategies, and establishing efficient classroom management, are centrally positioned in teaching effectiveness research because they encourage student achievement, as evidenced by multiple review studies (van de Grift et al., 2017). In addition, there are instructional behaviors that are specifically linked to a subject such as mathematics or history, which can include, for example, domain-specific teaching behaviors that align with conceptions of enacted PCK:

the specific knowledge and skills utilized by an individual teacher...in a particular setting, with a particular student...or group of students...with a goal for those students to learn a particular concept, collection of concepts, or a particular aspect of the discipline. (Carlson & Daehler, 2019, p. 83)

In addition, domain-specific instruction could include core teaching practices for different subject-domains; for instance, for the science and mathematics subject-domains these practices include eliciting student ideas and supporting sense-making during instruction (M. McDonald et al., 2014).

Student Impacts

As stated above, the effects of a video coaching intervention could even go beyond its immediate participants, and have an impact on student outcomes. Investigations of teacher professional development can include outcomes such as student achievement, that is, their performance on assessments, and student engagement: a multifaceted construct that refers to the student's active participation in academic and co-curricular or school-related activities, and commitment to educational goals and learning (Christenson et al., 2012, p. 816). Even though there has been conceptual overlap between engagement and motivation, most engagement scholars agree that motivation refers to intent, whereas engagement has more to do with action, as initially proposed by Russell et al. (2005, as cited in Christenson et al., 2012).

Conjectures

Conjectures can be made about relations between the conjecture map elements (Sandoval, 2014), that is, about which design features yield which enactment processes, how enactment processes engender teacher outcomes, or ways in which teacher outcomes influence student impacts.

These conjectures are (testable) hypotheses about the ways in which design features, such as videos of one's own practice, contribute to enactment, that is to observable behaviors and/or artifacts, such as the creation of curriculum materials, and about the way these enactment processes contribute to the teacher outcomes, that is cognitive, behavioral, or affective outcomes. In addition, conjectures can be made relating the teacher outcomes to the student impacts. In meta-analytic reviews that test teaching effectiveness, authors often use process-product models, focusing on teaching acts (processes) that affect student outcomes (products), which can often be explained by presage variables (such as teacher personality or experience), and influenced by the conditions in which teaching takes place (Seidel & Shavelson, 2007). The conjecture mapping described above includes attention to key process-product model elements, while also generating a visible theory of action for in-service teacher video coaching. This makes it especially suitable for exploratory studies.

About This Study

The overarching goal of this study is to map what empirical research tells us about the theory of action underlying video coaching for in-service teachers. As such, the first goal of the study is to identify the design features, enactment processes, outcomes, and student impacts of video coaching interventions as described in the literature. The second goal of this study is to investigate relationships between these elements. Specifically, as shown in the conjecture map of Figure 2.1, the following two research questions were investigated:

Research Question 1: *What (a) design features, (b) enactment processes, (c) teacher outcomes, and (d) student impacts were identified in the empirical research on in-service teacher video coaching and how often did they occur?*

Research Question 2: *For studies that showed positive changes in teacher outcomes, what co-occurrences were there between (a) design features and enactment processes, (b) enactment processes and teacher outcomes, and (c) teacher outcomes and student impacts?*

Method

A systematic literature review was conducted following the procedure detailed by Petticrew and Roberts (2006), in which the literature was searched

following a predefined procedure, studies were selected using predefined criteria, and the data were extracted and synthesized. Acknowledging the value of both qualitative and quantitative research for studying educational interventions in general and video coaching in particular, in light of our aims, no one form of research was privileged over another.

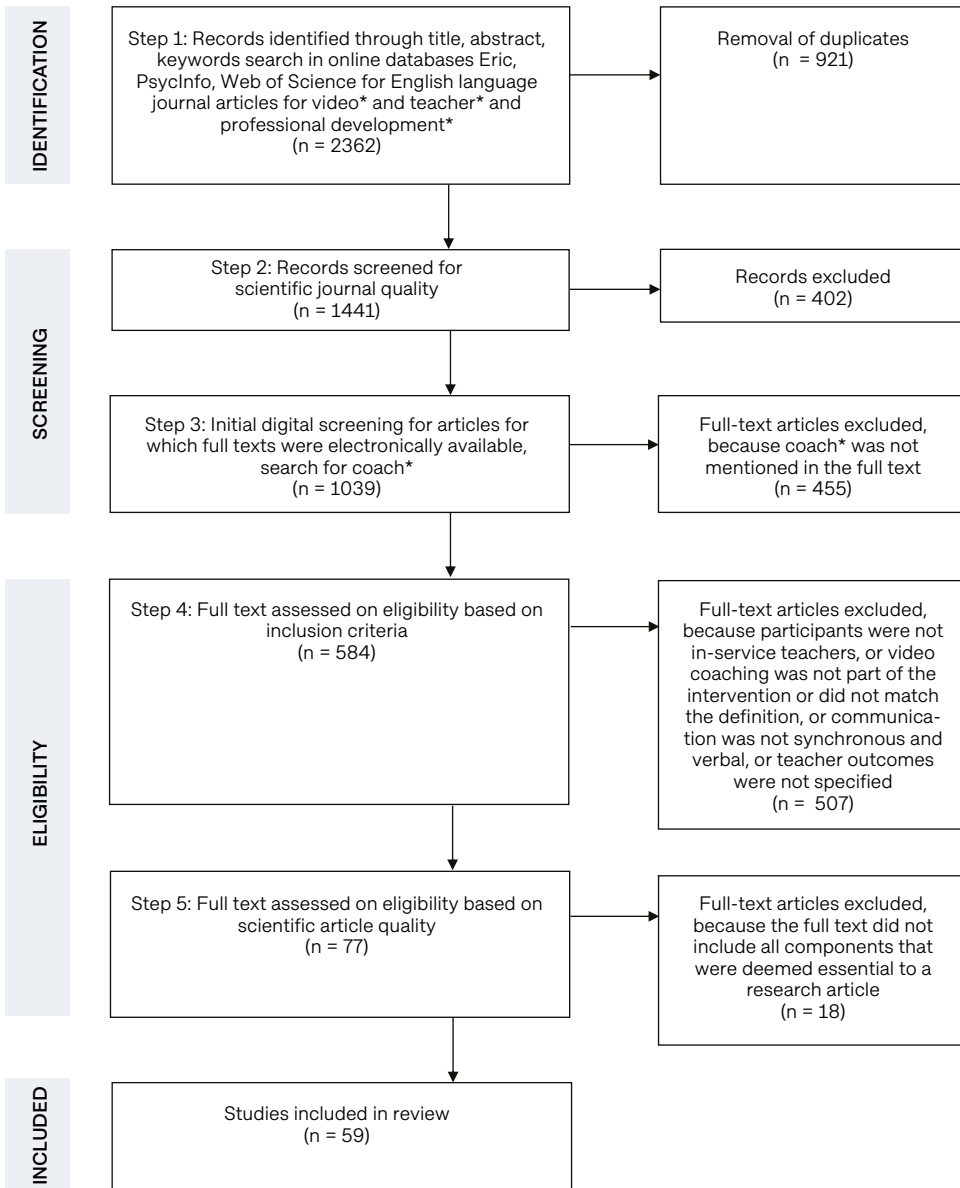
Design of the search procedure

The online databases Eric, PsycInfo, Web of Science, and Scopus were searched, because these contain relevant scientific literature on educational research in general, and were therefore most likely to house studies on video coaching. Keywords were derived from a database thesaurus and from those found in selected key articles. Queries were refined through pilot searches during which different combinations of keywords in the title, abstract, and keyword fields were entered across databases to determine if relevant articles would be identified. The results were inspected for articles on different types of video coaching interventions, such as My Teaching Partner and video clubs, and the search procedure was refined accordingly. For instance, the pilot queries revealed that key articles would be missed if coach, facilitator, coaching, or coaching synonyms were required in the title, abstract, or keyword search (Step 1). So, to reduce the risk of omitting relevant studies, the use of this inclusion criterion was postponed to the full-text search (Step 3); in the database query (Step 1), (synonyms for) a broader term, professional development, were used. Subsequently, refined queries confirmed that key articles, including the ones that described themselves as coaching interventions, were included. The final procedure used consisted of a 5-step selection process (Figure 2.2). The search was completed in January 2018.

Selection Process

First, titles, abstracts, and keywords were searched using Boolean operators for combinations of the keywords: video* AND (teacher* OR educator* OR instructor* OR lecturer*) AND ("professional development" OR "inservice education" OR "in-service education" OR "inservice teacher education" OR "in-service teacher education" OR "inservice learning" OR "in-service learning" OR "inservice teacher learning" OR "in-service teacher learning" OR "professional growth" OR "staff development" OR "faculty development"). The search was then limited to scientific journal articles (not just abstracts or meta-data) written in the English language. After removing duplicates, the search yielded a combined total of 1,441 unique articles. Second, articles that were not pub-

Figure 2.2
Selection Process



Note. Synonyms for the keywords* were also included in the search. See the full text for all of the search terms used within the study. Adapted from Moher et al. (2009).

lished in scientific journals included in the 2018 Social Sciences Citation Index were excluded. This listing was used as a proxy for scientific journal quality, because these journals have demonstrated the robustness of their peer review processes, as well as a production history according to their publication schedule, which are considered an indicator of journal quality. We added this proxy measure because the quality of the articles seemed to vary greatly, and through this measure the journal quality could be guarded in a transparent, consistent and efficient manner. We checked and confirmed that key articles were not omitted through this step. This second step narrowed our results to 1,039 articles. Third, the results were refined by searching the available PDF full texts of the articles using Boolean operators for key words related to coaching, using Adobe Acrobat®, namely: coach OR coaches OR mentor OR mentors OR facilitator OR facilitators OR trainer OR trainers OR expert OR experts OR tutor OR tutors OR counsel(l) OR counsel(l)ors. This narrowed the results to 584 articles. Fourth, relevant studies were selected by applying the following inclusion criteria to the abstract and full text of the documents, which narrowed the results to 77 articles:

- Participants: research that described a professional development intervention for in-service teachers working in early childhood, primary, secondary, tertiary or vocational education.
- Video coaching: video coaching was part of the professional development design and matched the definition used in this article.
- Synchronous verbal communication: communication between the teacher(s) and coach was verbal and synchronous in nature.
- Outcomes: the research reported on an empirical study that investigated the teacher outcomes of video coaching.

It must be noted that articles that focused on descriptions of the enactment of video coaching discussions and the role of the facilitator, but did not report on changes in teacher outcomes resulting from those discussions, were omitted at this step (e.g., Coles, 2013). These studies are very valuable for understanding how video coaching interventions are enacted and experienced. However, for mapping a proposed theory of action, it was deemed essential to focus on studies reporting (at least) teacher outcomes.

Fifth, scientific article descriptive quality indicators were applied to the texts of the remaining studies to ensure that the essential components of research articles were present. The introduction was checked to determine whether the authors described the research objective. The method section was checked for presence of a description of the sample and the context of the study, the data collection procedures, the data analysis procedures, and

whether the authors provided commentary on the strengths or weaknesses of the chosen methods (when absent, the discussion/limitations section was checked). Finally, the results section (and conclusion) was checked to determine whether the authors answered the research question using empirical evidence from their study. If the article contained information for all of the scientific article quality indicators, then we included the article in the review and started data extraction.

This last step completed the selection procedure and brought the final selection to 59 articles that were included in this review. The selection of studies was discussed within the research team and completed through mutual agreement between the authors. There were biweekly meetings to discuss progress and questions. The first author presented a written summary of the studies to discuss, either by email or during the meeting, after which the other team members shared their views. The summaries included the reference for the study, a description of the study including questions relating to the inclusion criteria, and excerpts to illustrate the study if needed. This process helped to fine-tune the selection criteria as new issues were encountered.

Extraction Process

After selection, each article was read completely to gain understanding of its content. First, in order to provide a description of the corpus, metadata, such as the study title, authors, year of publication, journal title, research methods, country, educational level, and academic subject were extracted. Second, to answer the research questions, conjecture-map data were extracted from specific sections that fit the conjecture-map elements as described in the theoretical framework. Data for the design features were extracted from the method section and in some cases from the theoretical framework/literature review section of the articles, but only if these sections described the intended or planned intervention. Data for the enactment processes were mainly extracted from the results section of the articles, because these sections described what happened when the intervention was implemented in practice. In some articles, data on the artifacts produced were extracted from the method section. Data on teacher outcomes and student impacts were extracted from the results section of the articles. Where fitting, entire paragraphs were extracted, and when paragraphs contained relevant data for multiple categories, these paragraphs were assigned to multiple categories.

Data Analysis

Data analysis was executed in two parts. First, individual articles were

analyzed to identify codes and create a codebook. Second, to answer the research questions, the aggregate occurrences and co-occurrences of conjecture-map concepts within the corpus were investigated. (Effect sizes were not aggregated because this would not have helped answer the research questions.) Data analyses were undertaken by the first author and discussed with the other authors until mutual agreement was reached. This form of peer debriefing serves as a viable alternative to joint coding or intercoder reliability checks (Evers, 2015). Detailed descriptions are given in the next sections.

Individual Analysis

Inductive analysis of the extracted data was conducted to create a preliminary codebook for the conjecture map elements. Extracted conjecture map data were imported into Atlas.ti. The extracted text within each of the conjecture map categories was divided into meaningful excerpts. A meaningful excerpt consisted of a paragraph, a sentence, or part of a sentence that communicates one idea. Descriptive preliminary codes were assigned to these excerpts. Through an iterative process of grouping the codes, categories of concept codes were developed until saturation was reached, meaning that the extracted data did not lead to the creation of new codes. Coding saturation began to become apparent after 10 articles had been analyzed, and this tapered off during analysis of the next 20 articles. Thereafter, no further substantive changes were made to the codebook. The iterative development of the codebook and the coding itself were discussed during the bi-weekly meetings. Unlike the inclusion discussions, which used summaries, the data analysis discussions focused on raw data extracted from the corpus. The first author presented a table containing each code, a description, and multiple quotes from the corpus. The code-names and descriptions were discussed to fine-tune their wording to represent the meaning of the extracted data, until 100% consensus was reached. This was the case for all of the analyses. A small part of the codebook is presented in Table 2.1; the complete codebook is available upon request. The finalized codebook was applied to all included articles. Data on the teacher outcomes and student impacts were not only coded by category (such as content knowledge), but also by the type of evidence presented (descriptive evidence or inferential statistics). Those data were initially coded as (1) negative results, (2) no change (also includes predominantly no change), (3) sometimes positive (the proportion of no change to positive results was unclear, rendering a majority decision impossible) or (4) predominantly positive. Predominantly positive results for inferential statistics included significant gains (scale or clear majority of the items), and significant difference from control (scale or clear majority of the items). When studies

investigated (aspects of) an outcome with different measures, namely, using both qualitative evidence and inferential statistics, then both are reported, and this is explicitly mentioned in the results section. These identified code occurrences were exported to an Excel table and recoded in SPSS. Because the unit of analysis for the deductive coding was the article, and the frequency of codes within articles was not of interest, code occurrences were transformed to categorical data (0 = not present and 1 = present) using SPSS. This resulted in a large summary table where the rows on the horizontal axis represented each of the articles and the vertical columns represented the codes. The summary table constituted both the final product of the individual analysis, and the starting point for the aggregate analysis.

Table 2.1**Occurrences of Design Features in the Corpus of Reviewed Studies**

Category	Code	Description	Example
Artifacts of practice	MR-P	Physical or digital objects collected from classroom practice, such as videos of teaching practice, audio tapes from practice, student assessments, student work, lesson plans and curriculum materials produced by the teacher or the learner	"During each cycle, the participating pre-k teacher makes a video recording of her or himself interacting with children in the classroom" (Early et al., 2017, p. 59) "examined their existing curriculum materials" (Furtak et al., 2016, p. 273)
Examples of practice	MR-EP	Digital or printed materials that demonstrate authentic representations of classroom practice (from classrooms other than those of the participants)	"teachers have access to the online library of video clips demonstrating best practice" (Early et al., 2017, p. 59) "In the first three to four sessions, the platform videos were used to scaffold observation abilities" (Grau et al., 2017, p. 26)
Observation tools	MR-OT	Printed or digital text-based assessment instruments, used to score instructional behavior and/or student learning	"Facilitators introduced each MQI-PD code and its scoring rules to participants" (Beisiegel et al., 2018, p. 74)
Ready-made curriculum materials	MR-CM	Prefabricated digital or printed instructional resources, such as textbooks, presentations or lesson plans that support teachers in the application of specific classroom practices May also include the kind of texts that, on their own, would be coded as professional readings	"LLC teachers also received a resource manual and book about word identification to support their content knowledge. The manual included a scope and sequence for word study and fluency, instructional activities, word lists, and additional resources." (Brownell et al., 2017, p. 149)
Reflection tools	MR-RT	Digital or printed written prompts that are designed to stimulate careful consideration of past practices.	"learning was guided...through the use of guided reflections about the learning that occurred in each PLC session. (Christ et al., 2017, p. 98)
Professional readings	MR-PR	Digital or printed written readings, such as books, scientific articles or compiled texts that support teachers' knowledge building (e.g., about student learning or the subject matter or PCK).	"At subsequent meetings, teachers read articles about student thinking in this domain" (Furtak et al., 2016, p. 273)

Aggregate Analysis

The unit of analysis then switched from the article to the aggregate conjecture map elements. In order to understand what the empirical literature reveals about the presence of video coaching elements (design features, enactment processes, teacher outcomes, and student impacts), frequencies were computed for each of the codes and descriptive statistics for the metadata. Next, to understand the relationships between the video coaching constructs, co-occurrences of these elements were inspected for a subset of the data. To investigate co-occurrences, the analysis took teacher outcomes as the point of departure for analysis, first analyzing co-occurrences between specific teacher outcomes and student impacts, then between specific teacher outcomes and enactment processes, and finally between specific enactment processes and design features. The reason for taking teacher outcomes as a starting point is that these are considered to be central in mapping a theory of action, and without (at least) teacher outcomes this would not be possible. Furthermore, we utilized critical case (positive case) selection to investigate a subset of the corpus for co-occurrences. Specifically, only teacher outcomes for which three or more studies reported any positive changes, including sometimes positive changes, were included in this part of the analysis. Similarly, only co-occurrences that were found in at least three studies are reported in the Results section. For example, to understand which student outcomes were featured in studies which reported changes in teachers' PCK, a selection of the corpus reporting on those outcomes was investigated for co-occurring student outcomes. Consequently, this analysis yielded theories of action (or lack thereof) for the different teacher outcomes.

Since project reports sometimes span multiple articles, we checked for redundancies of findings in our corpus. In this case, the sample characteristics, data sources, and teacher outcomes were checked for similarities. While we did find articles that appeared to report on the same project, and in a few cases possibly the same sample of participants, none of the articles reporting on the same broad categories of teacher outcomes used the same data sources. Therefore, we are confident that frequencies for the occurrences of design features or enactment processes accurately reflect how often certain features were reported in relation to teacher outcomes.

Results

Description of the Corpus

More than half of the 59 included studies were conducted in the United States of America, and most of the other studies stemmed from European countries. No studies from the African continent met the inclusion criteria, and only a handful of studies from South America, Asia, or Australia were included. Most studies were published in the past decade, the majority between 2014 and 2018. The corpus includes studies from all educational levels (early childhood education to tertiary education). Most studies were focused on teachers from early childhood to secondary education. Academic subjects varied, and there were many studies where coaching was focused on pedagogy. An overview is presented in Figure 2.3.

Occurrences within the corpus

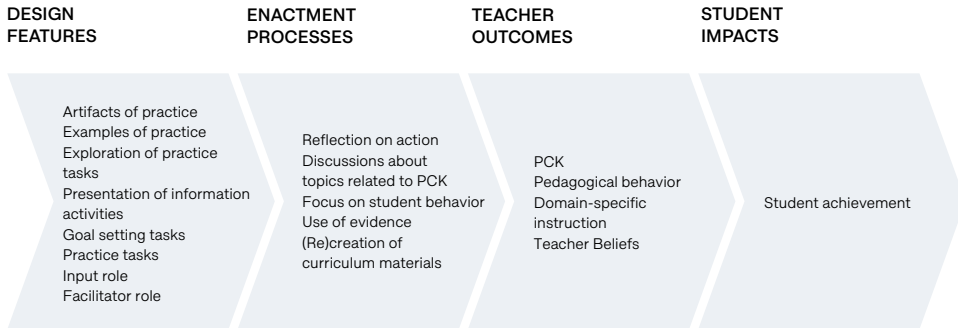
Taking individual articles as the unit of analysis, the following section answers Research Question 1. The results are organized by the categories described in the theoretical framework and shown in Figure 2.4. Thus, in sequential order we will describe the identified design features, enactment processes, teacher outcomes, and student impacts, along with how often they occurred within the set of 59 video coaching studies (codes used are given in parentheses). An overview of the occurrences within the corpus per article can be found in Supplemental Table S2.1.

Research Question 1a: Design Features

In the following section, we summarize the reported design features of video coaching interventions related to materials and resources, activities and tasks, and participation and practices. The reported design of video coaching interventions showed considerable variability. The total number of design features reported in the corpus of 59 studies ranged from 2-12 features (see Table S2.1). The studies in our corpus most often reported the presence of artifacts of practice and examples of practice (materials and resources); exploration of practice tasks, presentation of information activities, goal setting tasks, and practice tasks (activities and tasks); and an input and facilitator role (participation and practices) as part of the design. The results are described in more detail hereafter.

Figure 2.4

Most Frequently Occurring Constructs in relation to the Conjecture Map Framework (Research Question 1)



Materials and Resources

Six types of materials and resources were identified within the corpus, some of which were mentioned more frequently than others. An overview is presented in Table 2.2. Consistent with the selection criteria, all 59 studies described the use of *artifacts of practice* (MR-AP), which are physical or digital objects collected from classroom practice, such as student assessments, student work, lesson plans and curriculum materials produced by the teacher or the learner, audio tapes or, as one would expect, videotapes of teaching practice, as in the following example: “During each cycle, the participating pre-k teacher makes a video recording of her or himself interacting with children in the classroom” (Early et al., 2017, p. 59). Furthermore, 41% of the studies reported the use of *examples of practice* (MR-EP), which are digital or printed materials that demonstrate authentic representations of classroom practice (from classrooms other than those of the participants) intended for different purposes, such as “demonstrating best practice” (Early et al., 2017, p. 59), or “to scaffold observation abilities” (Grau et al., 2017, p 26). In addition, 22% of the sample mentioned the use of *ready-made curriculum materials* (MR-CM), which are prefabricated digital or printed instructional resources, such as textbooks, presentations or lesson plans that support teachers in the application of specific classroom practices (these may also include the kind of texts that, on their own, would be coded under professional readings): “LLC teachers also received a resource manual and book about word identification to support their content knowledge....It supported teachers in selecting appropriate words for instruction, teaching decoding rules, sequencing multisyllabic word analysis strategies, and selecting activities for instruction.” (Brownell et al., 2017, p 149). Similarly, 22% of the studies mentioned the use of *observation*

tools (MR-OT), which are printed or digital text-based visual assessment instruments used to score instructional behavior or student learning, such as the Mathematical Quality of Instruction for Professional Development instrument (MQI-PD): “Facilitators introduced each MQI-PD code and its scoring rules to participants” (Beisiegel et al., 2018, p. 74). Moreover, 19% of the corpus reported the use of *professional readings* (MR-PR) as input for professional development; these included digital or printed written readings, such as books, scientific articles or compiled texts that support teachers’ knowledge building, for example “Teachers read articles about student thinking in this domain” (Furtak et al., 2016, p. 273). Likewise, 19% of the studies reported the use of *reflection tools* (MR-RT), which are digital or printed written prompts designed to stimulate careful consideration of past practice and/or how to improve their future practice.

Activity and Task Structures

Six types of activity and task structures were identified, two of which were mentioned in more than half of all studies, while the other four were mentioned in more than one third of all studies. All 59 studies stated that teachers engaged in *exploration of practice activities* (AT-EP), where participants considered or analyzed their own practice in a more or less systematic manner using video recordings of practice, which was expected given the selection criteria. Furthermore, 64% of the studies in the corpus reported that teachers engaged in *presentation of information* (AT-PI) activities in which participants were provided with access to knowledge, for example, through attending lectures, doing readings, or participating in discussion about readings. For example, “In the first workshop, teachers received input on productive classroom discourse by a facilitator” (Kierner et al., 2015, p. 96). Next, 47% of the sample reported that teachers engaged in *practice tasks* (AT-PT), in which participants rehearsed targeted skills outside the classroom, for instance, through role-playing or practice discussions:

They practiced using the activities with each other, envisioning how they would facilitate their activities with students, and anticipating the types of feedback they would provide if different types of student ideas were surfaced in class (Practice Using the Tasks). (Furtak et al., 2016, p. 273)

Teachers engaged in *goal-setting activities* (AT-GT) in 41% of the studies; these are activities in which participants determined learning objective(s), for instance, through creating an action plan: “The coach also develops an action plan for improvement with the teacher and goals for the next cycle including which dimensions of the CLASS-S to consider implementing in subsequent

interactions with students.” (Gregory et al., 2014, p. 150). Moreover, 39% of the sample mentioned that teachers engaged in *enactment tasks* (AT-ET), where participants implemented (new) instructional strategies in their own classrooms. Finally, 37% of the corpus reported that teachers engaged in *design tasks* (AT-DT), during which participants planned and/or constructed future lessons and/or materials.

Participation and Practices

Four types of participation and practices were identified, two of which were mentioned by more than half the articles, while the other two were mentioned much less often. In 69% of the 59 articles, the coach enacted the role of a *facilitator* (PP-FR) and scaffolded teacher learning by providing support or resources during task execution, for example, providing feedback on the implementation of instructional strategies or asking questions to support reflection/interaction: “These facilitators practiced offering feedback – ‘what progress is made towards the learning objective?’ – and ‘feed forward’ – ‘what action needs to be undertaken to make better progress?’” (Meijer et al., 2017, p. 825). Furthermore, 56% of the corpus described how the coach enacted the role of *input provider* (PP-IR) and provided input to stimulate teacher learning before the start of a task, for example, through selection of videotaped classroom practices and/or readings. In 12% of the studies, the coach enacted the role of a *reviewer* (PP-RR) and tracked participants’ progress by assessing the quality of their instructional behavior with reference to a set of standards, such as an assessment tool:

The “nice work” clip helps the teachers see how their behavior in a particular interaction with students elucidate the principles of one of the dimensions of the CLASS- S. The “consider this” clip helps a teacher observe another interaction with students that typically reflects a CLASS-S dimension upon which the teacher needs to improve. (Gregory et al., 2014, p. 149)

Specific discursive practices were only occasionally described, with 5% of the studies explicitly mentioning that participants should interact in a way that is best described as a *critical friendship* (PP-CF), a situation where participants communicated in an open, friendly manner, and where trust was established that allowed for a critical investigation of each other’s practice.

Table 2.2

Occurrences of Design Features in the Corpus of Reviewed Studies

Category	Concept	Code	Article Number*	Frequency
Materials and resources	Artifacts of practice	MR-AP	All	59
	Examples of practice	MR-EP	01, 04, 05, 07, 08, 12, 16, 19, 21, 22, 23, 25, 27, 28, 30, 32, 35, 38, 39, 43, 48, 51, 53, 58	24
	Observation tools	MR- OT	01, 02, 12, 15, 21, 25, 26, 27, 32, 35, 39, 40, 48	13
	Ready-made curriculum materials	MR-CM	02, 10, 11, 17, 19, 23, 25, 27, 38, 39, 44, 45, 51	13
	Reflection tools	MR-RT	04, 05, 07, 12, 23, 25, 43, 45, 48, 53, 55	11
	Professional readings	MR-PR	04, 06, 08, 11, 15, 22, 32, 35, 39, 47, 53	11
Activities and tasks	Exploration of practice	AT- EP	All	59
	Presentation of information	AT- PI	02, 05, 06, 08, 09, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 25, 27, 32, 35, 38, 39, 41, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 54, 55, 58	38
	Practice tasks	AT- PT	01, 02, 04, 05, 08, 11, 16, 17, 19, 20, 23, 26, 27, 28, 29, 30, 32, 35, 38, 39, 42, 43, 44, 45, 48, 50, 53, 55	28
	Goal-setting activities	AT- GA	02, 03, 04, 07, 08, 10, 11, 12, 14, 15, 16, 17, 21, 22, 23, 26, 27, 35, 37, 40, 42, 44, 46, 59	24
	Enactment tasks	AT- ET	02, 05, 06, 09, 10, 11, 13, 16, 17, 21, 23, 25, 31, 38, 39, 41, 44, 47, 50, 52, 54, 58, 59	23
	Design tasks	AT- DT	04, 05, 09, 11, 13, 14, 16, 18, 22, 37, 38, 39, 41, 45, 46, 47, 49, 51, 52, 54, 58, 59	22
Participation and practices	Input role	PP- IR	04, 05, 07, 09, 10, 12, 13, 16, 17, 18, 21, 22, 23, 24, 25, 27, 31, 32, 33, 34, 38, 39, 40, 41, 43, 47, 49, 50, 52, 53, 55, 56, 57	33
	Facilitator role	PP- FR	01, 02, 07, 08, 09, 10, 11, 12, 13, 14, 15, 16, 17, 18, 21, 23, 24, 25, 26, 27, 28, 30, 33, 34, 35, 37, 38, 41, 42, 43, 44, 45, 47, 48, 49, 50, 51, 54, 55, 56, 57	41
	Reviewer role	PP-RR	12, 17, 21, 23, 39, 46, 52	7
	Critical friendship	PP- CF	04, 15, 53	3

Research Question 1b: Enactment Processes

In the following section, we summarize the identified enactment processes (directly, through observable behaviors and indirectly, through resulting artifacts) that occurred during participation in video coaching interventions. The number of enactment processes reported in the 59 empirical studies ranged from 0–9 (see Supplemental Table S2.1), but fewer than half of all studies included data on the enactment processes. Only 27% of the sample reported on observable behaviors that occurred during video coaching enactment. In addition, 34% of the sample reported on the construction of artifacts during the enactment of video coaching interventions. An overview of the identified enactment processes is presented in Table 2.3. Most often studies reported that participants reflected on action, talked about topics related to PCK, focused on student behavior, used evidence for their reasoning, and (re)created curriculum materials. The results are described in more detail hereafter.

Observable Behaviors

A number of studies reported that reflective behaviors occurred during video coaching. Almost all of the studies that mentioned observable behaviors (24% of the 59 studies) reported *reflection on action behaviors* (OB-RoA), in which the participant and/or coach engaged in an assessment of past (classroom) events as depicted in teachers' artifacts of practice, or depicted the nature, attributes, or characteristics of a past (classroom) situation, or tried to give meaning to events that had taken place (in the classroom). Some of these studies reported (the importance of) an interpretive stance during reflection on past actions:

In Meeting 7, by contrast, the teachers had taken responsibility for initiating these sense-making activities...Thus, not only did the teachers, over time, come to use more sophisticated strategies for reasoning about student thinking (which serves as evidence of the development of knowledge-based reasoning), they also came to notice more complex issues of student thinking in the videos. (Sherin & van Es, 2009, p. 27)

In addition, 14% of the studies reported *reflection for action behaviors* (OB-RfA), where teachers consciously considered future teaching scenarios:

When collectively planning the first lesson (Meeting 2)...The teachers all agreed to use a variation of teaching methods such as demonstrations, small group discussions and more traditional lecturing with the help of a PowerPoint presentation and using the whiteboard in order to make the students identify the critical features and overcome learning obstacles. (Nilsson, 2014, p. 1805)

Seven studies reported both reflection on action and reflection for action behaviors during video coaching. When teachers reflected, a number of topics were discussed. In 22% of the articles, the content of the discussion was focused on *topics related to pedagogical content knowledge* (OB-PCK), that is knowledge of students' understanding of the subject, of the curriculum, of instructional strategies and representations for teaching the subject, and of assessments of learning within the subject:

David [teacher] realized that he did not understand Daniel's [student] statement, and the teachers then, together, worked to make sense of Daniel's idea. They explored what Daniel meant by the term "curved" and what features of the conical flask Daniel was likely considering. In addition, the teachers began to connect Daniel's idea with what another student, Tina, stated previously, about a graph comprising two connected line segments. (Sherin & van Es, 2009, p. 26)

In addition, 8% of the studies reported that discussions focused on *topics related to content knowledge* (OB-CK), that is, knowledge of the subject being taught. Similarly, 8% of the studies reported that discussions focused on pedagogical topics related to general knowledge about teaching not specific to the subject (OB-PK): "Eight conversations focused on more general pedagogical issues like lesson planning, assessment tools, and other issues related to implementation within the school district's model of instruction." (Shanahan & Tochelli, 2014, p. 18). Finally, one study reported *mood-related communication* (Article 18 from Supplemental Table S2.1; OB-M), where teachers exchanged praise that contributed to a positive learning environment.

During reflection, attention was paid to certain classroom aspects. One fifth of the articles reported a focus on *student behaviors* (OB-F-S); for example, in Article 57, teachers increasingly focused on analyzing student mathematical thinking in video clubs: "Early on, the teachers gave little attention to mathematical thinking... even when prompted to do so by the facilitator... Instead, the majority of the teachers' comments focused on pedagogical issues. Over time, however, attention to student mathematical thinking increased" (Sherin & van Es, 2009, p. 26). In addition, 12% of the corpus reported a *focus on teacher-student interaction* (OB-F-ST), specifically on the cause-effect relationship between teaching and learning: "Watching their interaction on video, the educator clearly saw how P did not experience the intended object of learning." (Bjorklund, 2012, p. 511) and 8% of the studies reported a *focus on teacher behaviors* (OB-F-T): "In both cycles of observations, mentors and mentees reliably critiqued mentees' instruction." (Ceven McNally, 2016, p. 488).

A number of studies reported on the way data were used during video coaching. One fifth of the corpus explicitly reported that teachers *used the available evidence* (OB-D-UE), that is, the body of information (gathered from artifacts of practice) to support their reasoning or their decision making: “Teachers in these groups referred to the language of the MQI-PD, cited evidence in the clip” (Beisiegel et al., 2018, p. 76). And finally, 5% of the sample reported on the importance of sharing and watching *salient teaching moments* (OB-D-SM), which are video excerpts that illustrate more or less effective teacher practices and/or examples of student learning.

Artifacts

The analysis of the corpus revealed that three types of artifacts were produced during video coaching. One fifth of the 59 studies mentioned the (re)development of *curriculum materials* (A-CM) or digital or printed instructional resources, such as textbooks, learning environments, workbooks, presentations and lesson plans that were developed or adapted during video coaching sessions. For instance, in Article 51, teachers created their own inquiry-based lesson plans that they implemented in their own classrooms while being videotaped, on which they later received feedback from their coach. In addition, 12% of the studies reported on the creation of *action plans* (A-AP), or written digital or printed strategies for improvement, including concrete professional development actions to be executed in the upcoming teaching period, that were developed or adapted during video coaching sessions, for example: “A collaborative weekly coaching meeting which included developing a plan for implementing the targeted *BEST in CLASS* strategy with the focal children” (Conroy et al., 2015, p. 148). Finally, one study, Article 47, reported on the development of *written reflections* (A-WR), or reflective writings about teaching practice that were developed or adapted during the course of a video coaching intervention, where teachers thought back on what they learned from teaching the past lesson.

Table 2.3
Occurrences of Enactment Processes in the Corpus of Reviewed Studies

Category	Concept	Code	Article number*	Frequency
Observable behaviors-data use	Presenting salient moments	OB-D-SM	03, 22, 31	3
	Use of evidence	OB-D-UE	01, 03, 09, 18, 31, 33, 34, 45, 54, 56, 57, 59	12
Observable behaviors-focus	Focus on student	OB-F-S	09, 14, 18, 22, 31, 33, 34, 37, 54, 56, 57, 59	12
	Focus on teacher	OB-F-T	03, 31, 34, 54, 56	5
	Focus on teacher—student interaction	OB-F-ST	03, 14, 18, 22, 31, 54, 59	7
Observable behaviors-content of discussion	Pedagogical knowledge topics	OB-C-PK	03, 18, 45, 56, 57	5
	Content knowledge topics	OB-C-CK	22, 34, 37, 45, 59	5
	Pedagogical content knowledge topics	OB-C-PCK	09, 14, 18, 22, 31, 33, 34, 37, 45, 54, 56, 57, 59	13
	Mood-oriented talk	OB-M	18	1
Observable behaviors-reflection on action	Evaluating, judging or critiquing, describing, or interpreting past practices	OB-RoA	03, 09, 18, 22, 31, 33, 34, 37, 45, 54, 56, 57, 58, 59	14
Observable behaviors-reflection for action	Planning future practices	OB-RfA	03, 14, 22, 31, 37, 54, 5, 59	8
Artifacts	Written reflections	A-WR	47	1
	Curriculum materials	A-CM	14, 18, 22, 31, 37, 38, 41, 49, 51, 52, 54, 59	12
	Action plan	A-AP	02, 07, 08, 10, 12, 15, 21	7

Note. *From Supplemental Table S2.1.

Research Question 1c: Teacher Outcomes

In the following section, we summarize the identified outcomes (cognitive, behavioral, and affective) for in-service teachers who participated in video coaching interventions, how often these occurred within the corpus of 59 studies, and the nature of the evidence given for each outcome (see Supplemental Table S2.1 for an overview per article). Table 2.4 presents an overview of all identified video coaching outcomes and their frequencies of occurrence. In regard to teacher outcomes, positive changes in teachers' pedagogical behavior were most often reported, followed by positive changes in teachers' PCK and domain-specific instruction. The results are described in more detail hereafter.

Cognitive Outcomes

Approximately one third of all studies reported positive changes in teacher knowledge; however, the number of studies addressing each type of knowledge differed considerably between teacher knowledge types. Overall, 25% of the 59 studies reported positive changes in *teachers' pedagogical content knowledge* (PCK), that is, the knowledge of how to teach a specific subject (Article 56 included both descriptive and inferential evidence). Ten percent of the corpus reported statistically significant positive changes in teachers' PCK (CO-PCK-inf). One of these studies reported differences compared to a control group, for instance, in teachers' ability to analyze science lessons (Article 38), three studies reported differences between pre-test and post-test (Articles 11, 33, 56), and two studies reported sometimes positive changes, meaning that teachers showed statistically significant improvement on approximately half of the PCK outcome measures (Articles 1, 2). Fifteen percent of the sample reported descriptions of positive changes in teachers' pedagogical content knowledge (CO-PCK-desc), for instance, during mathematics video clubs in which teachers developed their mathematical lesson analysis abilities during the course of the training:

Thus, we see here that they discussed a range of topics, with a primary focus on pedagogy, particularly as it relates to the reform curriculum, and classroom climate...later in the series of meetings, though, the teachers initiated and sustained a detailed focus on examining and interpreting students' mathematical thinking based on the events in the clip. (van Es & Sherin, 2010, p. 166)

One study reported no changes in teachers' PCK (Article 26; CO-PCK-no change).

Second, 10% percent of the full corpus reported positive changes regarding *teachers' pedagogical knowledge* (PK), that is, general knowledge of teaching. Article 23 reported both descriptive positive results and a statistically significant difference on some, but not all competences regarding guiding students' reflections. Five percent of the corpus reported (some) statistically significant changes in pedagogical knowledge after training (CO-PK-inf), based on self-reports (Articles 23, 30, 32), although not all outperformed the control group (Article 32). Lastly, 7% of the corpus reported (some) descriptive positive changes in teachers' pedagogical knowledge (CO-PK-desc), for instance, teachers reported gaining: "Professional knowledge of teaching and learning processes: didactical training, professionalism, supporting students in their learning, and being able to assume the students' perspective" (Johannes et al., 2013, p. 159). Two studies reported no change in teachers' PK (CO-PK-no change) (Articles 7, 43). Finally, positive change in *teachers' content knowl-*

edge (CK), subject-matter knowledge within a specific teaching domain, were only reported in one study (article 38).

Behavioral Outcomes

A total of 44 of the 59 studies in the overall corpus reported positive changes in instructional behavior, either pedagogical behavior or domain-specific instruction. First, 53% of the overall corpus reported positive changes in *teachers' pedagogical behavior*, which encompasses all classroom practices concerning the organization of learning environments and teaching that are not related to a particular teaching domain. Thirty-seven percent of the sample reported statistically significant changes in teachers' pedagogical behavior after video coaching (BO-TI-G-inf). Seven studies (Articles 6, 18, 20, 26, 27, 30, 35) found that the intervention group receiving video coaching outperformed the control group on more than half of the outcome variables. For instance, participants in a video coaching intervention for caregivers in Dutch child care centers outperformed the control group on all outcome variables at posttest and on four out of six outcome behaviors at follow-up (Article 27). In addition, four studies (Articles 11, 29, 50, 55) reported statistically significant changes in teacher pedagogical behavior for more than half of the measured outcomes from pretest to posttest. For example, in a study where teachers were engaged in a video coaching intervention to enhance their feedback behavior (article 50), results showed that teachers improved their feedback behavior in all areas (frequency of feedback, frequency of specific feedback, ratio of positive and negative feedback). One study noted particular teaching behaviors predicting student outcomes (Article 52). Ten studies reported that teachers changed their pedagogical behavior on just some outcomes or that effects diminished on the retention test (Articles 7, 10, 12, 13, 25, 32, 36, 41, 43, 48).

Moreover, 17% of the 59 studies reported descriptive evidence of teachers changing their pedagogical behaviors after participating in video coaching interventions (BO-TI-G-desc). Seven studies presented descriptive evidence that most teachers changed their pedagogical behavior after training (Articles 5, 8, 20, 21, 24, 45, 58). For instance, in a study in which teachers engaged in a My Teacher Partner coaching intervention, teachers watched video examples of effective teacher—student interactions and engaged in coaching activities where they discussed videotaped classroom episodes with a coach to improve the quality of their interactions with children in preschool: “On average, teachers did improve over the course of the year in their classroom interactions in all three class domains, with the greatest improvement appearing in instructional support” (Pianta, DeCoster, et al., 2014, p. 504). Three studies presented data that some, but not all, teachers changed their pedagogical behaviors after video coaching (Articles 3, 14, 40). For instance, in an interven-

tion to promote teachers' transformative learning to stimulate the students' inquiry attitude, researchers found that teachers changed behaviors in only two out of the four groups and not in all behavioral areas:

a different picture emerged when examining the frequencies of the interventions ... We saw a substantial frequency increase in reflection and critical reflection. Zooming in on a group level, it became clear that this increase could be explained by one master's group and one bachelor's group. (Meijer et al., 2017, p. 834)

Two studies reported no changes in teachers' pedagogical behavior after taking part in the intervention (BO-TI-G-no change; Articles 23, 46).

Second, 25% of the corpus reported positive changes in *teachers' domain-specific instruction* (Articles 19 and 42 reported both descriptive and statistically significant changes). In nine studies, there was descriptive evidence of teachers changing their domain-specific instructional behavior after video coaching (BO-TI-DS-desc). Six studies described predominantly positive changes in teachers' domain-specific instructional behavior (Articles 14, 19, 22, 31, 37, 53). For example, a pre-school educator changed her mathematical practice after gaining understanding that the child experienced difficulty understanding larger numbers, through watching and discussing videotaped lesson episodes with a coach:

some of the practices improved are: the use of amounts that are possible to grasp, the importance of focusing on one aspect at a time and bringing in variation within this aspect, and the need for a clearly visualized shape and/or feature and demarcated whole. (Bjorklund, 2012, p. 512)

Also, three studies reported positive changes for some but not all teachers (Articles 4, 42, 57).

In addition, eight studies reported statistically significant changes in domain-specific instruction after participating in the intervention (BO-TI-DS-inf). In one study (Article 39), teachers outperformed the control group on most outcome variables after participating in the intervention. Teachers improved the quality of the classroom language environment and their instructional behavior, including language modeling. Two studies reported changes in teachers' domain-specific instruction measured before and after the intervention (articles 38, 56). Finally, three studies reported sometimes positive outcomes, either statistically significant changes for approximately half of the measured outcomes (Articles 2, 16, 42, 44) or that teachers' domain-specific instruction predicted student gains early, but not later in the intervention (Article 19). Two studies reported no statistically significant changes in teachers' domain-spe-

cific instruction (BO-TI-DS-no change; Articles 17, 49).

Affective Outcomes

About one fifth of the corpus reported positive changes in teachers' affective outcomes. Changes in *teachers' beliefs* were found most often, based on descriptive evidence. A total of eight studies reported descriptive changes in teachers' beliefs about teaching or learning for most of the participating teachers (AO-TB-desc; Articles 15, 22, 24, 31, 51, 54, 56, 58). For instance, Article 15 showed that after professional development, all teachers changed their beliefs about stimulating students' internal inquiry attitudes and 75% of the teachers changed their beliefs about stimulating students' external inquiry attitudes. In addition, one study (Article 23) presented evidence for positive statistically significant changes in teachers' beliefs (AO-TB-inf) for some, but not all, outcomes. In addition, one study (Article 53) reported descriptive positive changes in *teachers' attitudes* towards their profession (AO-TA-desc), and one study (Article 36) reported statistically significant changes in teachers' job satisfaction, for some, but not all, measured aspects (AO-TA-inf).

Table 2.4

Occurrences of Teacher Outcomes in the Corpus of Reviewed Studies

Category	Concept (total number of studies examining this outcome)	Code	Positive change article number*	Frequency	No change article number*	Frequency
Cognitive outcomes	Pedagogical knowledge-inferential (n = 5)	CO-PK-inf	23, 30, 32	3	07, 43	2
	Pedagogical knowledge-descriptive (n = 4)	CO-PK-desc	05, 23, 28, 45	4	NA	0
	Content knowledge-inferential (n = 1)	CO-CK-inf	38	1	NA	0
	Pedagogical content knowledge-inferential (n = 7)	CO-PCK-inf	01, 02, 11, 33, 38, 56	6	26	1
	Pedagogical content knowledge-descriptive (n = 9)	CO-PCK-desc	04, 09, 34, 47, 53, 55, 56, 57, 59	9	NA	0
Behavioral outcomes	Pedagogical behaviors-inferential (n = 24)	BO-TI-G-inf	06, 07, 10, 11, 12, 13, 18, 20, 25, 26, 27, 29, 30, 32, 35, 36, 41, 43, 48, 50, 52, 55	22	23, 46	2
	Pedagogical behaviors-descriptive (n = 10)	BO-TI-G-desc	03, 05, 08, 15, 20, 21, 24, 40, 45, 58	10	NA	0
	Domain-specific instructional behavior-inferential (n = 10)	BO-TI-DS-inf	02, 16, 19, 38, 39, 42, 44, 56	8	17, 49	2
	Domain-specific instructional behavior-descriptive (n = 9)	BO-TI-DS-desc	04, 14, 19, 22, 31, 37, 42, 53, 57	9	NA	0
Affective outcomes	Beliefs about teaching and learning-inferential (n = 1)	AO-TB-inf	23	1	NA	0
	Beliefs about teaching and learning-descriptive (n = 8)	AO-TB-desc	15, 22, 24, 31, 51, 54, 56, 58	8	NA	0
	Attitudes towards teaching and learning-inferential (n = 1)	AO-TA-inf	36	1	NA	0
	Attitudes towards teaching and learning-descriptive (n = 1)	AO-TA-desc	53	1	NA	0

Note. Positive change was coded for studies using inferential statistics (inf) when there were sometimes positive results, significant gains or significant differences, and for descriptive results when there were sometimes positive results (positive for some, but not all of the participants or outcomes) or positive results (positive for most participants or outcomes). No change was coded for studies using inferential statistics where there were no significant results, and for descriptive results when no change was reported. No negative change results were reported. *From Supplemental Table S2.1.

Research Question 1d: Student Impacts

In the following section, we summarize the reported student impacts from in-service teachers' video coaching interventions, in terms of the number of studies and nature of the evidence for each type of outcome. An overview is presented in Table 2.5. Compared with the teacher outcomes, there was little evidence of positive student impacts, but there was some evidence for changes in student achievement and engagement. The results are described in more detail hereafter.

Thirty percent of the corpus reported student impacts, that is, changes in student achievement, engagement, and motivation. First, 19% of the corpus reported on *student achievement*. Eight studies reported statistically significant changes in student achievement (SA-inf; Articles 2, 11, 17, 38, 39, 41, 44, 49), of which four studies reported that students performed better than the control group (Articles 2, 38, 39, 41). Students whose teachers participated in the STeLLA program, a program to support the professional development of science teachers through video analysis: "outperformed their peers in all content areas, making more than twice the gains in science knowledge" (Roth et al., 2011, p. 134). Two studies reported statistically significant gains for students (Articles 11, 17) and two studies reported sometimes positive results (Articles 44, 49). In addition, three studies provided descriptions of positive changes in student achievement (SA-desc; Articles 4, 24, 19).

Second, 10% of the overall corpus reported positive changes in *student engagement*, with one study describing positive changes (SE-desc; Article 14), while four studies reported statistically significant changes in students' active participation in academic and/or co-curricular or school-related activities (SE-inf) after their teachers participated in video coaching interventions (Articles 6, 10, 12, 32, 52). Article 10 reported statistically significant differences between the intervention and control groups for multiple indicators of children's engagement. Two studies reported statistically significant changes in student engagement from pretest to posttest (Articles 12, 52). Article 32 presented sometimes positive results, with statistically significant gains in some areas compared to a control group, but not in other areas. One study reported no changes in students' engagement (SE-no change; Article 18). Finally, one study (Article 13) found a statistically significant increase in *students' interest in the subject* compared to their peers in the control group (SM-inf), heightening their motivation for learning mathematics and science.

Table 2.5

Occurrences of Student Impacts in the Corpus of Reviewed Studies

Category (total number of studies examining this outcome)	Code	Positive change article number*	Frequency	No change article number*	Frequency
Student achievement-inferential (n = 8)	SA-inf	02, 11, 17, 38, 39, 41, 44, 49	8	NA	0
Student achievement-descriptive (n = 3)	SA-desc	04, 19, 24	3	NA	0
Student engagement-inferential (n = 6)	SE-inf	06, 10, 12, 32, 52	5	18	1
Student engagement-descriptive (n = 1)	SE-desc	14	1	NA	0
Student motivation-inferential (n = 1)	SM- inf	13	1	NA	0

Note. Positive change was coded for studies using inferential statistics (inf) when there were sometimes positive results, significant gains or significant differences, and for descriptive results when there were sometimes positive results (positive for some, but not all of the participants or outcomes) or positive results (positive for most participants or outcomes). No change was coded for studies using inferential statistics where there were no significant results, and for descriptive results when no change was reported. No negative change results were reported. *From Supplemental Table S2.1.

Co-occurrences

In this section, we summarize the reported co-occurrences associated with any positive teacher outcomes (including sometimes positive results). As mentioned previously, we have included only the teacher outcomes for which at least three studies reported any evidence of positive changes. Similarly, only co-occurrences which were found in three or more studies are reported. This means that teachers' CK and teachers' attitudes were excluded from this part of the analysis. For each outcome, the results are given for co-occurrences between teacher outcomes—student impacts (2C in the model, as shown in Figures 2.5, 2.6, 2.7, 2.8), teacher outcomes—enactment processes (2B), and enactment processes—design features (2A), in that order.

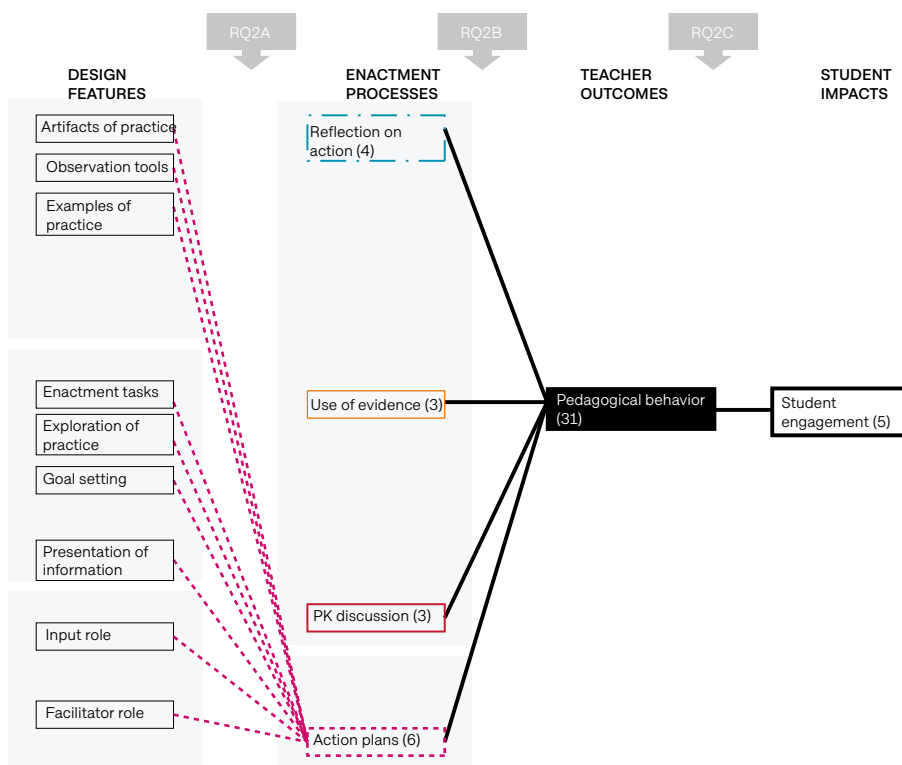
Teachers' Pedagogical Behavior

Inspection of co-occurrences in the 31 selected studies that reported positive changes in teachers' pedagogical behavior yielded no clear theory of action for how these outcomes were achieved, through a lack of data on enactment processes (see Figure 2.5). In comparing teacher outcomes and student impacts, the results show that positive changes in pedagogical behavior co-occurred with positive changes in student engagement in five studies (Research Question 2C). Only 12 of 31 studies reported on enactment, six of which reported the creation of action plans, four reported reflection on action,

and another three mentioned use of evidence and PCK discussions respectively (Research Question 2B). In this subset of 31 studies, it is surprising to find that no other enactment processes were reported more than three times and that the ones reported were not reported very often. In reviewing enactment and design features for this subset reporting changes in teachers' pedagogical behavior, only action plans co-occurred more than three times with the following design features: artifacts of practice, observation tools, examples of practice, enactment tasks, exploration of practice tasks, goal-setting tasks, presentation of information tasks, an input and a facilitator role (Research Question 2A).

Figure 2.5

Conjecture Map for Teachers' Pedagogical Behavior (Research Question 2)



Note. The starting point for the map is the black box of teacher outcomes (in this case, pedagogical behavior). Lines represent co-occurrences between teacher outcomes - student impacts; teacher outcomes - enactment processes; enactment processes - design features, respectively. The Research Question 2A line colors and types correspond with the lines used for the boxes around co-occurring enactment processes.

Teachers' Domain-Specific Instruction

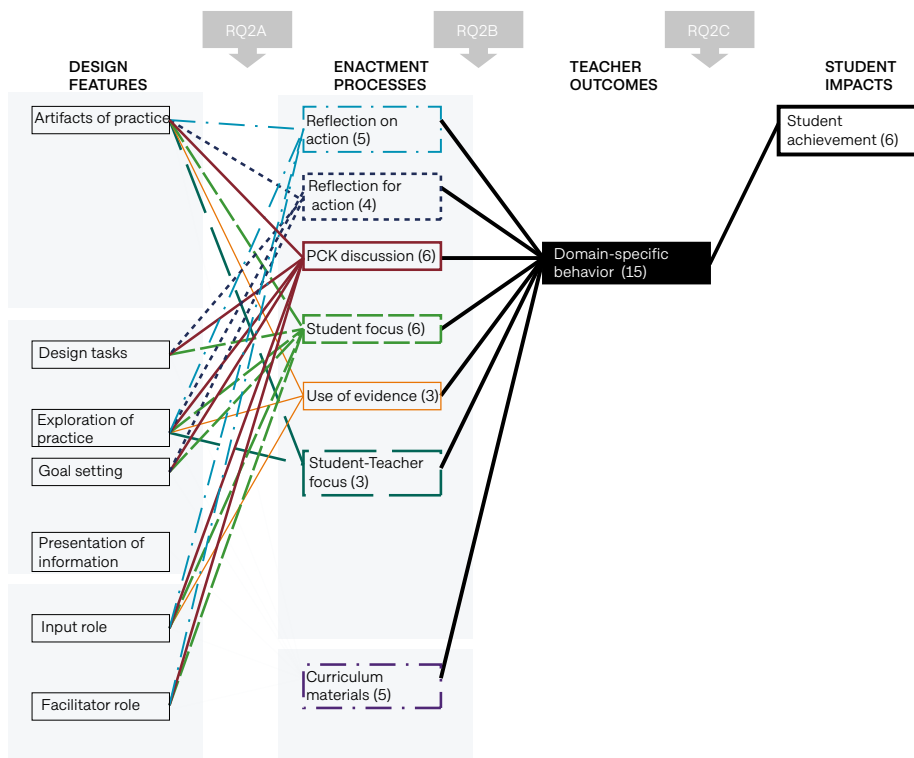
Inspection of the co-occurrences for the 15 studies reporting positive changes in teachers' domain-specific instruction revealed a potential theory of action (see Figure 2.6). In comparing teacher outcomes and student impacts, the results show that positive changes in domain-specific instruction co-occurred with positive changes in student achievement in six studies (RQ2C). Next, co-occurrences between teachers' domain-specific instruction and enactment processes were inspected. Changes in domain-specific instruction co-occurred with discussions about PCK-related topics (six studies), a focus on student behavior (six studies), reflection on action (five studies), curriculum materials (five studies), reflection for action (four studies), the use of evidence (three studies), and student—teacher focus (three studies; Research Question 2B). Exploration of practice and artifacts of practice co-occurred with all of the above-mentioned enactment processes, and will not be mentioned hereafter to minimize repetition. Reflection on action further occurred together with a facilitator and input role, and reflection for action co-occurred with design and goal-setting tasks. PCK-related discussions and a focus on student behavior occurred together with all four design features mentioned for the reflection processes. The same applies for the creation of curriculum materials, with the additional co-occurrence of presentation of information activities. Finally, the use of evidence also co-occurred with an input role.

Teachers' Pedagogical Content Knowledge

Inspection of the co-occurrences for the 14 studies reporting positive changes in teachers' PCK revealed a potential theory of action, which is rather clear (see Figure 2.7). In comparing outcomes and impacts, the results show that positive changes in PCK co-occurred with positive changes in student achievement in four studies (Research Question 2C). Next, co-occurrences between teachers' PCK and enactment were inspected. Positive changes in teachers' PCK occurred together with reflection on action (six studies), discussions on PCK-related topics (six studies), a focus on student behavior (six studies) and the use of evidence (seven studies) (Research Question 2B). All of these enactment processes in turn co-occurred with artifacts of practice, exploration of practice tasks, and an input and facilitator role (Research Question 2A).

Figure 2.6

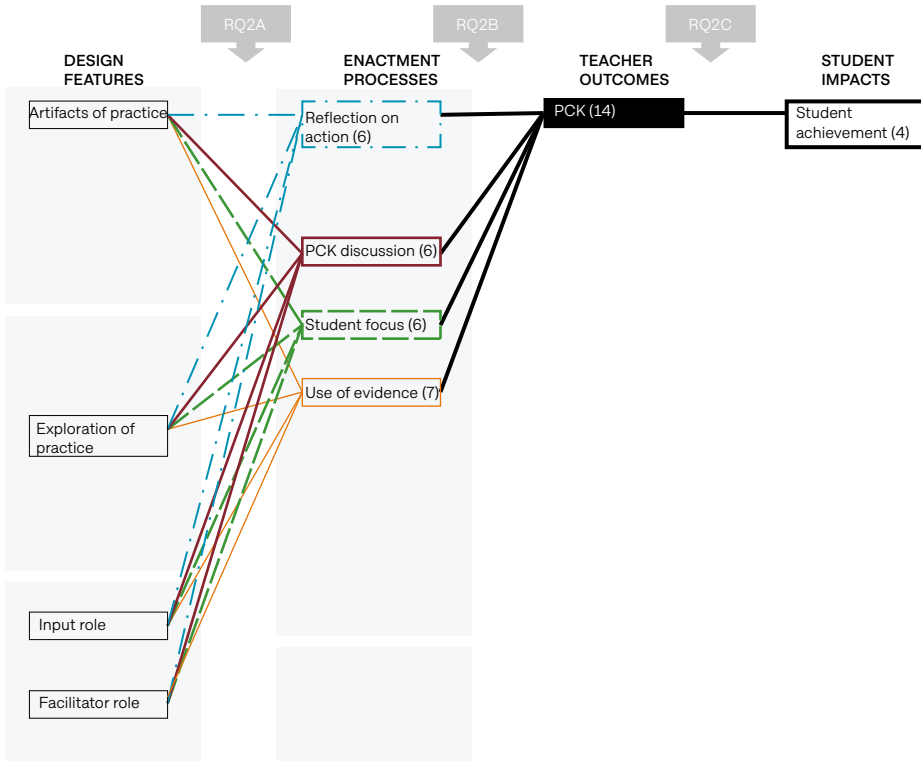
Conjecture Map for Teachers' Domain-specific Instruction (Research Question 2)



Note. The starting point for the map is the black box of teacher outcomes (in this case, domain-specific behavior). Lines represent co-occurrences between teacher outcomes – student impacts; teacher outcomes – enactment processes; enactment processes – design features, respectively. The Research Question 2A line colors and types correspond with the lines used for the boxes around co-occurring enactment processes.

Figure 2.7

Conjecture Map for Teachers' PCK (Research Question 2)



Note. The starting point for the map is the black box of teacher outcomes (in this case, PCK). Lines represent co-occurrences between teacher outcomes - student impacts; teacher outcomes - enactment processes; enactment processes - design features, respectively. The Research Question 2A line colors and types correspond with the lines used for the boxes around co-occurring enactment processes.

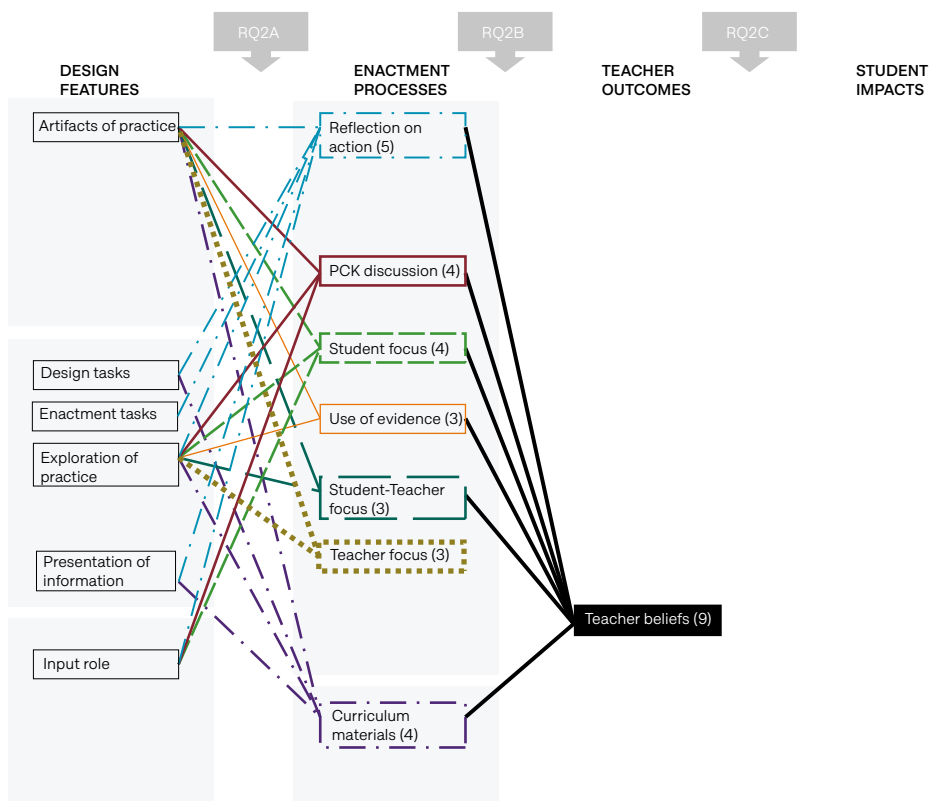
Teachers' Beliefs

Inspection of the co-occurrences for the nine studies reporting positive changes in teachers' beliefs revealed a potential theory of action, which is fairly clear, but for which the evidence is limited (see Figure 2.8). In comparing teacher outcomes and student impacts, the results show that positive changes in teachers' beliefs did not co-occur with positive changes in student outcomes in at least three studies (Research Question 2C). Next, co-occurrences between teachers' beliefs and enactment were inspected. Changes in beliefs co-occurred with reflection on action (five studies), discussions about PCK-related topics (four studies), a focus on student behavior (four studies), curriculum materials (four studies), the use of evidence (three studies), and student-teacher- focus (three studies) and teacher focus (three studies)

(Research Question 2B). Exploration of practice and artifacts of practice co-occurred with all above-mentioned enactment processes. Reflection on action occurred together with design tasks, enactment tasks, presentation of information activities, and an input role. PCK-related discussions and a focus on student behavior also co-occurred with an input role, and the creation of curriculum materials occurred together with design tasks and presentation of information activities.

Figure 2.8

Conjecture Map for Teachers' Beliefs (Research Question 2)



Note. The starting point for the map is the black box of teacher outcomes (in this case, teacher beliefs). Lines represent co-occurrences between teacher outcomes - student impacts; teacher outcomes - enactment processes; enactment processes - design features, respectively. The RQ2A line colors and types correspond with the lines used for the boxes around co-occurring enactment processes.

Additional Observations

Interestingly, many of the 31 studies that reported positive changes in teachers' pedagogical behavior provided no data on enactment processes.

It seems that the design features of artifacts of practice (mentioned in all 31 studies in this category), exploration of practice tasks (all 31 studies in this category), presentation of information activities (23 studies), practice tasks (16 studies), goal-setting (12 studies) and examples of practice (13 studies) could be supportive of changes in teachers' pedagogical behavior. However, the mechanisms through which this would happen remain unclear, due to the lack of enactment information.

Summary of Main Findings

The objective of this study was to gain insight into what the empirical literature has to say on how video coaching can influence teacher outcomes and potentially impact student learning. Therefore, driven by two research questions, this review systematically identified and summarized the occurrences and co-occurrences of video coaching design features, enactment processes, teacher outcomes, and student impacts, as reported in empirical literature on video coaching interventions for in-service teachers from early childhood education to tertiary education from all teaching domains. Four databases were searched and a five-step selection process resulted in a total of 59 studies included in this review.

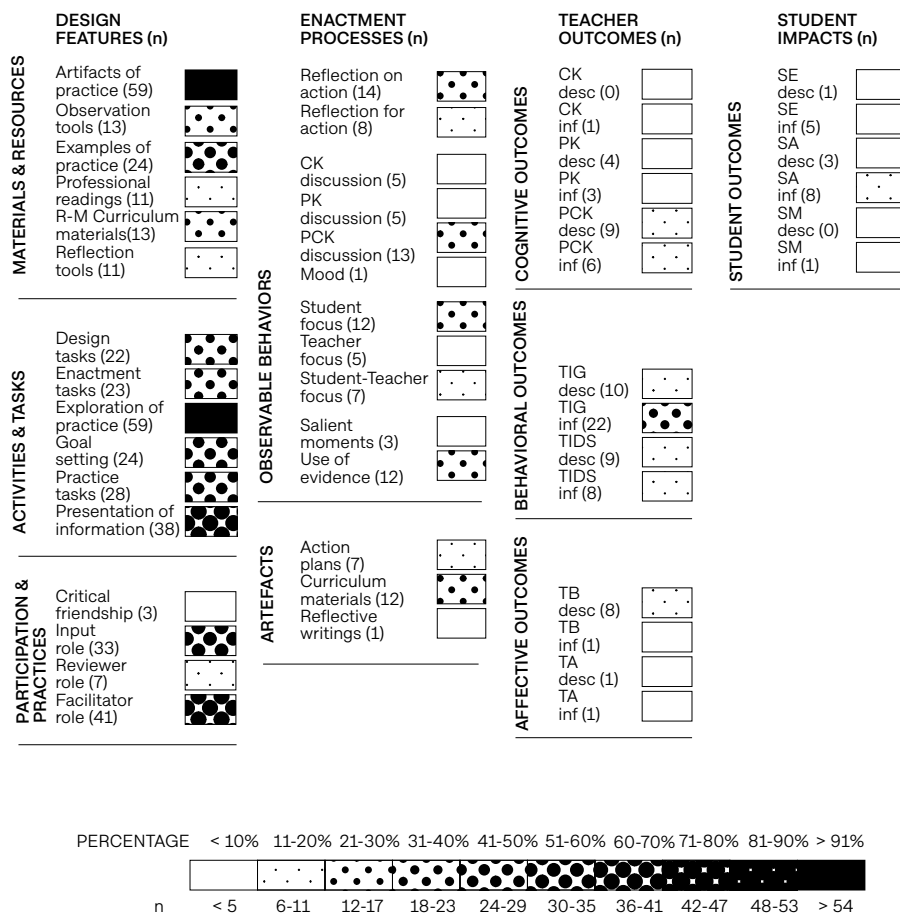
Research Question 1 asked: *What (a) design features, (b) enactment processes, (c) teacher outcomes, and (d) student impacts were identified in the empirical research on in-service teacher video coaching and how often did they occur?*

With regard to this question, the video coaching design features appeared more often than the enactment processes, teacher outcomes and student impacts, and varied from simple to rather complex. The included studies most often reported the presence of artifacts of practice, examples of practice (materials and resources), exploration of practice tasks, presentation of information activities, goal-setting tasks, practice tasks (activities and tasks), and an input and facilitator role (participation and practices) as part of the design. Only about half of the studies reported on enactment processes, and the ones that did often reported that participants reflected on action, talked about topics related to PCK, focused on student behavior, used evidence for their reasoning, and (re)created curriculum materials. With regard to teacher outcomes, positive changes in teachers' pedagogical behavior were most often

reported, followed by positive changes in teachers' PCK and domain-specific instruction. Compared to the teacher effects, there was very little evidence of positive student impacts. An overview is presented in Figure 2.9.

Figure 2.9

Overview of Occurring Constructs within Video Coaching Design Features, Enactment Processes, Teacher Outcomes, and Student Impacts



Note. No change teacher outcomes and student impacts are omitted from this figure.

Research Question 2 asked: *For studies that showed positive teacher outcomes, what co-occurrences were there between (a) design features and enactment processes, (b) enactment processes and teacher outcomes, and (c) teacher outcomes and student impacts?*

With regard to this question, the literature showed that there is evidence, (though limited) for possible relationships between the constructs identified (in answering Research Question 1). The possible relationships can best be summarized as the following conjectures:

- Improvements in teachers' domain-specific instruction can be supported through enactment of reflection on action, reflection for action, a focus on students and on student—teacher behavior, PCK-related discussion topics, and the development of curriculum materials. Artifacts of practice, exploration of practice, design tasks, goal-setting tasks, and presentation of information activities, together with having input and facilitator roles, can support this combination of enactment processes.
- PCK development can be supported through reflection on action, student focus, PCK-related discussion, and the use of evidence. In turn, all of these enactment processes can be supported by artifacts of practice and exploration of practice, along with having input and facilitator roles.
- Positive changes in teachers' beliefs can be supported through enactment of reflection on action, a focus on students and on student—teacher behavior, the use of evidence, PCK-related discussion topics, and the development of curriculum materials. Artifacts of practice, exploration of practice, design tasks, enactment tasks, presentation of information activities, coupled with the presence of input and facilitator roles, can support this combination of enactment processes.

We had hoped to develop stronger conjectures on the relationships between the teacher outcomes and student impacts, but the data on how designs were enacted were very limited. This points to an important gap in the current knowledge base. In particular, we observed a salient lack of evidence on the enactment processes that yielded (positive) changes in teachers' pedagogical behavior. Enactment processes were only reported on six times in the 31 total studies reporting positive changes in pedagogical behavior. This is important, because enactment data are needed to map theories of action, develop evidence-informed interventions, and replicate studies.

Discussion

The results from this review provide the foundation for video coaching theories of action. Much promising work has been done in this area, and the outcomes for teachers are encouraging. However, it must also be noted that the evidence for how design features supported some of the (more promising) outcomes is limited, and further work is needed in this regard. In the following sections, we reflect on the outcomes of video coaching and how these relate to previous findings, discuss unresolved issues and challenges in video coaching, and articulate the implications this review holds for research, policy, and practice. The suggestions below take our results as a point of departure.

Positive Outcomes of Teacher Video Coaching in Light Of Related Reviews

In this section, we consider what the review has taught us about the outcomes of teacher video coaching, and how this relates to existing reviews on video viewing and coaching. Most notably, the included studies report positive changes in teachers' classroom practices, especially pedagogical behavior. These promising findings are in line with findings of some previous reviews, but contradict others. For example, the finding that teachers made changes in their practice is in line with the recent meta-analytic review on causal evidence from (quasi)experimental studies of (web-based and face-to-face) coaching, which found pooled effect sizes of 0.47 *SD* for pedagogical practices and 0.49 *SD* for instruction (Kraft et al., 2018). Conversely, a different review on video viewing reported limited evidence of changes in teachers' classroom practice (Gaudin & Chaliès, 2015). A possible explanation could lie in the different focus of the reviews, as the Gaudin and Chaliès (2015) review included literature on the use of different types of videos (self, other, peers) for learning for in-service and preservice teachers, and was not specifically focused on interventions that included a coaching component.

In addition, this review shows that video coaching supported the development of domain-specific teaching knowledge (PCK), including professional vision. This finding is supported by the results of existing reviews on video viewing in teacher education and training (Gaudin & Chaliès, 2015; Marsh & Mitchell, 2014) and is promising, because this type of knowledge is possessed by expert teachers in particular, and is crucial for effective teaching of a subject (Park & Oliver, 2008a). Reflection on one's own practices appears to be important for developing this type of knowledge within video coaching. However, it should be noted that teachers do not always reflect in ways that

support their learning, for instance, by describing events or making quick judgements (Sherin & van Es, 2009), which is unfortunate, but expert guidance can be beneficial to help deepen their reflection (Gaudin & Chaliès, 2015). A recent study has shown that video-based peer feedback is more supportive for developing preservice teachers' professional vision when combined with expert feedback (Weber et al., 2018).

Comparing outcomes from this review to existing reviews, the combination of video and coaching seems promising. Existing reviews have shown that the analysis of videos (self, other, peers) could support cognitive outcomes, such as professional vision, but there was not much evidence for changes in behavior (Gaudin & Chaliès, 2015). Information gained from video viewing might not always automatically be transferred to changing one's own classroom practice, and expert support might be needed to make these changes. A recent study comparing digital video-based and face-to-face feedback environments found that digital video feedback in combination with expert feedback led to more high-quality suggestions (feedback behaviors) by preservice teachers in a practicum setting illustrating this notion (Prilop et al., 2020). Reflection was reported as an important outcome of video-viewing studies (Marsh & Mitchell, 2014; Tripp & Rich, 2012), but in this review reflection was more often reported as an enactment process that supported other outcomes, as was visible in Figures 2.5 through 2.8.

Gaps and Challenges in Empirical Video Coaching Literature

This review shows an important gap in knowledge with regard to a video coaching theory of action for pedagogical behavior, which is surprising, because this is the outcome for which the most evidence was found. Consequently, it was not possible to develop (strong) conjectures for the way that video coaching design features could lead to enactment processes that in turn supported these outcomes. Successful programs, such as My Teaching Partner, described design features through which teachers and coaches worked together to improve teaching according to teaching effectiveness frameworks (e.g., Gregory et al., 2014). Within this program, coaches reviewed participants' practices using a teaching effectiveness framework and provided feedback in order to support alignment of teaching practices with that framework. In addition, participants took part in a workshop and had access to a video library with examples illustrating the framework in practice. While this review confirms previous findings that interventions (in this case, coaching) that use models of effective practice can yield professional development (Darling-Hammond et al., 2017), it does not reveal *how* the ingredients work together in video coaching practice, or *how* enactment supports change in

teachers' pedagogical behavior. Given the design of these interventions it seems plausible that the feedback provided was directive and geared towards getting practices aligned with standards of teaching effectiveness. Gaining insight into these details would support coaches in aligning their coaching repertoire with the learning objectives of the teacher(s) receiving the coaching and/or those of the coaching program.

This review further reveals a very limited evidence base for changes in teachers' attitudes and some evidence for changes in teachers' beliefs. This is somewhat surprising, because video coaching as a professional development approach appears suitable for promoting these types of outcomes. For instance, it is plausible that throughout coaching, teachers could have mastery experiences or vicarious experiences by watching their peers succeed, which are important for enhancing self-efficacy (Bandura, 1997). A recent study showed that digital video-based reflection and feedback environments could be especially beneficial for fostering more constructivist beliefs rather than traditional (stemming from transmissive/ behaviorist theories of learning) beliefs, and more so than face-to-face or text-based settings (Prilop et al., 2019). Existing reviews mentioned belief changes, but mostly with regard to preservice teachers (Gaudin & Chaliès, 2015).

Finally, this review showed that there was limited evidence for impacts of video coaching on students. The related reviews also presented no clear answer when it came to impact on student outcomes. There were examples where effects of coaching on student achievement were established (Kraft et al., 2018), but other related reviews did not address this. This is surprising, because teacher professional development is designed to ultimately affect student learning. However, it is important to realize that changes in teacher outcomes do not easily translate to changes in student achievement, as shown by Kraft et al. (2018), who estimated that large changes in instructional behavior as a result of coaching are necessary before changes in student achievement occur. A study that did not meet our criteria because no teacher outcomes were included, but is worth mentioning, was a recent study by Taylor et al. (2017), who reported an effect size of 0.52 standard deviations in favor of students whose teachers participated in a video coaching intervention, compared to students whose teachers participated in a content-deepening program only. This points to a need to further investigate how video coaching should be designed in order to have an effect on student outcomes, because the current body of evidence does not present a clear answer to this question.

Methodological Discussion

The results of this review were shaped by the methodological choices made. Previous related reviews did not provide an elaborated map of in-service teacher video coaching design, enactment, outcomes, and impact that provided clear indicators for a theory of action, which would be needed for a meta-analytical approach. To generate such a map, and based on the types of interventions mentioned in related reviews, an inclusive approach was taken that welcomed studies from different philosophical backgrounds and associated research traditions, to build theoretical understanding of the phenomenon of in-service teacher video coaching. A conjecture mapping approach was taken to create this theory of action, with large generic categories that left no salient features behind. In order to map the theory of action, included studies had to at least report on the teacher outcomes from the intervention, meaning that studies only reporting on design and enactment (or learner outcomes) were not considered in this review. To represent the variety of studies in the corpus fairly, outcome evidence was summarized on the article level for each type of variable and type of evidence. This resulted in percentages of studies from the full corpus exhibiting specific characteristics. This approach was chosen (e.g., as opposed to identifying an outcome and reporting the percentage of studies that investigated that specific inputs and processes yielding that outcome) because the aim of the study was to represent what literature tells us about video coaching; namely, to present a map of the field. We do acknowledge that, since co-occurrences must be derived from the same sample, it would be likely to find little empirical support for patterns between teacher outcomes and enactment processes (or enactment processes and design features) when it comes to teacher outcome categories for which a limited sample of studies was identified in the first place. In the next section, the limitations of the study are addressed.

Limitations

The results of this review could have been influenced through our selection criteria and analysis approach. We chose to focus on peer-reviewed articles published in high quality scientific journals to ensure the quality of the corpus. As a result, book chapters, unpublished dissertations, conference papers, research reports, and other grey literature were excluded from this review. We recognize that the corpus was not fully inclusive, due to the exclusion of these as well as of non-English studies, and studies without pdfs. Publication bias could explain why not much negative evidence was reported in the included studies. We chose to focus on scientific articles that were

published in the English language, because it enhances the verifiability of the results. However, important work published in other languages may have been excluded, and language bias could explain why most of the studies in the review corpus were conducted in the USA. In addition, we only looked at the co-occurrences of concepts that emerged through the analysis in order to generate possible conjectures to be tested in future studies and meta-analyses. While this approach allowed us to create detailed knowledge about this type of intervention, by bringing together what is known about it, this study does not provide insight into the strengths of the relationships revealed in this review, and the results should be interpreted as such. Nevertheless, the results can help stakeholders to leverage existing work by building on the most promising directions identified in this study, and addressing the gaps that warrant attention in future research. Next, we acknowledge that there are other conceptualizations of the relationship between teachers' attitudes, beliefs, and dispositions besides the ones used to guide this review (e.g., using the theoretical framework from the individual studies could be used as an alternative approach). However, to ensure consistency across the review, the framework as depicted in Figure 2.1 was used for all included studies. Further, while other variables, such as instructional time, could have an influence on the outcomes, these were considered to be beyond the scope of the review. Finally, we acknowledge that there were studies of enactment processes that did not meet one or more criteria for inclusion in the review, for instance, because they did not include information on teacher outcomes. In addition, we acknowledge the possibility that studies in our corpus reporting non-significant results might have lacked statistical power due to their small scale, and that our approach to analysis did not attempt to compensate for this possibility.

Implications for Practice, Policy, and Future Research

The results of this review give indications of how to design video coaching interventions for different teacher outcomes, but this does not mean that all seemingly effective features should be combined without good reason. When designing professional development, such as video coaching, it is likely that multiple outcomes are targeted simultaneously. When looking across the results for teachers' PCK, domain-specific instruction, and beliefs, one might be tempted to combine all of the seemingly effective design features into one intervention, expecting that this will result in all these outcomes. However, as combining individually tasty ingredients does not necessarily guarantee a collectively tasty dish, solid reasoning for how powerful elements work together is required.

In part, this seems due to the fact that, even though similar design fea-

tures or enactment processes might be present across a range of studies, the content and manifestation of these features could easily vary depending on the objective. For example, videos of practice to support teachers in changing their beliefs about how students learn mathematics could be completely different from those used to support teachers in aligning their practices with standards of effective teaching. Furthermore, it is not only the goals, but also the stance taken on how to achieve them, that affects the design and enactment of interventions. The corpus in this review included a variety of video coaching programs, some of which took more situated approaches, whereas others aimed to support teachers' deliberate practice of evidence-based approaches to effective teaching. This is consistent with the existing literature, which has noted that some professional development interventions can be classified as highly adaptive, being responsive to changing goals, resources, and circumstances, whereas others are highly specified, with goals, content, and materials being predetermined to provide a particular experience (Koellner & Jacobs, 2015). One could view these distinctions along a continuum, the middle of which might contain interventions with elements of both. For instance, programs could start from a highly specified framework emphasizing effective teaching, during which participants become interested in how student behavior is affected by changes made in the classroom, and then allow the goals, content, and materials to be adapted accordingly to support open-ended exploration of how student behavior manifests itself within that particular context. Alternatively, professional development could start off with participants conducting a situated exploration of student learning, conclude that a given framework emphasizing evidence-informed instructional strategies might address the phenomena discovered, and decide to specify the goals, content, and materials to support enactment of these specific instructional strategies. It should be noted that, while this review can give direction regarding features to include when designing video coaching interventions and the enactment processes to aim for, a clear and well-justified theory of action is needed to further detail the specific requirements for video coaching interventions in line with their aims.

Coaches or schools wanting to implement video coaching should be aware of these findings and how they can be used to shape coaching practices. This review points to some helpful results, especially when domain-specific practices are the area of interest, and offers hypotheses for the way video coaching design could support these outcomes, which can be used as guidance for design. In addition, having insight into common design features could help with design thinking in the early phases of developing a coaching program. Unfortunately, it is hard to say which enactment processes support positive changes in pedagogical behavior; the awareness that research does

not provide a uniform answer to this is important. In addition, this review also illustrates that video coaching is not commonly utilized for all types of outcomes, and research is needed to establish the usefulness and effectiveness of video coaching when it comes to developing content knowledge, pedagogical knowledge, and affective outcomes (attitudes, in particular), and for supporting student outcomes.

This review also holds implications for policy, and especially for how research funding might be allocated. Investigations that have the objective of establishing how learning occurs when interaction with the learning environment happens seem especially needed when it comes to video coaching. In this way, the development of black box interventions in which learning is oversimplified as a linear causal pathway between the design (or input) and outcomes is avoided. Hence, this line of reasoning implies that efforts to create theory about how interventions work in practice and under different conditions are of great importance for the development of interventions, and qualitative methods can often help to shine light on the enactment processes during the initial phases of evaluation (McKenney & Reeves, 2019). These insights can help shape redesign efforts, while also developing theory on how interventions work under different conditions. Redesigned interventions can be tested in later stages of the research project. Funding efforts that try to close the identified gaps in relation to changes in teachers' pedagogical behaviors and the student impacts of video coaching are especially needed in order to further knowledge within the field. Specifically, policymakers should pay attention to the theories of action driving studies, the evidence supporting claims about these theories, and/or the actions that are undertaken within studies to further develop theories of action. The enactment of interventions deserves special attention in this regard.

Future research should test the conjectures that were revealed within this study. For example, research is needed to understand how video coaching can support changes in teachers' pedagogical behavior, the extent to which video coaching can impact student outcomes, and connections between the two. In this review, the articles that reported changes on teachers' pedagogical teaching behavior elaborated on the outcomes themselves more than the design or enactment of the interventions that engendered them. Given this, along with the fact that many studies were excluded for providing enactment process data but not outcomes data, it seems plausible that in-depth studies of enactment and outcomes are present, but reported separately due to length restrictions. This is important, because this information is needed to support the training of coaches in this area. To shed light on this gap in the research, an especially promising direction could be the use of mixed method studies, for example featuring qualitative investigation of enactment in relation

to quantitative measures of successful and unsuccessful outcomes at the student or participant level. A number of questions can be asked in this regard. For instance, how do reflection processes play a role in studies aimed at improving pedagogical behavior? What do teachers and coaches pay attention to? Do they reason based on context or is their reasoning knowledge-driven? Another recommendation pertains to reporting research in which design features, enactment processes and teacher outcomes are investigated. In larger projects, results are often broken up into different articles, some reporting on design and enactment, others on the outcomes, which can be difficult for an outsider to merge together. Authors could be encouraged to link the study they are reporting to other studies from the same project, by referencing published and unpublished works from the same project. Using a conjecture map (or another type of logic model) could help readers to understand how the different studies fit together and provide evidence for the theory of action. The connected studies could be made available on the project website or the research group website as additional resources.

A similar approach could also be taken by researchers reviewing published findings. In this case, relevant projects could be identified through initial searches focusing on articles reporting positive results, and the (principal) investigators could be approached to provide access to reports that detail other aspects of the same project. These documents could be used to identify the relevant design features, enactment processes, and teacher outcomes necessary for generating a conjecture map, as described above. Then, the coding could be verified and complemented (if necessary) with an interview with the (principal) investigator, for example, as done in the review by Roblin et al. (2018).

Finally, this review also points to a gap in research on student impacts, which need to be further investigated. A recent study showed that, in comparison with the content-deepening PD program, a video coaching program significantly improved teachers' knowledge and practice, and that there was a strong relationship between teaching practice and student learning (Roth et al., 2019). Existing evidence on the relationship between teacher change and effects on student outcomes (e.g., Kraft et al., 2018) points to the hypothesis that a fair amount of behavioral change is needed on the teachers' side to affect student outcomes. This is important to keep in mind for future research.

In closing, the conjecture-mapping approach of this review provides a language and structure for understanding how research can help to provide insight into video coaching mechanisms. As such, it constitutes the kind of argumentative grammar (Kelly, 2004; Sandoval, 2014) for unpacking learning processes (not just black box models) that is vital for understanding how interventions lead to outcomes and impacts. Educational research is conducted

in, through, and for practice. It strives not only to build understanding about whether or not learning takes place, but especially about how, for whom, and under what circumstances learning takes place. This type of knowledge is vital for monitoring as well as improving educational interventions. Thus, for professional development programs in general and video coaching in particular, thorough investigation of the enactment processes is crucial for understanding whether, how and in what way learners interact with the learning environment. Doing so reduces the risk of creating black box models and puts the focus where it needs to be: on the intervention map as a whole.

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Table S2.1

Overview of the Articles on Teacher Video Coaching Included in this Review and Assigned Codes

Authors	ID	Design features*	Enactment processes*	Teacher outcomes*	Student impacts*
Beisiegel et al. (2018)	1	AT-EP, AT-PT, MR-AP, MR-OT, MR-EP, PP-FR	OB-D-UE	CO-PCK-inf	
Berbano et al. (2006)	29	AT-EP, AT-PT, MR-AP		BO-TI-G-inf	
Bjorklund (2012)	37	AT-DT, AT-EP, AT-GT, MR-AP, PP-FR	OB-RFA, A-CM, OB-F-S, OB-CK, OB-PCK, OB-ROA	BO-TI-DS-desc	
Brownell et al. (2017)	2	AT-ET, AT-EP, AT-GT, AT-PT, AT-P, MR-AP, AT-OT, MR-CM, PP-FR	A-AP	CO-PCK-inf, BO-TI-DS-inf	SA-inf
Ceven Mccally (2016)	3	AT-EP, AT-GT, MR-AP	OB-RFA, OB-D-SM, OB-D-UE, OB-F-ST, OB-F-T, OB-PK, OB-ROA	BO-TI-G-desc	
Christ et al. (2017)	4	AT-DT, AT-EP, AT-GT, AT-PT, MR-AP, MR-EP, MR-PR, MR-RT, PP-CF, PP-IR		CO-PCK-desc, BO-TI-DS-desc	SA-desc
Chval et al. (2015)	14	AT-DT, AT-EP, AT-GT, AT-PI, MR-AP, PP-FR	OB-RFA, A-CM, OB-F-S, OB-F-ST, OB-PCK	BO-TI-DS-desc	SE-desc
Conroy et al. (2015)	10	AT-ET, AT-EP, AT-GT, MR-AP, MR-PR, MR-CM, PP-IR, PP-FR	A-AP	BO-TI-G-inf	SE-inf
Dekker-Groenet al. (2013)	23	AT-ET, AT-EP, AT-GT, AT-PT, AT-PI, MR-AP, MR-EP, MR-CM, MR-RT, PP-IR, PP-FR, PP-RR		CO-PK-desc, CO-PK-inf, BO-TI-G-inf, AO-TB-inf	
Derri et al. (2015)	6	AT-ET, AT-EP, AT-PI, MR-AP, MR-PR		BO-TI-G-inf	SE-inf
Early et al. (2017)	7	AT-EP, AT-GT, MR-AP, MR-EP, MR-RT, PP-IP, PP-FR	A-AP	CO-PK-no change, BI-TI-G-inf	
Ermeling (2010)	31	AT-ET, AT-EP, MR-AP, PP-IR	OB-RFA, OB-D-SM, OB-D-UE, A-CM, OB-F-S, OB-F-ST, OB-F-T, OB-PCK-OB-ROA	BO-TI-DS-desc, AO-TB-desc	
Fukkink & Tavecchio (2010)	36	AT-EP, MR-AP		BO-TI-G-inf, AO-TA-inf	

Furtak et al. (2016)	11	AT-DT, AT-ET, AT-EP, AT-GT, AT-PT, AT-PI, MR-AP, MR-PI, MR-CM, PP-FR	CO-PCK-inf, BO-TI-G-inf	SA-inf
Geiger et al. (2016)	54	AT-DT, AT-ET, AT-EP, AT-PI, MR-AP, PP-FR	OB-RFA, OB-D-JE, A-CM, OB-F-S, OB-F-ST, OB-F-T, OB-PCK, OB-ROA	AO-TB-desc
Grau et al. (2017)	53	AT-EP, AT-PT, MR-AP, MR-EP, MR-PR, MR-RT, PP-CF, PP-IR	CO-PCK-desc, BO-TI-DS-desc, AO-TA-desc	
Gregory et al. (2014)	12	AT-EP, AT-GT, AT-PI, MR-AP, MR-OT, MR-EP, MR-RT, PP-IR, PP-FR	BO-TI-G-inf	SE-inf
Helmerhorst et al. (2017)	27	AT-ET, AT-GT, AT-PT, AT-PI, MR-AT, MR-OT, MR-EP, MR-CM, PP-IR, PP-FR	BO-TI-G-inf	
Johannes et al. (2013)	28	AT-EP, AT-PT, MR-AP, MR-EP, PP-FR	CO-PK-desc	
Johansson et al. (2012)	35	AT-EP, AT-GT, AT-PT, AT-PI, MR-AP, MR-OT, MR-EP, MR-PR, PP-FR	BO-TI-G-inf	
Kiemer et al. (2015)	13	AT-DT, AT-ET, AT-EP, AT-PI, MR-AP, PP-IR, PP-FR	BO-TI-G-inf	SM-inf
Kuijpers et al. (2017)	20	AT-EP, AT-PT, AT-PI, AT-IMR	BO-TI-G-desc, BO-TI-G-inf	
LoCasale- Crouch et al. (2016)	8	AT-EP, AT-GT, AT-PT, AT-PI, MR-AP, MR-EP, MR-PR, PP-FR	BO-TI-G-desc	
Luna & Sherin (2017)	9	AT-DT, AT-ET, AT-EP, AT-PI, MR-AP, MR-IR, PP-FR	CO-PCK-desc	
McDonald et al. (2015)	42	AT-EP, AT-GT, AT-PT, MR-AP, PP-FR	BO-TI-DS-desc, BO-TI-DS-inf	
Meijer et al. (2017)	15	AT-EP, AT-GT, AT-PI, MR-AP, MR-OT, MR-PR, PP-CF, PP-FR	BO-TI-G-desc, AO-TB-desc	
Milburn et al. (2014)	16	AT-DT, AT-ET, AT-EP, AT-GT, AT-PT, AT-PI, MR-AP, MR-EP, PP-IR, PP-FR	BO-TI-G-inf	
Namasivayam et al. (2015)	17	AT-ET, AT-EP, AT-GT, AT-PT, AT-PI, MR-AP, MR-CM, PP-IR, PP-FR, PP-RR	BO-TI-DS-no change	SA-inf

Nilsson (2014)	59	AT-DT, AT-ET, AT-EP, AT-GT, MR-AP	OB-RFA, OB-D-UE, A-CM, OB-F-S, OB-F-ST, OB-CK, OB-PCK, OB-ROA	CO-PCK-desc	SA-desc
Peck et al. (1989).	24	AT-EP, MR-AP, PP-IR, PP-FR		BO-TI-G-desc, AO-TB-desc	SA-desc
Pehmer et al. (2015a)	18	AT-DT, AT-EP, AT-PI, MR-AP, PP-IR, PP-FR	OB-D-UE, A-CM, OB-F-S, OB-F-ST, OB-M, OB-PCK, OB-PK, OB-ROA	BO-TI-G-inf	SE-no change
Pehmer et al. (2015b)	41	AT-DT, AT-ET, AT-EP, AT-PI, MR-AP, PP-IR, PP-FR	A-CM	BO-TI-G-inf;	SA-inf
Pentimonti et al. (2017)	19	AT-EP, AT-PT, AT-PI, MR-AP, MR-EP, MR-CM		BO-TI-DS-desc, BO-TI-DS-inf	SA-desc
Perron et al. (2013)	30	AT-EP, AT-PT, MR-AP, PP-FR		CO-PK-inf, BO-TI-G-inf	
Perron et al. (2014)	26	AT-EP, AT-GT, AT-PT, MR-AP, MR-OT, PP-FR		BO-TI-G-inf	
Philippou et al. (2015)	58	AT-DT, AT-ET, AT-EP, AT-PI, MR-AP, MR-EP	OB-RFA, OB-ROA	BO-TI-G-desc, AO-TB-desc	
Pianta et al. (2008).	25	AT-ET, AT-EP, AT-PI, MR-AP, MR-EP, MR-CM, MR-RT, PP-IR, PP-FR		BO-TI-G-inf	
Pianta et al. (2014)	43	AT-EP, AT-PT, AT-PI, MR-AP, MR-EP, MR-RT, PP-IR, PP-FR		CO-PK-no change, BO-TI-G-inf	
Pianta et al. (2014)	21	AT-ET, AT-EP, AT-GT, AT-PI, MR-AP, MR-OT, MR-EP, PP-IR	A-AP	BO-TI-G-desc	
Piowar et al. (2013)	32	AT-EP, AT-PT, AT-PI, MR-AP, MR-OT, MR-EP, MR-PR, PP-IR		CO-PK-inf, BO-TI-G-inf	SE-inf
Rezzonico et al. (2015)	44	AT-ET, AT-EP, AT-GT, AT-PT, AT-PI, MR-AP, MR-CM, PP-FR		BO-TI-DS-inf	SA-inf
Roth et al. (2011)	38	AT-DT, AT-ET, AT-EP, AT-PT, AT-PI, MR-AP, MR-EP, MR-CM, PP-IR, PP-FR	A-CM	CO-CK-inf, CO-PCK-inf, BO-TI-DS-inf	SA-inf
Santagata & Bray (2016)	22	AT-DT, AT-EP, AT-GT, AT-PI, MR-AP, MR-EP, MR-PR, PP-IR	OB-RFA, OB-D-SM, A-CM, OB-F-S, OB-F-ST, OB-CK, OB-PCK	BO-TI-DS-desc, AO-TB-desc	

Sedova et al. (2016)	52	AT-DT, AT-ET, AT-EP, AT-PI, MR-AP, PP-IR, PP-RR	A-CM	BO-TI-G-inf	SE-inf				
Shanahan & Tochell(2014)	45	AT-DT, AT-EP, AT-PT, AT-PI, MR-APMR-CM, MR-RT, PP-FR	OB-D-UE, OB-CK, OB-PCK, OB-ROA	CO-PK-desc, BO-TI-G-desc					
Sherin & Han (2004)	34	AT-EP, MR-AP, PP-IR, PP-FR	OB-D-UE, OB-F-S, OB-F-T, OB-CK, OB-PCK, OB-ROA	CO-PCK-desc					
Sherin & van Es (2009)	57	AT-EP, MR-AP, PP-IR, PP-FR	OB-D-UE, OB-F-S, OB-PCK, OB-PK, OB-ROA	CO-PCK-desc, BO-TI-DS-desc					
Stephenson et al. (2011)	40	AT-EP, AT-GT, MR-AP, MR-OT, PP-IR		BO-TI-G-desc					
Suhrheinrich& Chan (2017)	46	AT-DT, AT-EP, AT-GT, AT-PI, MR-APPP-RR		BO-TI-G-no change					
Taylor (2012)	47	AT-DT, AT-ET, AT-EP, AT-PI, MR-APMR-PR, PP-IR, PP-FR	A-WR	CO-PCK-no change					
Tuan et al. (2017)	51	AT-DT, AT-EP, AT-PI, MR-AP, MR-EP, MR-CM, PP-FR	A-CM	AO-TB-desc					
van Es & Sherin (2008)	33	AT-EP, MR-AP, PP-IR, PP-FR	OB-D-UE, OB-F-S, OB-PCK, OB-ROA	CO-PCK-inf					
van Es & Sherin (2010)	56	AT-EP, MR-AP, PP-IR, PP-FR	OB-D-UE, OB-F-S, OB-F-T, OB-PCK, OB-PK, OB-ROA	CO-PCK-desc, CO-PCK-inf, BO-TI-DS-inf, AO-TB-desc					
Voerman et al. (2015)	50	AT-ET, AT-EP, AT-PT, AT-PI, MR-AP, PP-IR, PP-FR		BO-TI-G-inf					
Wasik & Hindman(2011)	39	MR-AP, MR-OT, MR-EP, MR-PR, MR-CM, PP-IR, PP-RR		BO-TI-DS-inf	SA-inf				
Wetzels et al. (2016)	49	AT-DT, AT-EP, AT-PI, MR-AP, PP-IR, PP-FR	A-CM	BO-TI-DS-no change	SA-inf				
Yow & Lotter (2016)	55	AT-EP, AT-PT, AT-PI, MR-AP, MR-RT, PP-IR, PP-FR		CO-PCK-desc, BO-TI-G-inf					

Zan & Donegan -Ritter (2014)	48	AT-EP, AT-PT, AT-PI, MR-AP, MR-OT, MR-EP, MR-RT, PP-FR	BO-TI-G-Inf
Zhang et al. (2011)	5	AT-DT, AT-ET, AT-EP, AT-PT, AT-PI, MR-AP, MR-EP, MR-RT, PP-IR	CO-PK-desc, BO-TI-G-desc

*Note. * Code definitions are given in the results pros*

Chapter 3

Design

This chapter is based on:

van der Linden, S., & McKenney, S. (2020). Uniting epistemological perspectives to support contextualized knowledge development. *Educational Technology Research and Development*, 68(2), 703-727.

<https://doi.org/10.1007/s11423-020-09772-7>

Abstract

The nature of knowledge and how it is developed have been debated in philosophy and research for centuries. In the literature on teachers' knowledge, two perspectives have been particularly visible. One perspective stresses cognitive processes and deliberate knowledge acquisition. Another perspective stresses the situated nature of teachers' learning and knowledge development through awareness. This theoretical article proposes that uniting both epistemological perspectives is beneficial for developing teachers' contextualized knowledge of how to teach at all phases of career development, and especially early on. In so doing, action and reflection are positioned as central to the development of teachers' knowledge, and affordances from both the deliberate and the aware perspectives are articulated. Specifically, this article explains why uniting the two perspectives supports better sense-making, more refined instructional planning, and more responsive teaching, before offering a united reflection model. These processes are then discussed in the context of video coaching interventions for early-career teachers. After presenting a blueprint for video-based reflection and key design features that could support teachers' learning, important differences compared to other reflection models are discussed and implications for (the design of) teachers' professional development based upon this united perspective are presented.

Introduction

Epistemology is the field of philosophy concerned with “the possibility, nature, sources and limits of human knowledge” (Sumner, 2006, p. 94). For centuries, there have been varied perspectives on the nature of knowledge and how it is developed, including empiricism, idealism, rationalism, constructivism, and pragmatism. When it comes to these perspectives in relation to teachers’ knowledge, we note that two epistemological perspectives have been particularly visible in the literature. One stresses cognitive processes, and the other stresses the situated nature of teachers’ knowledge.

The first perspective is aligned with empiricism, and positions knowledge as accepted truths that arise through systematic observations. These can be verified and tested, and therefore generalized until new observations cause one to discard those provisionally accepted truths. From this perspective, teachers’ knowledge includes a collective knowledge base on teaching that is commonly accepted (Carlson & Daehler, 2019). Individual knowledge acquisition as viewed within this perspective can be measured outside of teaching practice (e.g., Kaiser et al., 2017), for example by identifying certain behaviors in examples of practice. Central to this perspective is the deliberate attention to how one’s teaching relates to collective understandings of effective teaching behaviors.

The second perspective aligns with a form of rationalism. Closely connected to constructivist perspectives, this view positions knowledge as truth that is constructed within specific contexts and therefore explicitly linked to the individual knower (Sumner, 2006). This perspective acknowledges that much of teachers’ knowledge is also personalized (Carlson & Daehler, 2019), can only be developed in and through practice (Depaepe et al., 2013), and is sometimes tacit. Tacit knowledge, which supports intuitive understanding and decision-making (Eraut, 2000), can be understood as norms or dispositions that guide our actions (Herbst & Kosko, 2014) and has also been described as what we know, but cannot tell (Polanyi, 1967). This type of knowledge can be accessed when analyzing teaching or learning using representations of practice (Herbst & Kosko, 2014). Central to this perspective is an awareness of the learners’ needs, the school context, and one’s place in it.

If these two perspectives are viewed as entirely mutually exclusive alternatives, then it would be difficult to reconcile them, since the first stresses the view that knowledge exists separate from the knower, while the second stresses its inherent connection to the knower. But here, we embrace both perspectives, and submit that these types of knowledge can and do coexist.

Further, we note that each has implications for understanding teachers' cognition and resulting knowledge acquisition. In addition, we argue that attending to both maximizes the potential for experiencing the affordances of a deliberate, often deductive mindset as well as an aware, often inductive mindset.

While epistemological perspectives can have implications for designing education and training, Kirschner (2009) reminded us not to confuse them with the psychological bases of learning and the pedagogical bases of teaching. In particular, he pointed to the need to select pedagogies based on whether the learners are novices or experts. According to Kirschner (2009), novices still need to acquire knowledge, whereas experts already have integrated knowledge bases in which universal truths have been contextualized through experiences. Building on this observation, it is proposed that novices in the teaching profession, early career teachers (ECTs), can benefit from learning experiences that prompt the acquisition of both collective and tacit knowledge, while also providing opportunities to integrate those understandings into their growing knowledge bases. Given that novice teachers need to sustain and strengthen their effective teaching practices in context (Feiman-Nemser, 2001), bringing together these two perspectives seems particularly powerful for them.

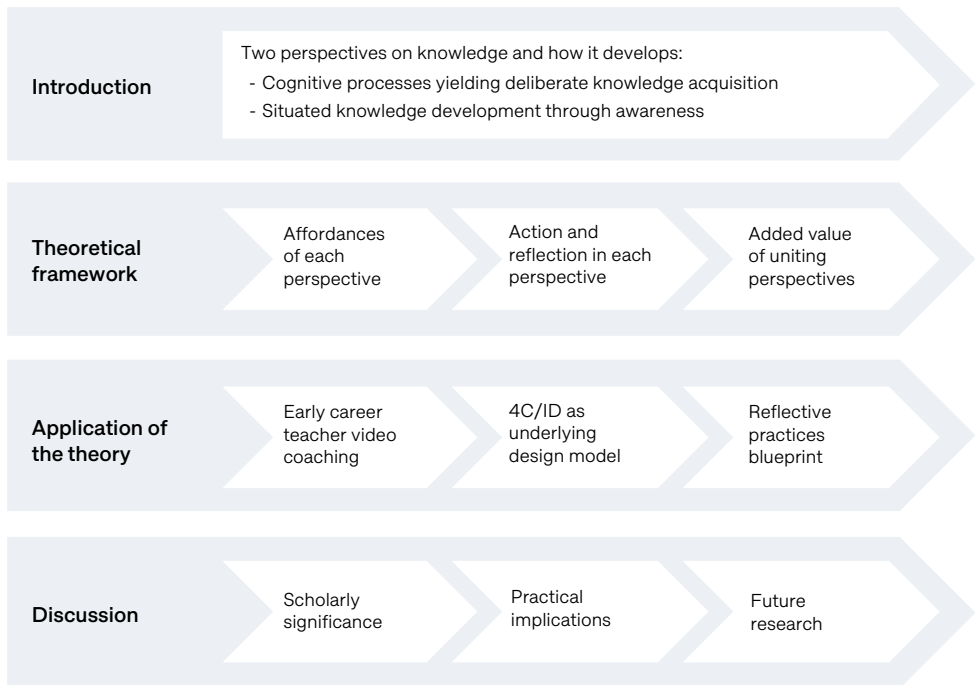
Thus, this paper argues that it can be consistent and productive to acknowledge that there are different types of knowledge and therefore, multiple pathways to knowledge acquisition. It further advocates the need to consider implications for instructional design based on the stance that teaching is a complex endeavor which requires the integration of knowledge about universal truths with understanding of contextual needs, opportunities, and constraints. Reflection is proposed as a key driver for knowledge acquisition in both perspectives. Within this article, Dewey's (1933) conceptualization is used, which defines reflection as the "active, persistent and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it and the further conclusions to which it tends..." (p. 9). Within the perspective based on empiricism, it is imperative that teachers reflect on their teaching in reference to standards that represent indicators of effective teaching practices. And within the perspective based on rationalism, it is imperative that teachers reflect on salient moments in their practice, taking into account the needs of learners, the school context, and their place in it. While the current literature offers some guidance for reflection, it lacks an integration of the two perspectives described here, guidelines for supporting such reflection in general, and specific considerations for implementation.

This paper looks specifically at the integration of these two perspectives in the context of video coaching. Here, we define video coaching as a professional development approach in which teachers and coaches record instances

of teaching and engage in video-based discussions in a sustained manner. Video coaching affords opportunities for reflective practice, which is especially useful for studying complex classroom interactions, provoking discussions, and supporting demonstration of events that are difficult to describe to others (Marsh & Mitchell, 2014). Our review of the video coaching literature (van der Linden, van der Meij, & McKenney, manuscript in preparation) revealed two dominant views, which align with the two epistemological stances described here. For example, My Teaching Partner (Pianta et al., 2008) is a video coaching program that is more closely connected to empiricism, in which the CLASS teaching effectiveness framework is used as a measure for improving practice. In this program, teachers' videotaped practice is compared to teaching effectiveness standards during coaching and the results of these discussions are used as input for making changes in the classroom. By contrast, video clubs are video-based professional development environments where groups of (mathematics) teachers led by researcher-facilitators watch videos excerpts from their own practice to enhance their professional vision, their ability to notice important classroom moments (Sherin & van Es, 2009). More closely connected to rationalism, these meetings feature no a priori standards that are used to view practice; rather, teachers are guided to focus on and understand student (mathematical) thinking, and thereby developing the ability to notice salient features of classroom practices (Sherin & van Es, 2009). Both video coaching approaches have value for the development of teachers' knowledge, but an integrated approach might offer additional value. Therefore, to support the work of coaches, teacher educators, and (teacher) education researchers, this paper elaborates upon the above argument, presents a conceptual model for supporting teachers' learning through reflection that brings the two perspectives together, and discusses key design features of video coaching for ECTs (see Figure 3.1 for an overview).

Figure 3.1

Graphic organizer of this article



Theoretical Framework

This article builds on the recent work of scholars who have acknowledged the importance of attending to both perspectives for understanding teachers' knowledge, and who have advocated a more integrated approach (e.g., Carlson & Daehler, 2019; Depaepe et al., 2013; Kaiser et al., 2017). It is important to state that these two views characterize two basic ways in which knowledge is acquired and what knowledge is, and are *not* labels for types of teachers, teacher educators, or teacher education researchers. This section explains why uniting both epistemological perspectives is beneficial for helping novice teachers, in particular, to develop contextualized knowledge of how to teach. First, the origins and habits of mind related to both the deliberate and the aware perspectives are presented. Next, relationships between teacher action, that is, providing instruction, and reflection are discussed in general, and from each perspective. Finally, the added value for teachers' knowledge

development of bringing together the two perspectives is articulated and a united reflection model is presented.

Affordances of Each Perspective

Deliberate: Understanding Practice in Reference to Standards

Aligned with empiricism, a deliberate perspective positions individual teachers' cognition as based on their acquisition of collective knowledge of teaching and learning, which serves as a frame of reference for developing their professional practice. Collective knowledge consists of commonly accepted truths about teaching and learning, within and across teaching domains, which have been developed by experts and practitioners, and have been verified in different contexts (Carlson & Daehler, 2019). This type of knowledge is often taken to include Shulman's (1987) content knowledge (CK), pedagogical knowledge (PK), and pedagogical content knowledge (PCK) (Kaiser et al., 2017). Individual acquisition of collective knowledge can be evaluated through multiple choice testing, as described elsewhere (e.g., Kaiser et al., 2017). While this type of knowledge can be acquired and measured outside of teaching practice, it can also be applied to practice, and could provide opportunities for the professional development of teachers. Frameworks of effective teaching practices can be used as lenses to observe isolated behaviors and to investigate the extent to which current teacher practices match these standards. As a result, teachers could gain understanding of their practice in reference to the standards of effective teaching. Structured reflection before, after, or even during teaching can facilitate knowledge development from this perspective.

Aware: Understanding the Context and One's Place in it

Aligned with rationalism, an aware perspective positions (teachers') knowledge as often tacit, developed through (inter)action with the context and within local systems (Brown, Collins, & Duguid, 1989; Lave & Wenger, 1991). This is often characterized as (intuitively) knowing-to-act within a certain context (Depaepe et al., 2013) and is constructed through the actors' interpretations of the local context, therefore being inextricably tied to the actor (Sumner, 2006). Consequently, this type of knowledge can only be measured and developed when teachers engage in practice, through enactment, planning, or reflection activities (Carlson & Daehler, 2019). In addition, the sense of control over one's everyday practices, or agency, is "... also shaped by the structures and cultures within which teachers work" (Biesta et al., 2017, p. 39). As such, teaching is not only determined by personal attributes, but is also dependent on the interplay between the teacher and the context. Thus, the

teacher's own understanding of who they are within their professional context (identity) shapes actions and over time, and conversely, actions also shape identity (Buchanan, 2015). From the aware perspective, discussion of teachers' own practice is promoted, a phenomenon which supports sensemaking and the shaping of one's own views of possible changes within the environment (Biesta et al., 2017; Sherin & van Es, 2009; van Es & Sherin, 2008). As a result, teachers gain understanding of their context, and their agency within it. So, like with the deliberate perspective, knowledge development from the aware perspective can be served by reflecting on what has transpired in the classroom, reflecting on classroom aspirations while planning lessons, and by reflecting while teaching.

Reflection and action

How Reflection and Action Support Knowledge Development

Reflection is an important process that can support teachers to develop content knowledge, pedagogical knowledge, and pedagogical content knowledge (Hoffman-Kipp et al., 2010). As described previously, Dewey (1933) considered reflection to be a mindful review of what is known, how this is known, and the implications it has. Therefore, reflection by teachers can be understood as the consideration of teachers' own knowledge of how to teach, which could be grounded in accepted understandings and/or experiences from their practice. Here, reflection is considered in light of both epistemological perspectives.

Reflection from a more deliberate perspective, sometimes referred to as technical reflection (Lindsay & Mason, 2000; van Manen, 1977), is a type of reflection in which teachers consider the quality of their practice in light of evidence-based standards. This type of reflection requires teachers to articulate their understandings of insights developed by others (e.g. teaching effectiveness standards), consider their practice in light of this framework, and determine if and to what extent, their practice meets these standards. Such an analysis provides insight into their current state of performance, the desired state of performance, and the difference between the two. The difference between the current and the desired states then guides further actions. Despite well-articulated affordances of this kind of approach (van der Lans, van de Grift, & Van Veen, 2018), it has long been argued that such a view of reflection is one-sided (van Manen, 1977), and could limit the potential richness of reflective practice. For example, educators and school leaders have acknowledged the importance of developing intuition for decision making in classroom contexts (Sipman et al., 2019), showing that, alongside an appreciation for evidence, stakeholders also attach relevance to additional facets of teachers'

knowledge development.

Reflection has also been approached from a more aware perspective, aiming to help teachers develop insight into the local context, and knowledge that is more finely tuned to situational needs and constraints. For example, teachers who participated in video clubs noticed more important teaching moments in practice after the last session (Sherin & van Es, 2009). This kind of reflection often relies heavily on social discourse communities (Ovens, 2002), in which teachers collaboratively negotiate their contextual understandings in order to develop new ones, as has been witnessed in video clubs for literacy or mathematics education (e.g., Wallin & Amador, 2019; Walsh et al., 2020). As with the deliberate perspective, such an analysis provides insight into the current contextual state, the desired contextual state, and the difference between the two. Discrepancies between states holds implications for further actions, ideally taking into account the needs of the learners, as well as the opportunities and constraints that are inherent to the local setting. This view specifically incorporates the idea of tailoring products to fit the needs of the learners and to the environment in which they will be implemented (McKenney, 2013).

In summary, the two perspectives on reflection can provide insight into the current state of affairs, the desired state of affairs, and the implications of each when compared, but their focus is different. Obviously, the proposed outcomes of reflection, that is the gap between the current state and the desired state, are closely connected to Vygotsky's zone of proximal development (1978), who positioned the potential development of children as the difference between the current developmental level as far as individual problem solving and the potential developmental level that could be reached with guidance of a more knowledgeable peer or teacher. While reflection from the deliberate perspective provides insight into performance in relation to a certain standard, reflection from the aware perspective provides insight into needs, opportunities, and constraints for growth within the local context. The different proposed outcomes of reflection build on Vygotsky's zone of proximal development (1978) as well as McKenney's (2013) zone of proximal implementation for technology innovations in schools. Relating to teaching, these are:

- ZPP: The Zone of Proximal Performance highlights understanding of collective teaching knowledge and acting upon this knowledge, specifically targeting the difference between *the pre-determined, explicated teaching behaviors* individual teachers can execute on their own, and those they could identify and perform with guidance.
- ZPI: The Zone of Proximal Implementation highlights situated understanding and acting upon this understanding, specifically targeting the difference between *the learner, classroom, and school-related*

insights that individual teachers can develop and apply on their own, and those they could identify and implement with guidance.

Temporal Differences in Reflection and Action

The reflection-action relationship can be further detailed in whether teachers are thinking about the past, future, or present. The first type of reflection is a retrospective process, referred to as reflection on action (RoA) (Schön, 1983), retrospective reflection (Loughran, 1996), or retroactive reflection (Mezirow, 1991). Causal reasoning can be useful during reflection on action, as this type of reasoning allows learners to explain phenomena and solve problems (Jonassen & Ionas, 2008). During reflection on action, teachers look back, consider their existing teaching practices, and reframe their understandings of their ZPP and ZPI.

A different type of thought process is required to consider how these understandings can be translated to (changes in) practice. This second type of reflection has been referred to as anticipatory reflection (Loughran, 1996), though we prefer to describe it as reflection for action (RfA). This can be understood as a planning process, where teachers engage in reasoning to connect their teaching practices (and their implications for students) to inform instructional decision making (e.g., Loughran, Mulhall, & Berry, 2008). Through this kind of causal reasoning, teachers consider how instructional changes could affect student outcomes, based on their understanding of (co-occurring) cause-effect relationships as well as any mediating processes (cf. Jonassen & Ionas, 2008). This process could inspire the design and/or construction of actionable plans or lesson materials that can support practice. The plans or actions that are developed bridge the gap between current practice and the desired practice, thus supporting development within one's ZPP and ZPI.

Finally, the third type of reflection occurs during the action itself, referred to as reflection in action (RiA) (Schön, 1983), contemporaneous reflection (Loughran, 1996), or thoughtful action (Mezirow, 1991). This type of reflection is based on the idea of knowing-in-action (Schön, 1995), or simultaneous thinking and acting that guide decision-making processes during teaching. This knowing-in-action includes not only the action itself, but also the perception and judgment of salient moments and the responses triggered (Schön, 1995). The results of RiA are visible in terms of (improved) performance and implementation. Next, the added value of uniting epistemological perspectives within reflection is described.

Uniting Epistemological Perspectives

By considering the three types of reflection (RoA, RfA, RiA) in light of the two epistemological perspectives (deliberate and aware), six reflective processes can be derived. While these reflection processes have value on their own, uniting the two perspectives could yield better sense-making, better instructional planning, and more responsive teaching. Here, the implications for each type of reflection respectively (RoA, RfA, and RiA) from each perspective are described and illustrated with examples, and summarized in Figure 3.2, thereafter.

Considering *RoA*, “[This] sense-making is generally defined as an (inter) active and dynamic process by which individuals and groups make meaning from the environments in which they operate, which in turn orients their actions” (März & Kelchtermans, 2013, p. 15). During *deliberate analysis of practice*, teachers use an explicit frame of reference to engage in knowledge-driven processing and identify evidence-based norms in action. By interpreting their performance in reference to these norms, they gain insight into their ZPP. By contrast, *explicating awareness* entails having teachers engage in context-driven processing to identify salient moments in practice, interpret them, and articulate insights into their ZPI. Uniting these perspectives would require teachers to compare their ZPP with their ZPI during *RoA* activities. Together, these views would paint a more complete picture of the situation at hand, because teachers would not only gain understanding of their performance relative to a set of standards, but this set of teaching practices is also compared to the context in which these actions are enacted to determine what is needed. This provides a rich understanding of the effectiveness of the actions within specific contexts and offer directions for refinement of practices in tune with the local environment.

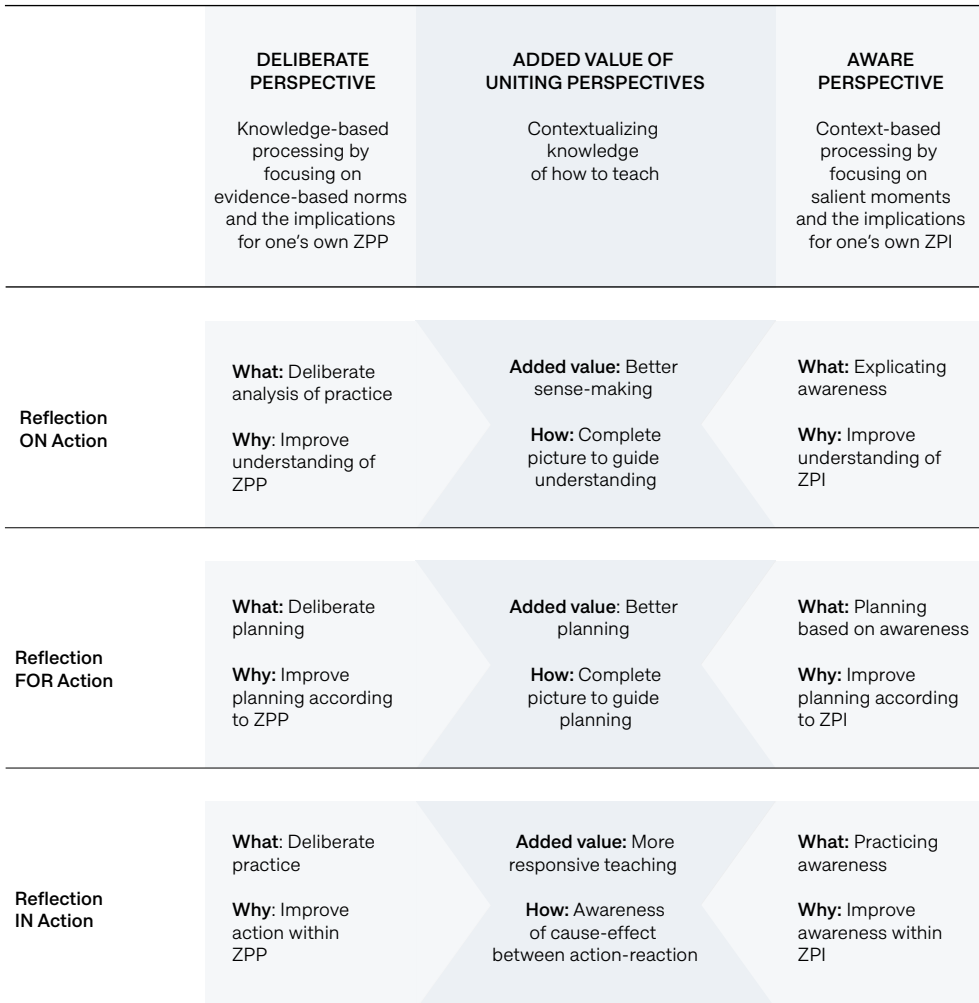
With regard to *RfA*, teacher instructional planning can be defined as the process of determining learning objectives, making pedagogical decisions, selecting learning activities, selecting assessment methods, and selecting tools and resources to support learning (Harris & Hofer, 2009). Deliberate planning features teacher use of an explicit frame of reference to generate evidence-based ideas for improving practice, based on the outcomes of *RoA*. This is then used to anticipate how performance could improve, and plan actions in line with their ZPP. By contrast, planning based on awareness features identification of salient moments in their practice and the generation of ideas about how to improve their practice. This information is subsequently used to anticipate how implementation could improve by adjusting these practices, planned in line with the teacher’s ZPI. Uniting the deliberate and aware *RfA* processes would result in planning that attends to frameworks of effective

teaching to design teaching scenarios, as well as the adaptation of these to the needs and constraints of the learners, classroom, and school context. This could provide solutions that are both effective and feasible, while also meeting the standards of the school context in which they are to be implemented.

Uniting the deliberate and aware perspectives during RiA could potentially lead to more responsive teaching, namely, the ability to perceive, judge and respond to interactions in the classroom. Deliberate practice involves the use of an explicit frame of reference to monitor one's own practice in reference to evidence-based norms (Hatton & Smith, 1995), and adjusting one's practice within one's ZPP. Practicing awareness involves context-based identification of salient moments in practice, direct interpretation of these salient moments, and immediate action within the ZPI. Uniting the two perspectives could support teachers in monitoring their own actions, as well as in monitoring the feedback that is received as a consequence of those actions. Heightened awareness of the context and the way actions affect that context might provide insight into the cause-effect relationships between teacher actions and student reactions, and offer opportunities for in-the-moment adjustment of practice (if the teachers' repertoire already includes alternatives). Next, the united reflection model will be applied to an instructional design for video coaching for Early Career Teachers (ECTs).

Figure 3.2

United reflection model



From Theory to Practice

A Rich Context for United Reflection

Early Career Teachers

Although it's important to provide differentiated pedagogy for experts as compared to novices (according to Kirschner, [2009]), the united reflection model holds potential value for all teachers, and it seems particularly beneficial for those with less experience, that is ECTs. These teachers have not yet acquired the same level of knowledge and skills as their more experienced colleagues (Maulana et al., 2010), which is important to address, since teaching quality has an effect on student learning gains (Hanushek & Rivkin, 2010). And even though preservice programs can be of excellent quality, ECTs still need to develop their professional identity and professional practice within new settings (Feiman-Nemser, 2001). Further, novice teachers experience a variety of challenges, such as those pertaining to job characteristics, school characteristics, and poor relationships with students or colleagues (den Brok et al., 2017; Smith, 2014), and a combination of these factors might be the reason for higher teacher attrition during the early years of teaching (den Brok et al., 2017). Feiman-Nemser (2001) identified a number of important learning tasks for ECTs: (1) gaining local knowledge of students, the curriculum, and school context; (2) designing responsive instruction; (3) enacting a beginning teaching repertoire; (4) creating a classroom learning community, and (5) developing a professional identity. Thus, professional development for ECTs should not only include opportunities to enhance knowledge and skills related to effective teaching and the local context, but also allow questioning of one's understandings of the self, others, and one's performance. Reflection affords opportunities to undertake these crucial learning tasks.

Video coaching

Reflection can be structured in many ways, and since video coaching has been shown to be powerful for supporting teacher performance and literature provide examples (e.g. Pianta et al., 2008; Sherin & van Es, 2009), from both epistemological perspectives (van der Linden, van der Meij, & McKenney, manuscript under preparation), it seems plausible that it can help address some of the challenges that ECTs face. As mentioned previously, video coaching constitutes a professional development approach in which teachers and coaches record instances of teaching (opportunities for RiA) and engage in video-based discussions (RoA, RfA), in a sustained manner. Re-

search has shown that the strophic interaction between teaching in action and reflection thereon play a crucial role in teacher professional growth (Clarke & Hollingsworth, 2002) and this process could support ECTs in studying their practice, getting acquainted with the local setting, developing and sustaining effective teaching practices, and negotiating their identities. Video coaching can provide a reflection-rich context for ECTs in which united epistemological perspectives on teachers' knowledge could be beneficial. A core assumption underlying the present work is that this type of professional development can allow teachers to reflect: on action using video to gain insight into the existing situation, for action to develop plans that can support their practice, and in action to adjust their practices. The following two sections describe how this can be accomplished.

Supporting Complex Learning

Developing new knowledge through action-reflection interaction, especially as part of video coaching, constitutes a complex learning task. It requires teachers to integrate reflection perspectives, to coordinate the requisite skills, and to apply their new insights to practice. Guidelines on how to support such complex learning have been provided in the literature on instructional design. In particular, the Four Components Instructional Design (4C/ID) model (Van Merriënboer & Kirschner, 2017) is well-suited to supporting the kind of complex learning that ideally takes place during video coaching. In a variety of professional situations, this holistic approach has been shown to stimulate the integration of knowledge, skills and attitudes (often referred to as competencies), thus mitigating the compartmentalization of learning tasks or fragmentation of constituent skills (Van Merriënboer & Kirschner, 2017). This model prompts designers to create authentic learning experiences that approximate real life, increase in complexity, and are clearly meaningful to the learners. The remainder of this section describes the four instructional components that should be included in video coaching based on the united reflection model in order to support complex learning: (1) whole learning tasks, (2) procedural information, (3) supportive information, and (4) part-task practice (Van Merriënboer & Kirschner, 2017).

Whole Learning Task: Reflection From United Perspectives

The whole task of united reflection, like other learning tasks, should be organized in task classes that are ordered from less complex to more complex (van Merriënboer & Kirschner, 2017). Bloom's revised taxonomy proposes that cognitive processes can be understood as involving sequential levels of complexity (Krathwohl, 2002). Broadly, these are (from least to most complex):

remember, understand, apply, analyze, evaluate, create (Krathwohl, 2002). With regard to reflection, the temporal focus influences the level of complexity. Here, we describe how each of these (RoA, RfA, and RiA) maps to a different task class.

RoA is classified as the least complex, because it requires teachers to identify and interpret events that align with frameworks and (other) salient moments in videotaped practice. Teachers elaborate on their understanding through reasoning, for example, regarding teacher-student interactions. Judgments concerning how well teachers' actions comply with collective knowledge about teaching or whether students are learning require teachers to remember and analyze their findings.

RfA requires teachers to apply collective and tacit knowledge to more or less familiar problems, rendering it medium complex. Here, teachers must have an idea of the problem situation and modify collective and tacit knowledge to fit the specific problem at hand. In addition, teachers must critique whether their proposed alternative scenarios are compatible with collective knowledge about effective teaching and/or emic insights about the context, which implies a predictive kind of evaluation process. In some cases, this might require teachers to create new products, and go through the stages of problem representation, generating alternatives, planning, and constructing.

RiA is considered the most complex, because it combines all of the above-mentioned cognitive processes in order to create and adjust practices in the moment. Teachers enact their teaching routines while monitoring the students' feedback and their own actions, and interpreting the classroom feedback to judge if instruction is having the desired effect. They often need to create alternative teaching scenarios on the spot.

Procedural Information: Reflection Steps

Procedural information involves how-to information or step-by-step instructions on recurrent task aspects (van Merriënboer & Kirschner, 2017). The 4C/ID model explains that procedural information is needed in order to automate certain aspects of the task, which allows learners to allocate their conscious cognitive processing to the non-recurrent aspects of the tasks. Here, recurrent aspects within the whole task of united reflection are considered.

"To reflect is to look back over what has been done so as to extract the net meanings which are the capital stock for intelligent dealing with further experiences"
(Dewey, 1938, p. 86, emphasis not in original).

Consistent with this description of the process (and in the context of engi-

neering design), Reymen et al. (2006) described a generic three-step procedure for reflection, consisting of (1) preparation, (2) image forming, and (3) conclusion drawing. Here, these steps are considered in light of the united perspectives, and summarized in Table 3.1.

The first step, preparation, refers to how practitioners (teachers) portray or understand the (classroom) situation (Berland & Hammer, 2012; Schön, 1983). The way teachers frame the situation influences their practice (Russ & Luna, 2013), because the frame that is being applied to a certain situation influences expectations and the way it will be interpreted (Berland & Hammer, 2012). This first step requires practitioners to detail the reflective question and to collect facts related to it (Reymen et al., 2006). Deliberate framing is guided by frameworks for effective teaching, whereas aware framing arises from attention to the teaching context and one's place in it.

The second step, image forming, requires practitioners to investigate the phenomena identified during the first step (Reymen et al., 2006), by using the framing to interpret (or anticipate) the teaching situation. Interpretation is regarded as an important process component of teachers' competence (Blömeke, Gustafsson, & Shavelson, 2015; Santagata & Yeh, 2016), and has been described as making sense of salient features of classroom interactions (Sherin & van Es, 2009), or explaining perceptions of teaching and learning processes in order to examine the effect of teaching decisions on student outcomes in line with the learning goals (Santagata & Yeh, 2016). Deliberate image forming is focused on sensemaking about the (proposed) alignment between frameworks of effective teaching and practice, whereas aware image forming is focused on making sense of the interplay between actors and the contextual needs and constraints.

The third step, is conclusion drawing. It can be used to inform decision making or lead to reframing. It requires practitioners to contrast their findings from image forming and consider the implications for practice (Reymen et al., 2006). From the deliberate perspective, conclusion drawing is focused on determining (considerations within) the ZPP, whereas conclusion drawing from the aware perspective is focused on determining (considerations within) the ZPI.

Table 3.1*The recurrent aspects of united reflection*

Recurrent aspects	Perspective	
	Deliberate	Aware
Preparation	Knowledge-driven framing	Context-driven framing
Image forming	Interpreting / predicting standards-based practices	Interpreting / predicting salient moments in practice
Conclusion drawing	Determining zone of proximal performance	Determining zone of proximal implementation
<i>Comparing perspectives</i>		

Supportive Information: Scaffolding Cognitive Processes

Supportive information provides a bridge between what learners already know and what they need to know (van Merriënboer & Kirschner, 2017). This type of information is directed towards supporting teachers in the novel aspects within the six recurrent tasks shown in Table 3.1). Supportive information consists of domain-specific information, examples of domain-specific information, and cognitive feedback (van Merriënboer & Kirschner, 2017). This section examines supportive information relevant to the three steps described above.

The framing undertaken during preparation is a cognitive process that shares common characteristics with other attentional processes described in the literature, such as noticing student thinking (Sherin & van Es, 2009; van Es & Sherin, 2008); perceiving particular events during instruction (Kaiser et al., 2015); and focus selection (Santagata & Yeh, 2016). Research has shown that framing can be difficult for (novice) teachers, because they are inclined to attend to surface-level events instead of salient classroom moments (Sherin & van Es, 2009; Wolff et al., 2017). Domain-specific information to support framing includes frameworks of effective teaching (deliberate perspective) or literature on noticing student learning (aware perspective). In addition, problem-solving guidance, such as guiding questions to focus ECTs' attention on priorities, could support this cognitive process (Sherin & van Es, 2009). Support could also take the form of watching other ECTs framing teaching issues while thinking aloud about the way these behaviors might be observed in practice. Finally, cognitive feedback could consist of including opportunities for ECTs to compare their framing of the problem to the work of other ECTs or the coach.

Next, teachers need to interpret or anticipate teaching experiences. Interpretation can be difficult for teachers, because they are inclined to describe or quickly judge a situation instead of engaging in deeper reflection (Sherin & van Es, 2009). Moreover, novice teachers can experience difficulty doing this without the help of a knowledgeable other (Gelfuso & Dennis, 2014). In addition, teachers do not always engage in developing explanations to fully grasp the nature of the problem, but jump to generating solutions through brainstorming (Boschman et al., 2014). Anticipating future actions supports teachers' learning when teachers engage in reasoning and justification processes instead of only brainstorming (Voogt et al., 2016). Without guidance, teachers' anticipatory reflections are often focused on practical issues, instead of the substantive issues (Voogt et al., 2016). Guiding questions for retrospective reasoning from a deliberate perspective could include: To what extent does the [recorded behavior] align with the framework? Why do you think that? Coaches could also model interpretive and anticipatory reasoning, and exemplify how to make sense of the connection between teacher actions and student learning. Produced artifacts, such as video annotations created during RoA, could serve as examples, but can also be examined and compared for the logic of reasoning about cause and effect, or the extent to which they convey a clear message and can thus be used as input for cognitive feedback.

Finally, teachers need to contrast their findings within perspectives in order to draw conclusions about their ZPP and ZPI, and doing so between perspectives can guide further actions. Examples of problem-solving guiding questions for drawing conclusions during deliberate RfA could be: What conclusions do you draw based upon consideration of different learning scenarios? What theoretical evidence did you find that supports your design choices? In addition, a worked example that illustrates how conclusions follow from the framing and interpretation processes could help teachers understand the process. Lastly, artifacts produced during the framing and interpretation/anticipation processes could be compared to the conclusion drawn about the ZPP and ZPI to check for logic and to what extent the initial question has been answered, which could provide cognitive feedback on the conclusion-drawing process and the quality of the conclusion.

Part-Task Practice

Part-task practice refers to routine aspects of the task that require a high level of automaticity and is therefore appropriate for elements of the learning tasks that are recurrent *within task classes* (van Merriënboer & Kirschner, 2017). Automaticity is necessary so that teachers can focus their attention on the non-recurrent aspects of the tasks. Within the context of video coaching, it can be helpful to design practice tasks that support learners in understanding

how to use specific frameworks for reflection, how to identify teaching practices that are in line with those frameworks, or how to focus on student learning while watching the videos. This could help ECTs develop frames of reference for each of the perspectives. In addition, if teachers know and can articulate the different steps in the reflection process, this could help them focus on the cognitive processing that is embedded within each of those steps. Having teachers think aloud about the sequencing of the steps could support the learning of the routines within each of the reflection tasks. The next section will operationalize the instructional design further as concrete building blocks that can be used to implement video coaching practices.

Video Coaching with ECTs: Reflective Practices Blueprint

While the 4C/ID considerations provide a theoretically sound approach to video coaching based on the united reflection model, further operationalization is needed to apply these ideas in practice. This section offers a video coaching blueprint, organized around the three components of a skeleton design (McKenney & Reeves, 2019): (1) the activities and tasks (what teachers do), (2) the materials and resources (what tools are used), and (3) the participation and practices (how teachers and coaches participate); see Figure 3.3 for highlights.

Figure 3.3
Blueprint for video coaching through reflective practices

		Activities & tasks		
		<i>Preparation, image forming, conclusion drawing</i>	<i>Support for cognitive processing</i>	<i>Part-task practice</i>
Reflection ON Action	<i>Deliberate</i>	Deliberate analysis of past practice to improve understanding of ZPP.	Frameworks of effective teaching, example videos of teachers engaging in deliberate analysis of practice, facilitator questions.	Automate identification of indicators of effective teaching behaviors using examples of practice.
	<i>Aware</i>	Explication of practical awareness during past practice to improve understanding of ZPI.	Literature highlighting the importance of attending to one's context, example videos of teachers engaging in explicating practical awareness, facilitator questions.	Automate a focus on salient moments.
Reflection FOR Action	<i>Deliberate</i>	Deliberate planning of future actions to improve practice within ZPP.	Frameworks of effective teaching, example videos of teachers engaging in deliberate planning of practice, facilitator questions.	Automate planning steps.
	<i>Aware</i>	Planning future actions based on awareness to improve practice within ZPI.	Literature highlighting the importance of attending to one's context, example videos of teachers using awareness while planning, facilitator questions.	Automate planning steps.
Reflection IN Action	<i>Deliberate</i>	Deliberate practice of actions to improve performance within ZPP.	Frameworks of effective teaching, facilitator questions.	Automate a focus on specific actions in (mini)lessons.
	<i>Aware</i>	Practicing awareness during action to improve performance within ZPI.	Literature highlighting the importance of attending to one's context, facilitator questions.	Automate recognition of salient moments in (mini)lessons.
		Materials & resources	Participation & practices	
<i>Priming tools</i>	Materials containing teaching theory, literature on situated learning, or tools for cognitive feedback. Used for activation of prior knowledge and experiences.	<i>Coordinator</i>	Organizes learning opportunities. Determines the appropriate task complexity.	
<i>Examples of practice</i>	Representations (e.g. video, text) of teaching, problem solving, or reflection processes. Used to practice identification of (specific) teaching practices.	<i>Facilitator</i>	Stimulates and scaffolds teacher learning. Asks guiding questions. Models the reflection processes.	
<i>Artifacts of practice</i>	Products of practice (videoed or text-based). Help promote discussions about practice.	<i>Curator</i>	Selects relevant and high-quality learning materials. Determines the authenticity of the task.	
		<i>Learner</i>	Responsible for own professional development. May also take on the facilitator role in a group setting.	

Activities and Tasks

The six reflective processes described previously are central to the design (see Figure 3.3). Tasks within task classes will always be executed sequentially, but not in a specific order, after which the conclusions are compared. Here, the nature of each task and the potential benefits for the professionalism of ECTs are illustrated.

During RoA, engaging in *deliberate analysis of practice* is important because it helps realize an essential aspect of professional development, namely, that teachers develop their practices in line with evidence-based frameworks of effective teaching (Pianta et al., 2008). For instance, there might be cases when a teacher questions if his (inter)actions (could) contribute to a positive pedagogical climate. The coach and teacher select a relevant framework as the basis for analysis of videotaped practice, and go through a process of reflection preparation, image forming, and conclusion drawing to determine if the videotaped actions contain evidence of these interactions. In addition, engaging in *explicating practical awareness* is important because it helps realize an essential aspect of professional development, namely, that teachers study their practice to gain understanding of (difficulties in) student learning, and the implications for their instruction, which can provide incentives for change (Santagata & Bray, 2016). For example, suppose that a teacher becomes aware that students do not appear to understand the subject-matter content, but is not sure what exactly is causing the lack of understanding. The coach and teacher decide to study the recorded interactions between students, teacher and materials to better understand what is causing this specific situation. The coach and teacher go through a process of reflection preparation, image forming and conclusion drawing to gain understanding of the situation.

During RfA, engaging in *deliberate planning of action* is important, because it helps to support an important part of teachers' professional practice, namely, that teachers integrate knowledge of effective teaching practices into their own professional practice (Pianta et al., 2008). For instance, suppose that a teacher and coach have reached the conclusion that the students are spending too much time off-task, which jeopardizes their learning. There is a large research base on strategies to promote on-task behavior by students, which could offer direction for the planning of future lessons. The coach and teacher select a conceptual framework that is thought to be beneficial, and go through a process of reflection preparation, image forming and conclusion drawing to plan future lessons. Moreover, *planning based on awareness* is a task that can support an important aspect of professional development, because it encourages teachers to make their reasoning about teaching-learning processes explicit, to argue for their convictions, and to share their knowledge (Voogt et al., 2016). To illustrate, suppose that a teacher and coach have deter-

mined that students are not very active during the lesson and that much of the lesson consists of teacher-led instruction. The teacher has a number of ideas based upon prior experiences about how future lessons could be designed to support more active behavior. The coach and teacher decide to explore those ideas, and go through a process of reflection preparation, image forming and conclusion drawing to plan future lessons.

During RiA, engaging in *deliberate practice* could benefit teachers because it incorporates an important component of professional development, namely framing teaching itself as learning opportunity by integrating small experiments or challenges (Bronkhorst, Meijer, Koster, & Vermunt, 2014). For instance, suppose that a teacher is going to present a lesson during which he will pay specific attention to providing feedback on student work. There is a three-step process that the teacher will carry out during instruction, consisting of providing feedback on the correctness of the answer, clarifying why the answer is correct or not and checking if the students understand the explanation. The teacher performs the feedback behavior and monitors its enactment through a process of reflection preparation, image forming and conclusion drawing in order to regulate, adjust, and improvise further action. *Practicing awareness* could also support teachers' professional practice, because it could support their ability to notice salient moments during teaching (Sherin & van Es, 2009), which could affect their instructional decision-making. To illustrate, the teacher implements lesson activities, and actively monitors students' feelings and actions in order to heighten his awareness of external feedback.

Materials and Resources

Three types of materials and resources are essential for supporting video-based reflection (see Figure 3.3), which can take the form of supportive information or tools for part-task practice. First, *priming tools* are (typically text-based) materials that support the learner's cognitive processing, by supporting activation of prior knowledge and experiences to make connections to new understandings (Windschitl et al., 2012). Priming tools, such as observation instruments that align with the collective frameworks for effective teaching, can support cognitive processing, because they help the learner to identify effective teaching practices. In combination with video, priming tools might be beneficial in light of a possible pre-training effect, which is defined as improving learning with multimedia by providing the names and characteristics of the main concepts beforehand, thereby equipping learners with the necessary information for processing the subsequently presented information (Mayer & Pilegard, 2014). The literature has suggested that pre-training before multimedia learning can be effective (Mayer & Pilegard, 2014), but is not always (e.g., Meyer et al, 2019). For example, it seems less likely that learners

who already have knowledge on the subject will benefit from pre-training (Mayer & Pilegard, 2014). In addition, guiding questions that support the comparison of the framework with practice can support teachers in reasoning about the connection between the two. For the aware perspective, there are no specific frameworks to guide problem solving, but the literature on noticing has indicated that guiding questions can support teacher thinking about student learning (Sherin & van Es, 2009; van Es & Sherin, 2008).

Second, *examples of practice* are text-based or videotaped examples of effective teaching and learning, which help bridge the gap between theory and application (van Merriënboer & Kirschner, 2017). These can be used during part-task practice to automate the identification of effective teaching practices using explicit frameworks of effective teaching. Alternatively, examples of practice can be understood as videotaped modelled reflection processes, that is, where an expert or coach models how to compare perspectives during RoA, RfA, and RiA.

Third, *artifacts of practice* are products of the teaching practice (videotaped or text-based), which can serve as vehicle for reflection (Herbst & Kosko, 2014). Videos of teaching practice can be analyzed and compared to frameworks for effective teaching (deliberate perspective) and used to derive contextualized knowledge (aware perspective) in RoA tasks. During RfA, it can be productive to analyze pre-existing lesson plans or other curriculum materials produced by the teachers as a starting point for planning. During RiA tasks, lesson plans or other materials can be used to guide monitoring of specific actions (deliberate perspective).

Participation and Practices

Coaching ECTs requires individual approaches to learning to meet the teachers' personal development needs, which requires coaches to fulfil different roles. Here, three roles are distinguished for coaches: coordinator, facilitator, and curator. In addition, the role of the coachee is also described (see Figure 3.3).

The *coordinator* is responsible for organizing learning opportunities and determines the appropriate task complexity. The coordinator consults with the individual teachers to determine the learning objectives and plans appropriate learning tasks. The coordinator helps teachers to determine and formulate reflection questions that can be used as input for the reflection activities.

The *facilitator* is responsible for stimulating teachers' learning and scaffolds the appropriate level of support. The facilitator supports cognitive processes during RoA, RfA, and RiA activities by prompting teacher thinking through (non)verbal interaction or through the presentation of priming tools during video coaching. The facilitator fulfils the role of an expert, who sup-

ports teachers in noticing important salient teaching moments that might be overlooked (e.g., Sherin & van Es, 2009; van Es & Sherin, 2008). Facilitators could also provide cognitive feedback on the problem solving within reflection tasks, by detailing their own framing, interpretation and conclusion drawing, or inviting peers to share their reflections, after which these can be compared. The facilitator supports the development of knowledge based on united perspectives.

The *curator* is responsible for selecting relevant and high-quality learning materials and determines the authenticity of the task. The *curator* selects the materials, supports production of them, and presents relevant and high-quality materials as input for coaching activities. Relevant types of materials include: (1) priming tools that can support teacher thinking prior to and during activities and that can take the form of questions or materials presented to the learner that help them unpack explicit or tacit understandings (Windschitl et al., 2012), (2) artifacts of practice that can be used as input for reflection activities and that connect to the coaching objectives, and (3) examples that can be used to illustrate productive reflection processes or that can serve as input for reflection activities in the initial sessions of the training.

The *learner* is responsible for managing learning behavior during engagement with the different activities and tasks. In some situations, learners may support the professional growth of their peers by taking on the role of co-facilitator. Within this co-facilitator role, the learner could: ask questions to unpack problems (problem-solving support), model activities and tasks (examples), and share confirming or contrasting observations (cognitive feedback).

Discussion

Significance

This article aims to contribute to thinking about the way epistemological views shape teacher training and education, by illustrating how uniting two differing epistemological perspectives on teachers' knowledge development could be possible and even beneficial for reflection. The deliberate perspective, aligned with empiricism, stresses the knowing that comes from systematic observation, while the aware perspective, aligned with rationalism, stresses the knowing that is derived from organic forms of perception. Both perspectives can clearly be intentional. Kirschner (2009) reminded us that we should take the level of expertise of the learner into account when designing

instruction, and thus not ignore the psychological bases of learning and pedagogy due to epistemological beliefs. He also noted that both epistemological perspectives have value and that (while wanting to avoid ideological discussions): "Of course, we, as rational right-minded people, know that neither faction is correct and that the "truth" lies in the middle" (p. 144). In a similar vein, this article illustrates how uniting two different epistemological perspectives presents added value for ECT knowledge development and use. It builds upon earlier work from scholars who advocated the integration of perspectives (Carlson & Daehler, 2019; Depaepe et al., 2013; Kaiser et al., 2017), and scholars who have written about reflection in the past (e.g., Hatton & Smith, 1995; Jay & Johnson, 2002; Schön, 1983, 1995; van Manen, 1977). At the same time, it acknowledges that some scholars have noted potential tensions between the perspectives. For example, while research has identified specific teaching practices that are effective (Muijs & Reynolds, 2018), over-reliance on this work alone would fail to capture the complex nature of teaching (cf. Schön, 1995; van Manen, 1977). Further, this article articulates three important types of reflection, and describes specific steps for undertaking each in united ways.

Implications

Uniting perspectives holds implications for the design of teacher education and teacher professional development trajectories. Acknowledging that teacher education should incorporate opportunities for development of both types of knowledge and for uniting the two, while taking into account the experience level of the learners, has consequences for the content and the operationalization of support. Preservice teachers are still learning to teach, and much of their training should be focused on collective knowledge acquisition, while also including opportunities to develop their teaching repertoire, as well as the tools to study their own practice (Feiman-Nemser, 2001). Teacher educators could implement the united reflection model by incorporating teacher training qualification standards for reflection tasks from a deliberate perspective, while taking an aware perspective to reflect on student learning. In comparing the conclusions from both the aware and the deliberate perspectives, preservice teachers could develop reflective abilities and routines. These could be used, for example, to support their investigation of student learning resulting from performing effective teaching behaviors as depicted by teacher qualification standards. This could be especially beneficial for novice teachers, because research has shown that they often focus on surface-level events, such as student behaviors and disruptions, instead of attending to student learning as expert teachers do (Wolff et al., 2017). In addition, coaching and reflection can support the belief that learning is an essential part of teaching

and necessary for the development of their practice (Feiman-Nemser, 2001).

Further, we have argued that teachers at the beginning stages of their careers, that is ECTs, can benefit from integrating both perspectives within reflection, because doing so allows them to develop and sustain effective teaching practices, while also negotiating their teacher identities. ECTs experience tensions in the beginning stages of their teaching careers, such as the tension between what they desire to accomplish during their teaching and what is possible in reality (Pillen et al., 2013). Taking a united approach to reflection could allow teachers to question their own practices in light of standards of effective teaching, and in light of the contextual opportunities and constraints, providing an opportunity to explore these tensions. Exploring tensions through discussion could strengthen their identities as teachers and support the development of coping strategies (Pillen et al., 2013). The attention to identity development can in turn support teacher resilience, especially when this is explored in relationships with others (Pearce & Morrison, 2011). However, it should be noted that a focus on developing personal resources alone is not sufficient to support teacher resilience, and contextual factors, such as school culture and support from school management, should be taken into account as well (Ainsworth & Oldfield, 2019; Johnson et al., 2014).

Finally, uniting perspectives within reflection could support experienced teachers to integrate new evidence-based practices into their teaching in order to strengthen their professionalism. Strengthening and refining their practice (Feiman-Nemser, 2001) might require the incorporation of additional evidence-based practices and more detailed study of how these actually contribute to student learning within specific contexts. These refinements often occur through changes in the school vision or through reform, and understanding the opportunities and constraints of the local context will be needed to implement changes that are efficient and feasible. Teacher coaches or teacher leaders could incorporate the united reflection model by using the newly adopted standards to reflect from a deliberate perspective, while the aware perspective could be adopted to focus on the interplay between the students, other colleagues, the classroom setting and the larger organizational setting to gain understanding of how these standards can be enacted in practice to fit the local context. Within these settings, the coach's role can be played by other teachers, who are all working together to improve their practice.

Future directions

More research based upon the united reflection model is needed to strengthen the theoretical understanding of the interplay between knowledge

bases and of how contextualized knowledge can be measured and developed in training settings, throughout the course of a teaching career. Research by Kaiser et al. (2017) has illustrated that there are different aspects of teachers' knowledge, which require different measurement instruments and methods. However, in line with the argument presented, other instruments might be needed that do justice measuring the newly contextualized knowledge after reflecting on past practice, after planning future practices, and during teaching. Expert-novice research has shown that expert teachers draw from their integrated knowledge in order to perceive, interpret and predict teaching situations (Wolff et al., 2015) and subsequently use this information to propose alternatives. But further work is needed to identify ways to better support novices who lack such experience.

This article articulates promising directions for professional development trajectories by supporting teachers in uniting their deliberate and aware perspectives, but these ideas need to be developed and tested in practice under different conditions and with teachers at different stages of their teaching careers. Education for preservice teachers and more experienced teachers using the united reflection model can be enacted using different artifacts, such as videos, lesson observations, or student work, and the conversations can take place in online or face-to-face settings, depending on the contextual needs and constraints. The development of interventions could especially benefit from the knowledge and experience of coaches, teacher leaders, and teacher educators as co-designers in order to operationalize the model. Specifically, they could contribute by jointly developing domain-specific information, procedural information, part-task practice items, and support for coaches in order to enhance the usability, feasibility, and viability of implementation of the operationalized model in practice. Ecologically valid studies to iteratively test the model in different manifestations or settings could be especially beneficial next steps, because they could provide insight into (1) to what extent and in what way the model supports contextual knowledge development, and (2) the experiences of coaches and teachers enacting the model. The outcomes of those studies could be used to revise the design, to develop initial design guidelines for implementation in practice, and to set the stage for larger experimental studies of effectiveness. In so doing, it seems prudent to anticipate that the reflective processes enacted will rarely flow as cleanly as depicted in the model; for instance, coaches and teachers might go back and forth between framing and image forming before drawing final conclusions.

In conclusion, before it is worth knowing anything else, one must come to know oneself, as described in Plato's *Phaedrus* (229e-230a, trans. 1925), and this idea seems especially important for those who serve others. Understanding oneself in relation to collective knowledge bases (what constitutes good

teaching) and in relation to educational contexts (where am I teaching) is argued to be important for continued development as a teacher and considered central to the united reflection model. Reflection can provide opportunities to unpack the knowledge and beliefs teachers hold about teaching and learning processes and the educational context, and to (possibly) review them in light of collective knowledge of teaching. As such, uniting perspectives on reflection can provide opportunities to question existing ideas and practices, and opportunities for development throughout a teaching career.

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Intermezzo

This intermezzo is based on:

van der Linden, S., van der Meij, J., & McKenney, S. (2019). Design and Enactment of Mobile Video Coaching. *TechTrends*, 63(6), 693-702.
<https://doi.org/10.1007/s11528-019-00413-2>

Abstract

Video coaching can powerfully support teacher learning, but its implementation in face to face form presents substantial practical challenges. While mobile learning offers several potential solutions, we have limited insight into the design of mobile video coaching programs and especially into how specific technologies can attend to teacher learning needs during video coaching. Using conjecture mapping concepts, this theoretical article presents a generic model for video coaching, and proposes specific design features for mobile video coaching. After distinguishing between technologies that primarily facilitate access and technologies used as cognitive tools, attention is given to (their role in) the design of mobile video coaching in terms of the: activities and tasks planned; materials and resources used; and participation and practices envisioned. Following discussion of mobile video coaching in light of the situated, social, and distributed nature of teacher learning, the article concludes with implications for educational technology coordinators.

Introduction

Video coaching is an increasingly popular approach to teacher professional development, which has been found to have an effect on both instruction and student outcomes (Kraft, Blazar & Hogan, 2018). In video coaching, teachers and coaches go through cycles of recording observations and conducting synchronous verbal discussions which are based on the videos. Despite its affordances, the implementation of large-scale in-person teacher coaching programs faces certain challenges, such as high program costs and possible shortage of effective coaches (Kraft et al., 2018).

Technology could potentially mitigate these challenges for a number of reasons. First, transforming video coaching from face-to-face to mobile learning could address the shortage of coaches by enabling them to work regardless of their physical location. This would reduce travel time and expenses, thus lowering program costs. Second, this could increase accessibility of high-quality coaches. Where teachers in face-to-face video coaching situations are dependent on the coaches that are available in their school or district, mobile video coaching would allow teachers to choose coaches from all over the country. And finally, when teachers are dependent on coaches within schools or district, it is unlikely that there are sufficient coaches available to cater to all teaching domains, e.g. mathematics, biology, language learning etc. Mobile video coaching could offer opportunities to provide coaches with the relevant disciplinary expertise.

Although, mobile technologies offer potential solutions to these challenges, scholarship is lacking on how video coaching could be designed to support both teacher learning and mobility. This theoretical article presents a design for high-quality video coaching and details how technology can support both mobility and important facets of teacher learning. We begin by addressing three questions: What constitutes high quality teacher learning? What do we mean by mobile leaning? and What is video coaching?

Theoretical Framework

What Constitutes High-Quality Teacher Learning?

Putnam & Borko (2000) describe teacher learning as situated, social and distributed. These facets of teacher learning are deeply related, and can overlap. As elaborated next, the situated nature speaks to *where* teachers learn, the social nature speaks to *how* teachers learn, and the distributed nature speaks to *what* knowledge, skills or attitudes are learned.

Teacher Learning is Situated

Situated perspectives on learning acknowledge that it is not only the learning tasks that influence learning, but that it also encompasses the context, i.e. the interactions and systems in which the learning takes place, making this an integral part of learning itself (Lave & Wenger, 1991). Following this line of reasoning, teacher learning activities cannot be viewed independent from classroom practice. By acknowledging and attending to the context as part of the learning activity itself, it is possible to create knowledge and skills that are directly applicable to practice (Putnam & Borko, 2000), therefore heightening relevance and potentially eliciting a sense of agency within teachers. Including authentic tasks is a way to integrate context and relevant support teacher learning (Putnam & Borko, 2000). Authentic tasks are learning activities that represent real-world tasks (Brown, Collins, & Duguid, 1989). As such, they are typically ill-structured and often take place in a natural, live settings. Reflection on teaching performance is an authentic task which can be based on first-hand experiences (e.g. viewing videos of one's own classroom practice and reflecting on the action in the video), or second-hand experiences (e.g. viewing videos of other teachers' practice and reflecting on that action).

Teacher learning is social

If the context is inextricably linked to learning itself, then the social systems in which learning takes place provide the pathways through which teachers learn. Hence, learning does not take place in isolation, but rather "interactions with the people in one's environment are major determinants of both what is learned and how learning takes place." (Putnam & Borko, 2000, p. 5). One common social structures through which interaction and thus learning takes place is the community of practice (Lave & Wenger, 1991). While studies of teacher communities show strong affordances (Pareja Roblin et al., 2014), research on teacher discourse within communities of practice clearly

show that not all interaction yields teacher learning (Horn et al., 2017). In fact, research points squarely to the importance of support in order to move from more practical conversations to a depth of interaction that stimulates learning (Boschman et al., 2016). Similarly, while videos can present a strong stimulus for discussion and critical reflection on practice, teachers typically require support to focus on the important events or engage in deep reflective talk (Hiebert et al., 2002).

Teacher learning is distributed

If learning is social and takes place in and through communities, then it follows that knowledge does not reside in only one place or in one person, but is rather distributed amongst people, places and materials (Salomon, 1993). Within communities of practice, each participant contributes unique knowledge and beliefs, which together, represent the cognitive resources teachers can draw from to make sense of their practice (Putnam & Borko, 2000). This knowledge extends the knowledge of individual teachers but can also be combined. In this view, knowledge is not be seen as a static entity, but rather as something that grows within a community and in the end becomes known to all. This phenomenon has been referred to in the learning sciences as shared cognition. From a perspective of shared understanding, the sum of individual knowledge structures is greater than its parts. Classroom video represents a unique knowledge source that can be used to study classroom practices. Specifically, videos can serve as discussion objects, which prompt participants to share and critique each other's understandings (e.g. about the way students learn or how certain instructional strategies support students). But research shows that expert facilitation is required to bring knowledge sources together, create connections between participants, and assemble or curate materials to support the process (e.g. van Es & Sherin, 2008).

What do we mean by mobile learning?

Mobile learning can be understood as a type of learning where learners and the learning itself are not bound to a predetermined physical location (Seppälä & Alamäki, 2003). This type of learning has been described in terms as immediate (Kynäslähti, 2003), convenient (Kynäslähti, 2003) and portable (Seppälä & Alamäki, 2003). These attributes of mobile learning can be understood as a need to provide access to learning. In this paper, we also stress the *cognitive* learning supports that (mobile) technologies can provide.

Access tools: Learning through and from technology

Access to learning relates to permissions, rights, abilities, and means to connect to learning. We distinguish two facets here: Access to expertise and access to materials. Access to *expertise* means a (technological) connection to actors that can provide (expert) knowledge. Access to expertise can be supported through hardware, software, and infrastructure. For example portable devices with internet connections are needed to connect to wireless networks that facilitate communication. Microphones and cameras can support verbal and non-verbal communication. Access to expertise can also be facilitated through a number of software applications, such as conferencing, messaging or email programs. For verbal communication, an infrastructure is needed with bandwidth that allows for audio conferencing and the addition of non-verbal communication requires bandwidth that supports video conferencing.

Alongside access to expertise, teacher learning requires access to *materials*, which can be used as input to support teacher development. Next to hardware, such as a portable device and an internet connection, software is needed to (structure permission to) access learning environments. Web authoring, course management applications or shared online storage are examples of this type of software. To access individual file types, different software applications are needed for opening text, image or video files. On an infrastructure level, bandwidth is needed that allows for streaming video. Data storage requires secure storage facilities, especially when it concerns personal data. Moreover, privacy protocols need to be in place, that explicate the people who have the rights to access the data and the duration it will be stored.

Cognitive tools: Learning with technology

In addition to tools that provide access (to expertise and learning materials), mobile learning can be supported through the use of cognitive tools. Cognitive tools are those that directly assist learners to accomplish cognitive tasks (Lajoie, 1993). In the context of mobile learning, where learning is mediated through a handheld device, some software applications serve cognitive tools. This software supports 'learning with technology, instead of learning from technology' (Jonassen and Reeves, 1996). Cognitive tools amongst others can be used to (1) aid cognitive processes, such as attention, reflection, problem solving, and metacognition, (2) incorporate activities for learners that would otherwise be inaccessible (Pea, 1985). Cognitive tools can take the form of productivity tools, e.g. word processors, file editors, databases, video software, which are normally used for efficiency purposes (Kirschner & Erkens, 2006) but have also been shown to enhance learning (Jonassen & Reeves, 1996). Hence, individual tools can fulfill multiple functionalities.

What is video coaching?

Video coaching is a professional development activity whereby teachers and coaches engage in cycles of recording observations and holding video-based synchronous verbal discussions. To be effective, video coaching cycles are ideally implemented repeatedly or combined with other activities that support teacher learning. Video coaching can be aimed at the development of pedagogical knowledge and/ or general teaching skills, such as classroom management (e.g. Early, Maxwell, Ponder & Pan, 2017). Alternatively, video coaching can be aimed at the development of pedagogical content knowledge and/ or domain-specific instruction (e.g. Roth, Garnier, Chen, Lemmens, Schwille & Wickler, 2011). In some cases, video coaching can be aimed at changing beliefs towards teaching and learning (e.g. Meijer, Kuijpers, Boei, Vrieling & Geijssel, 2017). Video coaching attends to situated learning because it includes authentic tasks that integrate classroom practice with professional development. Video coaching attends to social learning because it prompts teachers and coaches to construct and negotiate knowledge through discussions. Video coaching attends to distributed learning because it makes use of different knowledge sources and aims to construct new knowledge that is applicable to practice.

Research Objective and Approach

Video coaching most often takes place in a face-to-face context (e.g. Roth et al., 2011; Meijer et al., 2017). To our knowledge, there is limited insight into ways technology can facilitate mobile video coaching in environments that attend to the situated, social and distributed nature of teacher learning. Thinking about effective ways to mobilize video coaching, requires looking further than technological solutions alone, to take into consideration how teachers learn through video coaching and the role(s) that (mobile) technologies can play in those processes. Consequently, the objective of this article is to answer the following research question:

- *How can mobile technologies attend to the situated, social, and distributed nature of teacher learning within the context of high quality video coaching?*

To answer this question, a two-stage literature synthesis was conducted. First, literature on video coaching was reviewed to articulate an evidence-informed theory of action for video coaching in general. Then, literature was reviewed to understand how and to what extent *mobile* technologies might provide or support the constituent features of video coaching. The results of this two-stage process are given in the following sections.

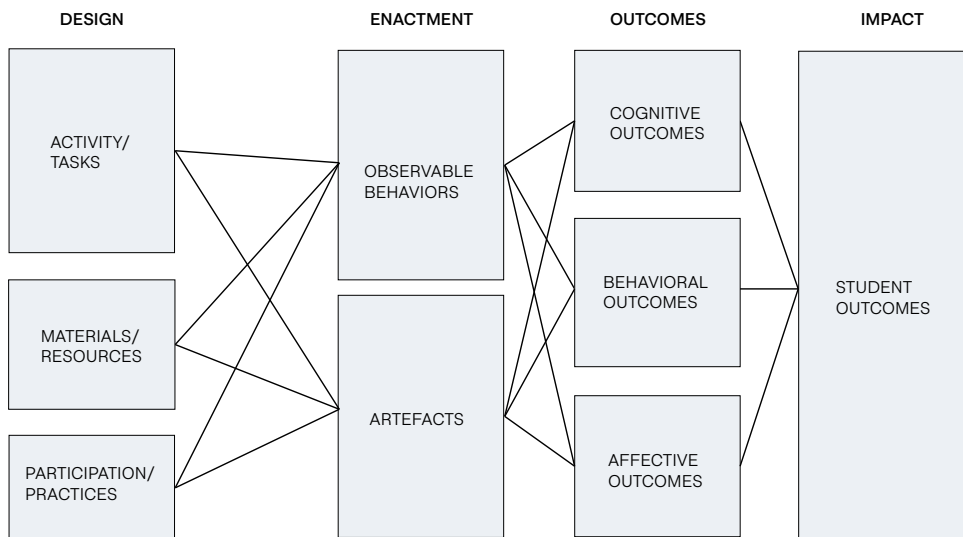
Stage 1: Video Coaching Theory of Action

Overall structure

Logic models have been recommended as tools for articulating the theory of action underpinning (educational) designs (McKenney & Reeves, 2019). Here, we use a specific form of logic modelling, conjecture mapping, because of its explicit attention to the argumentative grammar for how learning occurs (Sandoval, 2014). As shown in Figure I.1, the conjecture map visualizes a chain of effects.

Figure I.1

Generic Video Coaching Model



Note. Model is based on Sandoval (2014).

Design

The design encompasses all the planned features of the learning environment. These include the *activities/tasks* that are planned for learning, the *materials/resources* that support the learning processes, and the *participa-*

tion/practices that are envisioned, including the roles and responsibilities of those involved. In video coaching, key activities/tasks include: presentation of information; practicing classroom observation; exploring current practice; setting goals, and designing new teaching and learning experiences. Important materials/ resources for video coaching include tools to activate prior knowledge; examples from practice; and artifacts from practice. Finally, three roles are crucial to the participation/ practices of video coaching: curator; facilitator; coordinator.

Enactment

Once the learners engage with the learning environment, one speaks of *enactment*. While enactment is difficult to capture, the conjecture map portrays it through *observable behaviors* (reflection on, for, and in action) and *artifacts* (that support practice), both which can be understood of manifestations of teacher learning. Reflection on action pertains to discussion in which teachers consider past teaching events. Productive reflection on action is characterized through selective attention, where teachers focus on important actors and events, make productive use of evidence (e.g. use specific video excerpts to support their reasoning about teaching and learning), and demonstrate knowledge-based reasoning (i.e. use of pedagogical, content, or pedagogical content knowledge to interpret the videoed events (Van Es & Sherin, 2008). In reflection for action, teachers consider future events. Productive reflection for action is focused on important actors and events in the learning process and involves use of pedagogical, content, or pedagogical content knowledge to reason about steps to be taken and new instructional scenarios. In anticipation of future events, teachers typically create artifacts to support practice. Examples of these products are curriculum materials for teachers and/or students or action plans that detail concrete steps to be taken. Finally, during reflection in action teachers consider their current actions to decide if adjustments are necessary (Schön, 1983) while engaging in deliberate practice.

Outcomes and Impact

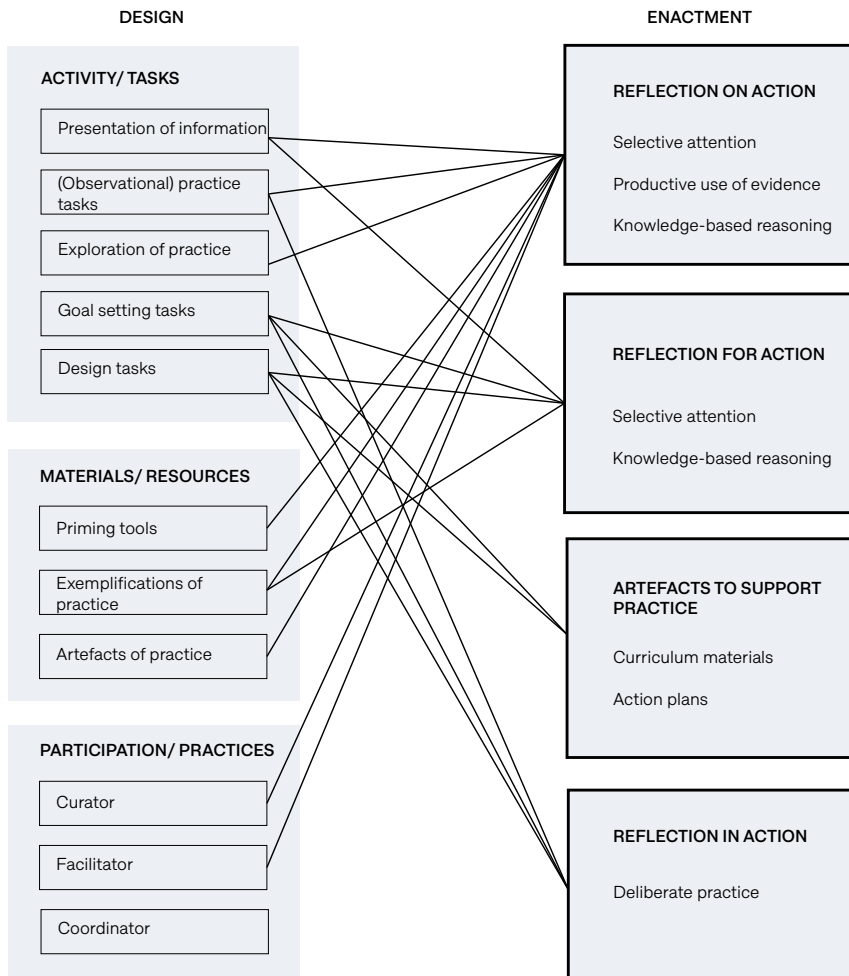
Teacher *outcomes* are produced as a result of the processes during enactment. Teacher outcomes can be understood as *cognitive outcomes*, i.e. knowledge, *behavioral outcomes*, i.e. changes in practice, or *ffective outcomes*, i.e. changes in attitudes or beliefs. Finally, it is expected that positive changes in teacher outcomes elicit *impact* on *student outcomes*, such as achievement or engagement.

Stage 2: Mobile Video Coaching Design Guidelines

As shown above, designing video coaching learning environments requires consideration of activities/ tasks, materials/ resources and participation/ practices in ways that yield reflection in, on and for action as well as artifacts to support practice. This section reports on the second stage of the literature synthesis, and discusses how *mobile* video coaching could be designed. Following the structure of the detailed conjecture map shown in Figure I.2, this section examines the theory of action behind each design feature, the associated nature of teacher learning, and the role of (mobile) technology to enable or support teacher learning.

Figure I.2

Detailed Model of Video Coaching Design Features and Enactment Processes



*Activities/tasks**Presentation of information activities*

During presentation of information activities, teachers are provided with access to knowledge. This often happens through, for example, the provision of (online) lectures, provision of readings and/ or collaborative discussion about the readings provided. These activities support conceptual understanding of pedagogical or domain-specific teaching strategies and/ or student learning.

To attend to the social nature of learning, teachers and coaches should critically discuss materials. In mobile video coaching, technology should provide access to expertise through remote interaction, which can be facilitated by cameras and microphones, sufficient bandwidth for audioconferencing and communication software such as audioconferencing apps. To attend to distributed nature of learning this type of activities should incorporate opportunities to share knowledge resources that could contribute to a shared cognition, such as digitalized articles or compiled texts. Technology should provide access to materials and expertise through devices with internet connections, through bandwidth for streaming and through course management software, file readers/ viewers or video players.

Observational practice tasks

During observational practice tasks, teachers rehearse targeted (video analysis) skills, for example through practicing critical video-based discussions and/ or analyzing videos of unknown teacher practice using priming tools. Observational practice tasks are necessary to develop useful lenses for viewing practice. Otherwise, teachers will view classroom video according to lenses that they developed during their study and work (Miller & Zhou, 2007).

Learning within observational practice tasks is situated, as teachers engage in reflection on simulated classroom practice, which is represented by unknown teachers video. In mobile video coaching, cognitive tools, such as video players allow teachers to connect with authentic learning contexts, which would otherwise be out of reach. Video annotation tools attend to situated learning by supporting reflective processes (Rich & Hannafin, 2009), e.g. by directing teachers attention to specific moments and by prompting them to use evidence from the videos to support their reasoning. To attend to the social nature of learning, teachers and coaches should critically reflect on the simulated practice. In mobile video coaching, this facet of learning can be supported by access to expertise, which can be facilitated through the use of cameras and microphones, audio conferencing software and bandwidth. To attend to the distributed nature of learning, technology should facilitate ac-

cess to expertise and materials through devices with internet access sufficient bandwidth for streaming.

Exploration of practice tasks

During exploration of practice activities, teachers consider their teaching practice using (pre-recorded videoed) artifacts of practice in a manner can vary from highly structured to fairly unstructured.

The nature of learning within exploration of practice tasks is authentic, as teachers engage in reflection on artifacts from their own practice. In mobile settings, cognitive tools, such as file viewers, video players and video annotation tools, allow teachers to connect with authentic learning contexts. Similar to observational practice tasks, video annotation tools can support reflective processes and reasoning skills (Rich & Hannafin, 2009), e.g. by directing attention. The social nature of learning is reflected through interaction between teacher(s) and coach(es) when they critically reflect on artifacts of practice, which should be supported by technology that facilitates distance interaction. In exploration of practice tasks different knowledge sources, e.g. digitalized artifacts and teachers, are needed to share and construct knowledge. In mobile settings technology should provide (secured) access to materials and expertise.

Goal setting tasks

During goal setting activities, teachers and coaches (together) determine the learning objective(s), for example by deciding on the focus of the next planned observation or by creating an action plan. Goal setting activities allow for situated learning as the identification of concrete actions to improve growth areas has a direct relation with and is meant to have an effect on teachers' classroom practice, making it an authentic task.

Goal setting tasks, which requires learners to engage in the metacognitive process of planning the way to approach a task, i.e. to determine which actions to take and set priorities. In mobile video coaching, cognitive tools such as word processing tools can support planning processes, for example by outlining the different steps to be taken. Critical discussions wherein teachers and coaches try to identify which next actions would best support identified growth areas attend to the social nature of learning, although goal setting might as well be an individual activity. Mobile technology supports communication through access to expertise with the help of cameras and microphones, audio conferencing software and bandwidth. Planning next actions often requires consulting different resources for which access to expertise and materials is required, which can be facilitated through technology.

Design tasks

During design tasks, teachers arrange, redesign, or create or teaching and learning scenarios, including the tasks, strategies, resources and roles that enable them. Design tasks often follow exploration of practice and or goal setting tasks, where potential growth areas are identified and concrete actions are listed. Design tasks embody opportunities for situated learning, as teachers develop learning scenarios to improve growth areas, which make design activities, participatory authentic tasks.

In mobile video coaching, cognitive tools can support cognitive processes that are important in authentic design tasks, such as creative thinking. Collaborative writing tools can support the visualization of individual ideas, and therefore support processes of idea generation or building on the ideas of others. Attendance to social and distributed nature of learning manifests and can be supported through technology in similar ways as in goal setting tasks.

Materials/ resources

Priming tools

Priming tools help activate prior knowledge and experiences to make connections to (new) conceptual understanding (Windschitl, Thompson, Braaten, & Stroupe, 2012). We use this term in video coaching to refer to text-based resources (digital or printed) that support teachers in recognizing and unpacking specific instructional strategies or aspects of student learning. Use of these tools also supports development of a shared language to communicate about key issues such as learning progressions or observable behaviors. Priming tools provide useful lenses for teachers to review their practice. Varied tools are particularly useful because otherwise, teachers tend to view classroom video (consciously or not) according to the lenses that they developed during their study and work (Miller & Zhou, 2007).

Priming tools are inherent cognitive tools because of their function. Priming tools support learning in authentic tasks because they allow teachers to connect specific behaviors to broad conceptualizations of teaching. In addition, these tools support social learning because they help communities to develop a shared language. In mobile video coaching, these tools can be considered artefactual knowledge sources, which need to be made accessible through technology.

Exemplifications of practice

Exemplifications of practice are digital or printed materials that demonstrate authentic representations of classroom practice (from classrooms other than those of the participants), often characterized as good or non-examples.

These materials can illustrate more or less effective cases of teacher instruction or student learning (within a certain domain). Often video-based exemplifications are used for video coaching activities.

Exemplifications of practice contribute to simulated authentic tasks because these materials illustrate real-life examples. These resources are needed to build shared understandings of effective practices. In mobile video coaching, technology is needed to access these materials and expertise. Technology can facilitate access through devices with internet connections, course management software and file readers or video players that provide access, and bandwidth for streaming as well as secure storage for personal data with privacy protocols in place.

(Videoed) Artifacts of practice

(Videoed) Artifacts of practice are physical or digital objects collected from classroom practice, such as videos of teaching practice, audio tapes from practice, student assessments, student work, lesson plans and curriculum materials which are produced by the teacher or the learner. Video-based artifacts of practice are essential components of video coaching and allow teachers to investigate (the effect of instruction on) student learning.

Artifacts of practice provide an authentic context, can act as a stimulus for discussion (Hiebert et al., 2002), and are resources that hold unique information on classroom practices. In mobile settings, technology is necessary to access the materials and indispensable for the collection process, e.g. recording classroom practice or digitalizing student work. In addition, secure storage space is essential for keeping personal data.

Participation/ practices

Curator

Fulfilling the curator role entails preparing artifacts of practice for use during coaching activities, e.g. editing classroom video into excerpts that illustrate valuable moments of teacher instruction and/ or student learning (in line with the goals of PD); selection of student work to discuss, etc. This role can be fulfilled by the coach or the participants.

In mobile video coaching, cognitive tools can be used to support the cognitive process of organizing, assembling and selecting digital materials, such as file editors, transcription software, video editors and video annotation software by allowing curators to re-structure the materials and help to represent authentic contexts for learning. In addition, technology is needed to access the materials that need curating.

Table I.1
Mobile technology functions in video coaching design features

		Activities/tasks					Materials/resources			Participation/practices		
		Presentation of information	Observational practice tasks	Exploration of practice	Goal setting tasks	Design tasks	Priming tools	Exemplifications of practice	(Videoed) Artefacts of practice	Curator	Facilitator	Coordinator
Hardware	Portable device											
	with internet connection											
	with camera and microphone.											
	Audio (video) conferencing											
	Messaging											
	Email											
	Web authoring software											
Software	Project/coursemanagement tools											
	File reader/viewer											
	File writer											
	File editor											
	Transcription software											
	Video player											
	Video editor											
	Video annotation software											
	Video recording software											
	Visualization tools											
	Planning tools											
	Collaborative writing tools											
	Collaborative planning tools											
	Shared online storage space											
Infrastructure	Bandwidth for streaming											
	Bandwidth for audio/video conferencing											
	Secure storage (online or offline)											
	Secure storage (online)											
	Privacy protocols for data											

Note: Blue/ Grey cells = access tools, diagonal = cognitive tool

Facilitator

Fulfilling the facilitator role means directing teachers' attention (e.g. to salient events in a video). It can take place in a variety of ways, e.g. by voicing observations or asking questions and is typically done in a way that aligns with the goals of PD. While the coach does this in most scenarios, participants often co-facilitate in group coaching settings.

By guiding teachers attention to representations of real-world contexts, the facilitator can attend to the situated nature of learning. In mobile video coaching, cognitive tools such as video players and video annotation tools can support attention processes, by highlighting imported events. Often this type of scaffolding takes place during verbal discussions of video, attending to the social nature of learning. The facilitator also attends to the notion of distributed learning by making direct use of resources for learning, which are facilitated through technology.

Coordinator

Those fulfilling the coordinator role organize and communicate about how the coaching will ensue (where, when, with what tools, etc). This is often, but not exclusively, fulfilled by the coach. Even though the role is highly organizational, it is very important for bringing together expertise and materials.

In mobile settings, all communication and the sharing of resources is enacted through technology. Devices with internet connections and software that support communication and the structuring of course materials, i.e. web authoring software or course management software, are needed to support the organization of learning.

Conclusion

This study reviewed literature to understand how mobile technologies can attend to the situated, social, and distributed nature of teacher learning within the context of high quality video coaching. After distilling a theory of action for video coaching in general (see Figures I.1 and I.2), specific design guidelines for *mobile* video coaching were discussed. Based on that discussion, Table I.1 provides an overview of the technologies (specifically, hardware, software and infrastructure) that are essential components mobile video coaching and reveals why, by linking them to the key design features.

The table shows that, in terms of hardware, portable device with internet connections are needed to support all features of the design. In addition,

cameras and microphones are most often used communicative and recording functions. In terms of infrastructure, bandwidth is essential for communicative functions in observational practice and exploration of practice tasks. Bandwidth is also essential for distribution and access of video materials. Additionally, secure online storage and privacy protocols are needed to safely store and access (videoed) materials. Finally, software can either be used as an access tool or as a cognitive tool, depending on the function with a design feature.

Discussion

Mobile technologies can accommodate the *situated nature of teacher learning* by incorporation of authentic contexts and tasks that would normally be out of reach. Detailed analysis of classroom practice can be facilitated through cognitive tools such as video technology, which not only incorporates an authentic context, but also creates an authentic task. Video software supports detailed analysis by allowing teachers to stop, rewind and replay classroom events over and over. Video technology has the advantage that teachers can view their own classroom and study (the effect of instruction on) student learning, which would be impossible otherwise. Moreover, cognitive tools can support (meta)cognitive processes in ill-defined tasks that have real-world relevance. Video annotation can support reflective processes as it allows teachers to connect tacit knowledge to evidence from the video, therefore allowing often hidden processes of instructional decision making to surface (Rich & Hannafin, 2009). In addition, video annotation can support teachers reasoning skills when frameworks are incorporated, because teachers are asked to apply the frameworks or lenses to the practice in the video, therefore connecting abstract concepts to instructional behaviors (Sherin & van Es, 2005). Further, technology can provide access to expert performance, which is an important aspect of an authentic context (Herrington & Parker, 2013). These simulated contexts provide opportunities to watch experts perform tasks while not being present. Video of expert performance or exemplifications of practice can illustrate how to perform instructional behavior, therefore acting as a form of modelling, which is commonly associated with coaching.

Mobile tools that provide access to expertise and support cognition can attend to the *social nature of teacher learning*. If social learning is perceived as learning that occurs through interaction in communities of practice, then tools are needed to make interaction possible between remote actors.

Communication tools can provide access to expertise through use of audio or video conferencing software. In addition, the infrastructure and hardware that permits verbal interaction from a distance needs to be in place. Technology can facilitate (inter) institutional communities of practice, but the implementation of technology that facilitates communication between distant actors does not guarantee learning. The question remains if and how technology can support verbal reflective discussions. It appears that a facilitator or coach is still important in facilitating these processes (e.g. Hiebert et al., 2002).

Mobile technologies support the *distributed nature of teacher learning* through access to expertise and materials. Technology allows access to materials which are indispensable for teacher learning. Through technology, teachers can share resources and provide access to their classrooms. As such, videoed classrooms can now act as knowledge sources that can be studied and used to construct new knowledge. This is important for teacher learning, because teaching is an isolated profession where these contexts would normally stay hidden, due to practical constraints (Zhang, Lundeborg, Koehler, & Eberhardt, 2011). Other teachers' video provides a window into practice that allows teachers to compare their own teaching to their peers.

Implications

Mobile video coaching can offer many affordances for practice. This article shows that technology can support access (to materials and expertise) as well as cognition, both of which are important aspects of mobile learning. However, the technology itself does not guarantee learning. The tools mentioned in this article are all productivity tools and therefore easily accessible. However, these tools should be considered dumb tools, which means that the way these tools are used determines in what way and to what extent they can support learning. Before thinking about the technology, the learning objectives should be clarified for different activities, where after technology can be fitted to these objectives.

We close by noting that technology coordinators have an important role to play in mobile video coaching. They can help coaches think about ways teachers can learn from, through, and with technology; they can also co-design learning environments. But if educational technology coordinators need to fulfil these roles, they need to have awareness of the functional opportunities that the different tools have to offer, instead of only focusing on the technical specifications. The theory of action the design guidelines provided

here articulate important considerations for all of those who would endeavor to realize mobile video coaching for teacher professional development.

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Chapter 4

Construction

This chapter is based on:

van der Linden, S., Anantharajan, M., Nieveen, N., & McKenney, S.
(under review) Assessing Teachers' Video-Based Reflective Conversations:
Expert Views and an Initial Instrument.

Abstract

Teacher reflection is essential for productive video-rich professional development, but standardized instrumentation to assess these video-rich conversations is needed. This three-round Delphi study operationalized the key aspects of teachers' video-rich reflection, based on an existing conceptual model for teacher reflection. Experts ($N = 27$) validated the fit of the reflection model as the basis for an instrument, agreed that an observation instrument focusing on formative assessment would be most useful, and recommended that all phases of teacher reflection, preparation, image forming, and conclusion drawing, were equally important. Thereafter, draft indicators were evaluated for clarity, which resulted in an initial framework for observing teachers' reflective conversations.

Introduction

Coaching and reflection are widely known to be beneficial for teacher-learning, and are considered essential for professional development interventions (Darling-Hammond et al., 2017). Reflection, in line with Dewey's (1933) conceptualization, can be understood as the conscious consideration of action, how one has come to know what is known, and the implications these insights hold. Reflection is thought to support practical knowledge development through problem-solving and awareness (Mena Marcos & Tillema, 2006). As such, it can be seen as a mediating learning process, as well as a learning outcome (Tripp & Rich, 2012; Ward & McCotter, 2004).

While teacher reflection has many forms, video-rich reflection is widely recognized as a powerful process for supporting teacher learning by providing opportunities for detailed analysis of practice, eliciting discussion, and representing complex situations (Marsh & Mitchell, 2014). Video-rich reflection occurs sometimes in conversations with colleagues and often together with facilitators or coaches (e.g., Sherin & van Es, 2009; van Es & Sherin, 2008). Two perspectives on teacher knowledge development seem especially relevant for shaping (video-rich) reflective processes. One emphasizes cognitive processes in teacher learning through goal-oriented reflection (e.g., Gregory et al., 2014), while the other perspective emphasizes the context-specific nature of teacher learning by means of reflection through an awareness of the specifics of a situation (e.g., Sherin & van Es, 2009). An assumption underlying this study is that both these perspectives matter, and that combining them can have added value for the quality of video-rich reflection conversations between preservice or in-service teachers and a facilitator or coach (van der Linden & McKenney, 2020).

While reflection is widely considered to be beneficial, the relationship between reflection and outcomes (e.g., actions resulting from reflection) is not always evident (Mena Marcos & Tillema, 2006). Further, the limited number of review studies on the processes and impacts of reflective practices suggests that comparing studies on reflection is difficult. Indeed, reflection means many things to many people (Clarà, 2015), and differences in theoretical foundations have led to differences in measurement, making comparison between studies challenging (Van Beveren et al., 2018). This is problematic, because practitioners require clear guidance on what outcomes can be supported by reflection and in what ways. Research is thus needed to establish (a) an empirically derived understanding of what varied, yet high-quality reflective conversations look like, and (b) how these can be assessed in practical and valid ways. Such

work could help to provide an argumentative grammar (Kelly, 2004), that is, warranted claims about how and what learning occurs through reflective practices. In addition, this information can be used to improve teachers' future reflective conversations and their outcomes. This is currently difficult, because reliable and validated observation instruments that assess the various aspects of (teacher) reflection are scarce. To address this situation, a three-round Delphi-style study was undertaken with experts on teacher reflection to (a) identify and (b) operationalize key aspects of teacher reflection in the context of video-rich conversations.

Conceptual Framework

Important Aspects of Teacher reflection

Perspectives on Knowledge Development

Different epistemological perspectives that are present in the literature on teachers' knowledge development can shape reflective practices, together these have informed the united reflection model (van der Linden & McKenney, 2020). On the one hand, teachers can consider their practice from a *deliberate perspective*, utilizing frameworks for teaching effectiveness in order to align their practices with what is already known and accepted as effective teaching by researchers and practitioners. For instance, teachers can use the CLASS framework to reflect on past teaching practices, as shown in the various My Teaching Partner studies, where teachers engage in coaching conversations based on this framework (e.g., Gregory et al., 2014). On the other hand, teachers can consider their practice from an *aware perspective*, where knowledge is constructed through (inter)action with the context and within local systems (Brown et al., 1989; Lave & Wenger, 1991). From this view, knowledge is constructed by planning, enacting, and looking back at teaching. Video clubs are such settings, where teachers discuss and reason about what they notice in videos of their practice (Sherin & van Es, 2009; van Es & Sherin, 2008). Uniting both the deliberate and the aware perspectives might have added value by providing a more complete picture of what has happened and/or consideration of teaching effectiveness frameworks and what is needed and possible in practice, to detail possible next steps (van der Linden & McKenney, 2020). For instance, a recent study on instructional coaching showed that ambitious instruction is supported by paying attention not only to effective instruction, but also especially to when and why particular behaviors are implemented,

which provides initial evidence for a united reflection perspective (Witherspoon et al., 2021).

Teachers' Video-Rich Reflection

Several important aspects can be identified regarding video-rich reflective practices. During video coaching, teachers or coaches record teaching episodes and engage in video-rich discussions in a sustained manner (van der Linden & McKenney, 2020), which can happen in groups (e.g., Sherin & van Es, 2009; van Es & Sherin, 2008), or individually with a coach (e.g., Gregory et al., 2014, 2017). Sometimes there are pre-defined frameworks used to guide reflection, such as CLASS in the context of My Teaching Partner (Gregory et al., 2014), while at other times reflection is more open and the coach provides guiding questions to direct focus or challenge teachers to make sense of what is being seen, as in video clubs (Sherin & van Es, 2009; van Es & Sherin, 2008). According to Dewey (1933), reflection is the "active, persistent, and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it and the further conclusions to which it tends..." (p. 9). Thus, teacher reflection relates to what teachers know and believe about their practice as teachers, the justifications for their knowledge and beliefs, and what comes next based on these insights. Reflection on action refers to considerations of past actions (Schön, 1983), whereas anticipatory reflection (Loughran, 1996) or reflection for action (van der Linden & McKenney, 2020) is focused on shaping future actions. Reflection can be divided into separate phases, namely, preparation, image forming, and conclusion drawing (Rey-men et al., 2006), and corresponding behaviors. The first phase in a reflective process is the *preparation* of the reflection, that is, determining the frame that will be applied. The second phase is *image forming*, which is a sensemaking process to gain understanding of past actions or to compose future teaching scenarios. Scholars of video-rich professional development have noted the importance of moving beyond descriptions to interpretative stances (Sherin & van Es, 2009; van Es & Sherin, 2008). The final phase is *conclusion drawing*, which often requires teachers to compare findings to form conclusions (Rey-men et al., 2006), and can help them identify growth areas or next steps. In addition, materials and resources can support reflective practices, for instance, artifacts of practice (i.e., products of teaching practice), priming tools (i.e., materials that support cognitive processing), and examples of practice (i.e., illustration of effective teaching; van der Linden & McKenney, 2020). Finally, during a reflective conversation, different roles can be observed, each influencing the reflective talk, such as a facilitator role (i.e., providing learning support), a coordinator role (i.e., organizing learning opportunities), and a cu-

rator role (i.e., selecting the materials). The teacher who is reflecting takes on a learner role (i.e., managing one's learning; van der Linden & McKenney, 2020).

Purposes of Assessing the Quality of Reflection

Even though reflection is typically regarded as important for teacher development in video-coaching settings, an argumentative grammar on how it supports teacher outcomes and impacts student outcomes is still under construction (van der Linden et al., 2021). Understanding which aspects of reflection contribute to teacher and student learning could support training efforts and enhance teaching and learning. Standardized instruments that pay attention to important aspects of high-quality reflective conversations are needed to establish these links. In order to develop these standardized instruments, more insight is needed as to which aspects of reflection need to be included, because this is currently unclear from the scientific literature. Even though the literature provides guidance on the various reflection elements, it is not certain if all of the aforementioned elements are essential for observing reflective conversations in general, or when observing reflective conversations for different purposes, that is, for formative, summative, or descriptive purposes.

What aspects to pay attention to might be influenced by the purpose of the assessment. A *formative purpose* can be understood in this context as an assessment process used by teachers and coaches during coaching that provides feedback to adjust and improve teaching and learning (cf. American Educational Research Association [AERA] et al., 2014). These types of instruments can thus be used for the training or professional development of coaches and teacher educators and help to improve future reflective conversations. This is important because research has shown that teachers do not always reflect in ways that support their practice (e.g., Boschman et al., 2014; Sherin & van Es, 2009; Wolff et al., 2017). Reflection can also be assessed for *summative purposes*, and here the goal would be to evaluate the quality of the reflection. This type of instrument could be used in teacher education settings to track reflection quality over time or across preservice teachers (cf. AERA et al., 2014). Finally, the lack of standardized instruments makes it difficult to research reflective talk and associated outcomes on a larger scale, and measures with a *descriptive purpose* could help with this. Researching reflection on a larger scale in naturalistic settings is important, because the evidence base that links reflection to teacher outcomes in video-coaching contexts is limited (van der Linden et al., 2021).

In designing each of these instruments, choices need to be made based on the purpose that they serve (AERA et al., 2014). Without question, essential content needs to be included in each of the instrument types, but depending

on the information that should come out of the instrument, choices can be made about what to foreground, background, and exclude, or how to present information. For instance, one could argue that an instrument used for descriptive and summative purposes could be longer, because the measurement precision often resulting from a longer test (AERA et al., 2014) is of greater importance than the time required to complete the assessment. When using a formative instrument, one could argue that to understand what to improve, attention should be paid to all aspects of the reflective conversation to identify what is present or not. Practically, however, the length of the instrument could influence how likely teacher educators and coaches are to use the instrument in their practice. This points to the second goal of this study, which is how operationalize aspects of teachers' video-rich reflective talk.

Operationalizing Teacher Reflection

Existing Instruments

To our knowledge, few standardized instruments to measure teacher video-rich reflection have been reported in the scientific literature, and most have focused on assessing reflective writings. Teachers' reflective writings can be assessed with rubrics, which detail the criteria and gradations of quality (Andrade, 2005). An example is the Reflection Rubric, which pays attention to three different dimensions of reflection (focus, inquiry, and change), the levels of reflection (routine, technical, dialogical, and transformative), and provides descriptions for the gradations for each level on each dimension (Ward & McCotter, 2004). In contrast, checklists list the different dimensions or criteria, but do not describe the gradations of quality in detail, and scores are given per dimension, thereby providing moderately detailed feedback. For example, the Reflection Checklist (Nagro, 2020; Nagro et al., 2017), is used to score the reflective ability of preservice teachers from their video-rich writings. The writings are scored for reflection across the four dimensions of reflection, namely, describe, analyze, judge, and apply, on six elements for reflection that align with the Framework for Teaching Evaluation Instrument by Danielson (2011, cited in Nagro et al., 2017).

Video-rich reflective conversations are often analyzed by coding transcribed data, which is an effective method for deep analysis of a limited set of data, but might not be suitable for analyzing larger sets of data or for formative assessment by practitioners. Reflective conversations can be inductively coded with a coding scheme developed during the study (e.g., Lee, 2005), or deductively coded using a predefined coding scheme (e.g., Sherin & van Es, 2009). The coding can focus on attention or sense-making aspects, such as noticing and interpreting student thinking (Sherin & van Es, 2009; van Es

& Sherin, 2008) or discussing new practices (Santagata & Bray, 2016). Even though coding is an effective, well-known method for analyzing (these types of) conversations, it is time-consuming, and therefore might not lend itself to studies where a larger amount of conversation needs to be analyzed or when practitioners need direction on how to improve their reflective conversations.

Gaps in Existing Scientific Literature

In summary, the literature discussed above provides no clear guidance as to whether all aspects of reflection are essential for assessing a reflective conversation, or what aspects should be foregrounded, backgrounded, or excluded. Similarly, there are no clear guidelines for what aspects of reflection are essential for assessing a reflective conversation with different uses (formative, summative, or descriptive) in mind. In addition, standardized instruments to assess video-rich reflective conversations that pay attention to the various aspects (i.e., perspectives, reflection types, phases, and underlying behaviors) are not present in the scientific literature.

Research Objective and Questions

The aim of this study was to determine the characteristics of an instrument for assessing aspects of teacher reflection in valid and clear ways according to experts on teacher reflection. Expert advice was sought based on research insights as well as practical experience. Three research questions, each relating to a different challenge, guided the study. The first two relate to identifying priorities for assessing reflection from the united reflection model (focusing on validity aspects), and the third relates to operationalizing these priorities (focusing on clarity aspects). Based on the united reflection model applied to teachers' video-rich reflective conversations:

- What are important aspects of (a) teacher knowledge development in general and (b) reflection in particular?
- What are (a) important purposes (formative, summative, descriptive) of using an observation instrument, and (b) important aspects of reflection in light of these three purposes?
- What are the characteristics of a clear instrument for assessing these aspects of reflective conversations?

Method

Study Design

A three-round mixed-methods Delphi-inspired study was conducted to investigate the characteristics of a valid and clear instrument for assessing reflective conversations; see Figure 4.1 for a conceptual model of the study. Specifically, the study began by collecting expert opinions on essential aspects of reflection to include, and concluded by gathering their opinions on the clarity of reflection indicators that had been drafted according to their recommendations. Experts can be involved in the gathering of evidence regarding the content of an instrument (AERA et al., 2014, p. 219). For this reason, a Delphi-inspired method was chosen, which uses expert opinions to reach consensus or engage in problem solving on emerging issues (Puig & Adams, 2018). Although not standardized, a Delphi method usually includes four common characteristics, each of which were present in this study: anonymity (participants do not know each other), iteration (study is executed in a series of rounds), controlled feedback (the Delphi facilitator decides what the feedback entails), and statistical group response (numerical or graphical representation of answers; von der Gracht, 2012). We refer to the present study as 'Delphi-inspired' because the guiding questions came to differ in each round. Namely, when consensus was reached after only one round (which was the case more often than we originally expected), new questions were formulated for the subsequent round (as opposed to asking similar questions in different ways). Throughout the study, we followed the recommendations for methodological rigor in studies that utilize group consensus methods (Humphrey-Murto et al., 2017).

Figure 4.1
Conceptual Model of the Study

PURPOSE	Formative		
	Summative		
	Descriptive		
PHASE	Preparation	Image Forming	Conclusion Drawing

PERSPECTIVE	Deliberate	Knowledge-driven framing	Interpreting/ predicting evidence-based practices	Determining based on evidence-based practices
	Aware	Context-driven framing	Interpreting/ predicting salient moments in practice	Determining based on salient moments
	United	<i>Comparing perspectives within phases</i>		

Note. Black outline = focus of round 1; dotted outline = focus of round 2; grey cells = focus of round 3. Grey cells show reflection behaviours that occur within phases and perspectives.

Participants

A purposeful sampling strategy was chosen to identify individuals with expertise on teacher reflection. Expertise “refers to the characteristics, skills and knowledge that distinguish experts from novices and less experienced people” (Ericsson, 2018, p. 3). For this study, the relevant knowledge and skills relate to the field of video-rich reflection and facilitating reflection in teacher education or training. This expertise may be developed in both research and practice settings. We therefore deemed two types of experts necessary, namely, experts in teacher reflection research, and expert practitioners of reflection working in teacher development settings.

Expert selection

In order to identify research experts, publication history was taken as the point of departure. The *Web of Science Web Collection Tool* was searched using the search terms reflect* AND teacher* AND video* in titles, keywords, and

abstracts and restricted to the SSCI index from 2010-2020. This resulted in a total of 1381 authors with a total of 579 publications. The corpus was scanned for authors who had published a minimum of two relevant articles using the following selection criteria: The study reported on *teachers* (in-service and preservice) as participants or subjects AND the study reported on *reflection*, that is, (the shaping of) reflective processes as the subject of the investigation AND the study reported on reflection in a *video-rich context*. Videos of teachers' own practice were used to support teachers' professional development. Studies that used reflections only as a data source to investigate other phenomena or reported on the analysis of unknown teachers' practices were excluded. This resulted in an initial selection total of 39 authors. All selected authors were contacted to participate in the study and 15 authors from 14 different universities in North America, Europe, and Asia initially agreed to participate. To identify *practitioner experts*, a call was placed in the newsletters of the teacher educator society in the Netherlands, and with the directors of teacher education programs of eight universities in the Netherlands. Additionally, the coordinators of two professional development school partnerships were contacted by email and asked to provide the names of teacher educators/coaches whom they considered practitioner experts on teacher reflection. Each practitioner expert considered for inclusion had a minimum of 4 years of experience of facilitating teacher reflection, was working as a teacher educator or teacher coach, and had a bachelor's degree. A total of 18 practitioner experts from 16 different institutes initially agreed to participate. In all, a total of 33 experts initially agreed to participate. Attrition occurred before and during the study: In round 1 there were 27 experts (12 research and 15 practitioner), in round 2 there were 19 experts (9 research and 10 practitioner), and in round 3 there were 13 participants (6 research and 7 practitioner). Experts were not asked to explain their withdrawal from the study, but some provided reasoning, most commonly that other responsibilities had arisen that did not allow them to allocate time for the study anymore.

Data Collection

During *round 1* (RQ1), the goal was to identify important aspects of (a) teacher knowledge development in general and (b) reflection in particular. All experts received an article describing the united model for teacher reflection, which was intended to be the basis for an instrument, and were asked to complete an English online questionnaire with closed-ended and open-ended questions in 6 blocks. All experts were asked to indicate how much attention should be given in an observation instrument to characteristics of knowledge development within the deliberate or aware perspectives using a constant

sum (block 2; RQ1a). They were also asked to describe their core values about coaching and reflection to gain insight into their dispositions (block 1), and to rate the themes related to teacher reflection as “essential,” “useful, but not essential,” or “not necessary” and to explain their answers or suggest additional considerations for each set of questions (i.e., for reflection on action; blocks 3, 4; RQ1b). Next, experts were asked about their considerations for paying attention to materials/ resources and participation/ practices in the instrument (block 5), and if there were any other ideas or considerations that had come to mind while filling in the questionnaire (block 6).

Participants received a summary of the results from round 1, which helped them understand why the goal of *round 2* (RQ2) was to identify (a) important purposes of using an observation instrument (formative, summative, or descriptive), and (b) important aspects of reflection for these purposes. Similar to round 1, participants were asked to complete the online questionnaire with closed-ended and open-ended questions, this time divided into 5 blocks, as shown in Figure 4.2. Experts were asked to describe their envisioned purposes for using an observation instrument for assessing reflective conversations (block 2; RQ2a). In addition, experts were asked to rate the behaviors related to teacher reflection as “essential,” “useful, but not essential,” or “not necessary” when using an instrument for formative, summative, or descriptive purposes (i.e., for reflection on action and reflection for action), and for assessing materials and resources and/or participation and practices in the instrument when assessing reflection on action and reflection for action in general (blocks 3, 4), and if there were any other ideas or considerations that had come to mind while filling in the questionnaire (block 5; RQ2b).

Participants received a summary of results from round 2 prior to *round 3* (RQ3), during which they completed a final questionnaire and were asked to share any comments related to indicator clarity if they wanted to do so in an online session. In an online survey containing 6 blocks (Figure 4.2), participants rated whether or not indicators for assessing reflection on and for action from the deliberate, aware, and united perspectives were clear enough to be used (i.e. yes or no evaluation). The rationale for mixing qualitative and quantitative data in all rounds was complementarity, in order to come to more complete conclusions about how to assess the construct under study (Plano Clark & Ivankova, 2016). Figure 4.2 provides an overview of the data collection procedures.

Figure 4.2

Graphic Organizer of the Delphi Input, Surveys, and Example Questions

INPUT	Question blocks	ROUND 1	Example questions				
ARTICLE ON UNITED MODEL	1. Dispositions (1.1 - 1.4)	Your values and experiences about reflection and coaching		<p>1.2. Please provide three words or phrases that convey your core values with regards to reflection.</p> <p>3.1. - 3.3. Three RoA behaviors could be observed during deliberate analysis of practice. We wonder: Should an observation instrument portray all of them? Please indicate your stance for each one.</p>			
	2. Perspectives in general (2.1 - 2.9)	Deliberate					
		Aware					
	3 - 4 Perspectives in use during	3. RoA (3.1 - 3.10)			4. RfA (4.1 - 4.10)		
		Deliberate	Aware		United	Deliberate	Aware
	5. Supporting teachers' reflective talk (5.1 - 5.2)	Materials and resources					
Roles and interactions							
6. Considerations (6.1 - 6.2)	Your experiences with this survey						
ROUND 2							
SUMMARY ROUND 1 RESULTS	1. Experiences (1.1 - 1.2)	Your experiences with using a reflection observation instrument.			<p>2.2. In light of the above situation, please indicate the purpose(s) for which an observation instrument to portray teachers' reflective conversations may address a genuine need (check all that apply).</p> <p>3.1. - 3.3. When the observation instrument is used to improve future (video-based) reflection on action conversations (formative purposes), how essential is the inclusion of the following phases in the instrument to fulfil that purpose?</p>		
	2. Purposes (2.1 - 2.5)	Formative	Summative	Descriptive			
	3. Reflection on Action (3.1 - 3.18)	RoA in light of instrument purposes				Supporting teachers' RoA talk	
		Formative	Summative	Descriptive		Materials and resources	Participation and practices
	4. Reflection for Action (4.1 - 4.18)	RfA in light of instrument purposes				Supporting teachers' RfA talk	
Formative		Summative	Descriptive	Materials and resources	Participation and practices		
5. Considerations (5.1 - 5.2)	Your experiences with this survey						
ROUND 3							
SUMMARY ROUND 2 RESULTS	1. Deliberate RoA (D1 - D6)	Preparation	Image forming	Conclusion drawing	<p>Please indicate whether the indicator is clear enough to use in its current form.</p>		
	2. Deliberate RfA (D7 - D12)	Preparation	Image forming	Conclusion drawing			
	3. Aware RoA (A1 - A6)	Preparation	Image forming	Conclusion drawing			
	4. Aware RfA (A7 - A12)	Preparation	Image forming	Conclusion drawing			
	5. United RoA (U1 - U6)	Preparation	Image forming	Conclusion drawing			
	6. United RfA (U7 - U12)	Preparation	Image forming	Conclusion drawing			

Note. RoA = Reflection on action, RfA = Reflection for action. All materials were provided in English

Data Analysis

The analysis regarded all experts as a single group, so that the findings would reflect a consensus between experts from research and practice on how to assess teachers' video-rich reflection in an instrument. This approach was chosen to facilitate exchange between viewpoints from research and practice, instead of only within groups. Three types of quantitative agreement measures were used. First, Kendall's W coefficient of concordance was used on the ranked data ($W = 0.1$ indicating very weak agreement, $W = 0.7$ indicating strong agreement), after investigating differences using a Friedman test, with Dunn-Bonferroni corrections for multiple comparisons to protect for false positives. Kendall's W coefficient of concordance has been applied in other Delphi studies to determine consensus when this type of data was used (Pastore & Andrade, 2019; von der Gracht, 2012). Second, Lawshe's content validity ratio (CVR) (Ayre & Scally, 2014; Lawshe, 1975) was used for content validation, as the CVR is used with panels of experts to establish what content is important to include in a measure so that it measures what it intends to measure (Ayre & Scally, 2014). Finally, for ascertaining if topics warranted further exploration, a simple majority (> 51%) was considered sufficient.

In addition to the agreement calculations, qualitative thematic analysis based on open-ended question responses was used to understand experts' core values related to coaching and reflection, as well as whether and how an instrument should attend to assessing materials and resources and/or participation and practices, in round 1, and to understand what instrument purposes would be most needed in round 2. The qualitative data were exported to Word. Phrases and sentences were coded individually where applicable. Phrases and sentences covering several topics were split into separate excerpts. A codebook was developed by the first author containing the codes, descriptions, and examples, and the coding was discussed iteratively to facilitate understanding of the emerging constructs between coders. Interrater reliability was calculated for 20% of the responses by two authors and all values were above $k = 0.78$, signaling sufficient-good agreement. When it proved more difficult to find sufficient agreement, which was the case for answers relating to supporting teachers' reflective talk, then the full set of coded answers was discussed between two authors till 100% consensus was reached. An overview of the round-specific data analysis is given in Table 4.1.

Table 4.1

Overview of Data Analysis Methods per Round and Block

	Round 1	Round 2	Round 3
Kendall's <i>W</i> coefficient	Block 2	-	-
Lawshe's CVR	Block 3, 4	Blocks 3, 4	-
51% majority	Block 5	-	Blocks 1 - 6
Inductive qualitative coding	Blocks 1, 5	Blocks 1, 2	-

Results

RQ1: Important Aspects of Teacher Knowledge Development and Reflection

In the first round, the objective was to identify priorities for assessing video-rich reflection in an instrument, using the united reflection model as a point of departure. To gain insight into the dispositions of the expert group, their values regarding reflection and coaching were explored. The group of experts held a diverse set of values related to reflection and coaching, as can be seen in Figure 4.3. The responses included 6 main types of valued aspects: (1) dispositions: orientations brought by participants, such as truthfulness or openness; (2) frames: lenses participants use to make sense of the situation, such as self-investigation; (3) outcomes: goal that the efforts or actions are intended to attain or accomplish, such as change and self-insight; (4) activities and task structures: what participants do, such as sense-making or coaching activities and tasks; (5) participant roles and practices: how participants take part, such as the peer-coach; and (6) conditions for good coaching: aspects of the coaching environment and interactions, as well as the relationship established. With regard to reflection core values, sensemaking as a core task was mentioned most often, and was mentioned most often together with truthfulness, routines, self-investigation, change orientation, and self-insight. Aspects of the coaching environment and/or interactions were mentioned most often as core values of coaching and were most often mentioned together with coaching activities and task structures, and truthfulness. In addition, self-insight and a change orientation were mentioned more often together as core values of coaching. The variation in (combinations of) values showed that the

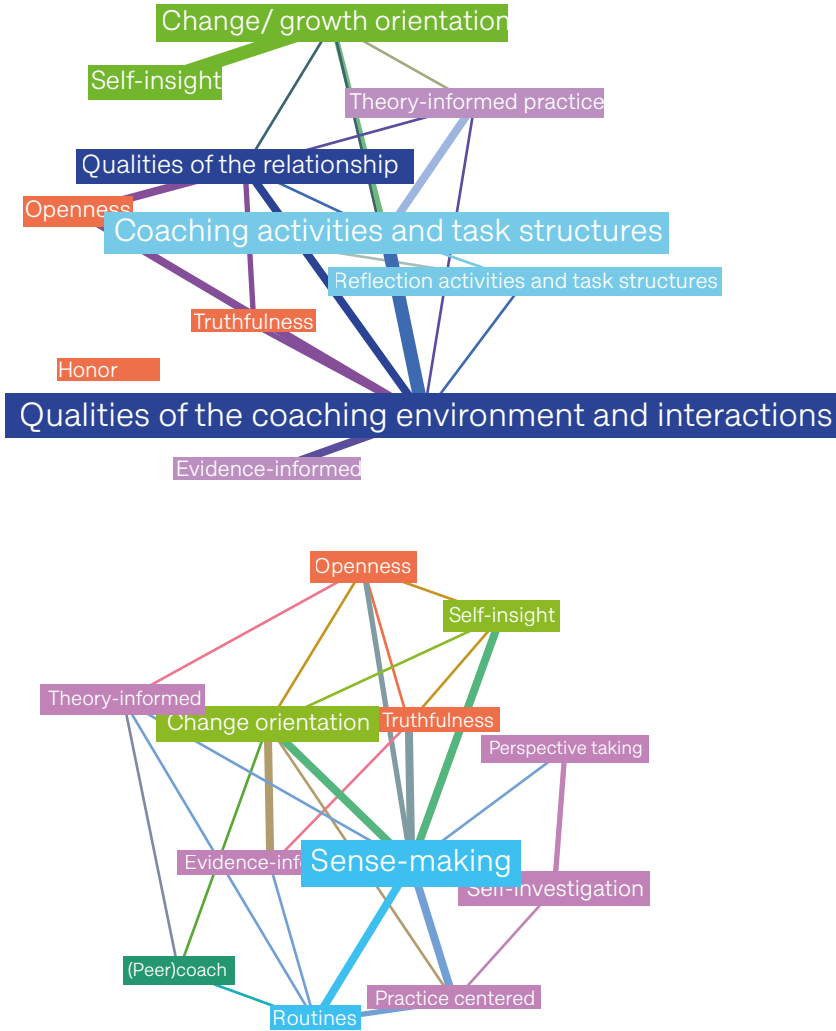
expert group represented diverse perspectives.

In addition to sharing their values, experts were asked to indicate how much attention should be given in an observation instrument to characteristics of knowledge development. There was fair to medium concordance between experts on the deliberate ($W = 0.432, p = .000$) and aware knowledge aspects ($W = 0.496, p = .000$) that an instrument should (not) pay attention to. In other words, for both perspectives, there is a significant difference between the two highest (see Figure 4.4, rank = 4 is highest rank; rank = 1 is lowest rank, red boxes) and lowest ranked aspects, but experts did not fully agree on the exact order. A Friedman test was carried out to compare constant sum scores for how much attention should be paid to the four aspects of knowledge development within the *deliberate perspective*. There was found to be a significant difference between the four aspects, $\chi^2(3) = 35.018, p = 0.000$. Dunn-Bonferroni post hoc tests were carried out and there were significant differences between the following items: (2.2) knowledge serves as a lens for developing practice > (2.3) knowledge is acquired outside practice ($p = 0.000$) and (2.4) knowledge is explicit ($p = 0.01$); in addition, (2.1) knowledge consists of commonly accepted truths > (2.3) knowledge is acquired outside practice ($p = 0.004$) and 2.4. knowledge is explicit ($p = 0.037$), after Bonferroni adjustments.

Second, a Friedman test was carried out to compare constant sum scores for the amount of attention that should be paid to the four aspects of knowledge development within the *aware perspective*. A significant difference was found between the four aspects, $\chi^2(3) = 40.144, p = 0.000$. Dunn-Bonferroni post hoc tests were carried out and there were significant differences between the following items: (2.6) knowledge developed through planning enactment reflection > (2.8) knowledge is implicit ($p = 0.000$) and (2.5) knowledge based on interpretation of local context ($p = 0.02$); In addition, (2.7) knowledge is developed through interaction > (2.8) knowledge is implicit ($p = 0.01$) and (2.5) knowledge based on interpretation of local context ($p = 0.037$), after Bonferroni adjustments. The four highest ranking aspects of knowledge development served as guiding principles for instrument development.

Figure 4.3

Graphical overview of coaching values (above) and reflection values (below) and their co-occurrences



LEGEND

- The larger the text, the more often a value is mentioned.
- The lines connect the values mentioned together by the experts.
- The thicker the line, the more often the values were mentioned together.
- Line colors are a mix of the two label colors the line connects.

- Dispositions
- Frames
- Outcome orientations
- Activity and task structures
- Roles
- Conditions

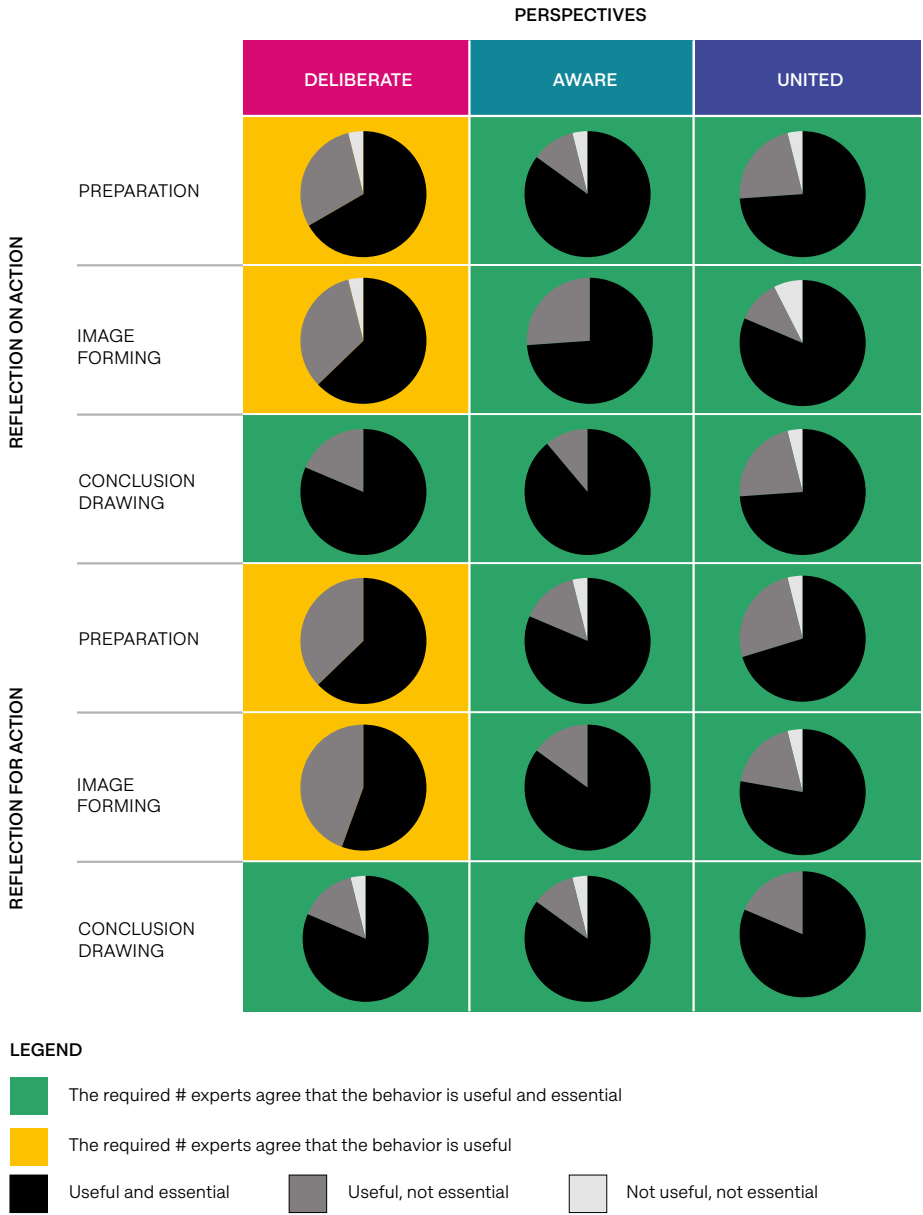
Figure 4.4
Knowledge Development Aspects



Note. Ranks are reversed, meaning that rank = 4 is the highest rank, and the rank = 1 is the lowest rank. N = 27.

The second part of the first research question asked what the important aspects of united teacher reflection are, according to experts. Table S4.1 shows the values used to calculate the agreement as described in the methods section. Experts agreed that each of the 18 reflection-on-action and reflection-for-action behaviors were at least useful for assessing the reflection type from the respective perspective, and 14 out of 18 behaviors were regarded as both useful and essential; see Figure 4.5. All reflection behaviors were regarded as useful for further consideration.

Figure 4.5
Essential Reflection Aspects



Note. $N = 27$. Total needed to agree item is useful and essential: $N_{critical} = 19$, Total $CVR_{critical} = .407$, $p = .026$, based on Ayre & Scally, 2014.

Lastly, experts were asked if supports for reflective talk should be assessed in a general instrument; the majority recommended doing so for materials and resources (MR; 74%) and participation and practices (PP; 82%). A majority of the experts were interested in both of these in the instrument, because including them supports the development of theoretical understanding (1.1). For example, Expert 22 stated, “Yes, I think this is also important. Noting the presence or absence (or quality) of these roles would be important to make inferences about how and why teachers benefit (or fail to benefit) from coaching reflections.” Consequently, experts advised linking MR and PP to practice (1.2). For example, Expert 17 stated, “Yes and these should be related to the reflective talks itself as materials themselves do not provide any evidence on teaching or teaching reflections.” MR and PP also shape coaching and reflection practices (2.1). For example, Expert 27 mentioned, “Yes, the materials and resources can function as central resources and triggers for further reflection and understandings of practice.” As such, experts recommended including information, training, and examples of how to use MR and PP (2.2). For example, Expert 8 mentioned that “It is useful to model the use of different practices because it helps and supports the users.” Finally, experts stressed that MR and PP are commonly part of coaching, and usage is influenced by the context (3.1). For example: Expert 6 said:

I think so: I ask the student on beforehand what part or aspect of the lesson we should pay special attention to. As an example, if this is the use of a hinge question, we use theoretical material, articles, to relate the actual behavior in the videoed lesson.

Therefore, experts recommended finding ways to design a flexible instrument (3.2), as shown in this quote from Expert 8: “I see that it would be good if an instrument is flexible and enables the use of many kinds of materials and resources, such as the use of technology.” Thus, the assessment of materials and resources as well as participation and practices should be further explored.

Design Choices Based on RQ1 Results

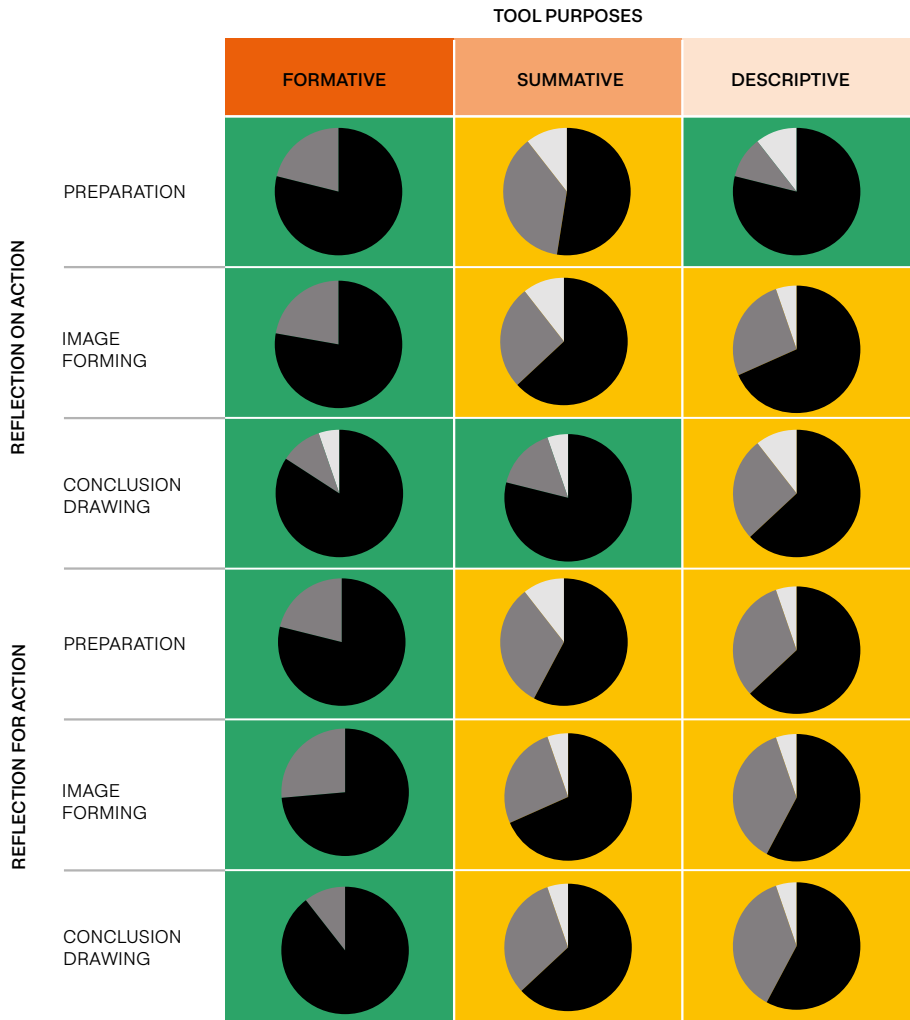
Given the results above, three decisions were made about developing the instrument. First, the four high-ranking knowledge aspects (highlighted in Figure 4.4) were deemed guiding principles. Second, an instrument would need to include most and could include all reflection behaviors (shown in Figure 4.5). And third, attention should be given to both materials and resources and participation and practices in the next round.

RQ2: Instrument Purposes and Related Aspects

Experts mentioned limited use of instruments to assess teachers' video-rich reflective talk; when instruments were mentioned, they referred to coding schemes to analyze reflective talk. Having answered the question of which aspects to include in the instrument, the next phase focused on how to attune them. The first part of RQ2 asked experts about the purposes an observation instrument should fulfil (formative, summative, or descriptive). The vast majority of experts (89%) indicated that there is a genuine need to create an observation instrument to assess teachers' reflection for formative purposes. By contrast, 63% indicated that a tool was needed for descriptive purposes and 47 % for summative purposes. The majority of respondents said that they would use such an observation instrument themselves. As for use by others, all but one expert thought that teacher coaches or teacher educators would use such an instrument; around half said that researchers would realistically use it. Across all purposes for use, two thirds of the experts thought that the instrument should devote equal attention to the four main knowledge development aspects. Therefore, attention to a formative purpose should be foregrounded.

The second part of RQ2 asked about important aspects of reflection to be included in an observation instrument intended for formative, summative, or descriptive purposes; an overview of the responses can be found in Figure 4.6 (for details, see Tables S4.2 and S4.4). Experts agreed that all reflection phases were at least useful, and were considered essential and useful in light of certain purposes. For *formative purposes*, experts agreed that all reflection on action and reflection for action phases were essential and useful. For *summative purposes*, experts agreed that only conclusion drawing was essential and useful for assessing reflection on action. For *descriptive purposes*, only preparation was considered essential and useful by experts for reflection on action. Therefore, all reflection phases should be included in a formative instrument.

Figure 4.6
Essential Reflection Aspects in Light of Tool Purposes



LEGEND

- The required # experts agree that the behavior is useful and essential
- The required # experts agree that the behavior is useful
- Useful and essential Useful, not essential Not useful, not essential

Note. $N = 19$. Total needed to agree phase is useful and essential: $N_{critical} = 14$, Total $CVR_{critical} = .474$, $p = .032$, based on Ayre & Scally, 2014.

In assessing reflection on action and reflection for action in general, the only support that was deemed essential and useful by 17 experts was the learner role (Tables S4.3 and S4.5). Since a maximum of two experts viewed each of the supports as not essential and not useful, the remaining supports can be regarded as useful, but not essential, for assessing reflection on action and reflection for action in general. Thus, the learner role should be included in an instrument.

Design Choices Based on RQ2 Results

Given the clear expert agreement, the decision was made to (initially) create an instrument for formative purposes. Further, it would include all reflection phases and the learner role (i.e., that of the teacher who is reflecting) was to be foregrounded in the design.

RQ3: Clarity of the Instrument Features

After the second round and before the third, potential instrument items were developed. Namely, 36 indicators were constructed to operationalize the choices made in the first and second rounds (12 indicators each for the deliberate, aware, and united perspectives). During the third round, 13 experts evaluated whether or not the indicators were clear enough to be used in an instrument. Experts agreed that all indicators were clear enough to be used (> 51% agreement on yes/ no evaluation). Specifically, the agreement varied between 69.2% and 100% (between 9 and 13 experts). An overview of the results is presented in Table 4.2, and results per indicator can be found in Table S4.6.

Table 4.2

Expert agreement on indicator clarity

Frequency ($N = 13$)	Percentage	Indicators
13	100%	D2, D5, D7, A3, A5, A8, A10, U6, U8, U9, U10, U12
12	92.3%	D4, D8, D10, D11, D12, A1, A6, A7, A9, A12, U3, U7
11	84.6%	D1, D3, D9, U1, U5
10	76.9%	D6, A2, A11, U2, U4, U11
9	69.2%	A4

Design Choices Based on RQ3 Results

All of the indicators were evaluated by the experts as clear enough to be used and can therefore be included in their current form. The indicators are shown in Figure 4.7 and Figure 4.8.

Figure 4.7
Indicators Deemed Clear Enough to be Used in an Instrument

		DELIBERATE PERSPECTIVE	UNITED PERSPECTIVE	AWARE PERSPECTIVE
		<p>Knowledge consists of commonly accepted truths within and across teaching domains that have been verified across context.</p> <p>Common knowledge serves as a lens for developing practice .</p>		<p>Knowledge is developed in practice, through planning, enactment or reflection activities.</p> <p>Knowledge is developed through interaction with others.</p>
In the video coaching conversation that you saw, the teacher was able to...				
Reflection ON action	Preparation	<p>identify the reflection goal and connect this to teaching effectiveness standards.</p> <p>recognize the relevant teaching behavior using teaching effectiveness standards.</p>	<p>specify the reflective goal based on the context and teaching effectiveness standards.</p> <p>describe the teaching behavior as well as the salient student behavior using context knowledge and teaching effectiveness standards.</p>	<p>specify the reflective question and connect this to the teaching context.</p> <p>recognize salient student behavior based on contextual knowledge.</p>
	Image forming	<p>interpret the teaching behavior based on teaching effectiveness standards and provide evidence to justify the claims.</p> <p>evaluate the alignment between teaching effectiveness standards and the teaching behavior.</p>	<p>interpret the teacher and student behavior using teaching effectiveness standards as well as contextual knowledge.</p> <p>evaluate the impact of teaching on student behavior using teaching effectiveness standards and what worked for whom, why and how in this context.</p>	<p>explain the student behavior using contextual knowledge and provide evidence to justify the claims.</p> <p>evaluate whether the student behavior is matching the learning expectations.</p>
	Conclusion drawing	<p>summarize the teaching behaviors from teaching effectiveness standards that were present.</p> <p>list potential growth areas related to teaching behaviors based on the comparison to teaching effectiveness standards.</p>	<p>summarize the evidence that showed that the teaching behavior had the envisioned effect on student behavior within this context and using teaching effectiveness standards.</p> <p>list potential growth areas related to the impact of teaching behavior on student behavior within this context and based on teaching effectiveness standards.</p>	<p>summarize the evidence that showed that students were learning and compare this to the lesson objectives.</p> <p>list potential growth areas related to student learning based on the lesson objectives.</p>

Figure 4.8

Indicators Deemed Clear Enough to be Used in an Instrument

	DELIBERATE PERSPECTIVE	UNITED PERSPECTIVE	AWARE PERSPECTIVE
	<p>Knowledge consists of commonly accepted truths within and across teaching domains that have been verified across context.</p> <p>Common knowledge serves as a lens for developing practice .</p>		<p>Knowledge is developed in practice, through planning, enactment or reflection activities.</p> <p>Knowledge is developed through interaction with others.</p>
In the video coaching conversation that you saw, the teacher was able to...			
Preparation	<p>identify the gap between current and desired teaching behavior and connect this to the teaching effectiveness standards.</p> <p>describe what the desired teaching behavior(s) might look like according to the teaching effectiveness standards.</p>	<p>specify the gap between current teaching performance and envisioned student outcomes within this context and using teaching effectiveness standards.</p> <p>describe the envisioned teaching performance using teaching effectiveness standards and difficulties that the students could encounter within this context.</p>	<p>identify the gap between the current and desired student behavior and connect this to the teaching context.</p> <p>describe difficulties that the students could encounter within this context</p>
	Image forming	<p>predict how changes in teaching behavior will contribute to student outcomes using the teaching effectiveness standards.</p> <p>determine what is needed to perform the envisioned teaching behaviors from the teaching effectiveness standards.</p>	<p>predict how the envisioned instructional responses from teaching effectiveness standards might support student learning within this context.</p> <p>determine what is needed to adapt the envisioned instructional responses to this context to support student outcomes.</p>
Conclusion drawing		<p>summarize which teaching behaviors from the teaching effectiveness standards are in reach and the needed support.</p> <p>conclude whether the plan closes the gap between current and desired teaching performance based on the teaching effectiveness standards.</p>	<p>summarize which teaching behaviors from the teaching effectiveness standards and student outcomes are in reach within this context and what support is available.</p> <p>conclude whether the adapted instructional response will close the gap between the current and desired student outcomes within this context.</p>

Discussion

This study set out to identify (rounds 1 and 2, mainly focusing on validity) and operationalize (round 3, focusing on clarity) key aspects of teacher reflection in the context of video-rich conversations. The results from the first round suggest that the united reflection model (van der Linden & McKenney, 2020) largely aligns with expert views on teacher reflection, and can serve as a foundation for observing video-rich reflective talk in general. This is promising, because there has been ambiguity on the concept of reflection in education settings due to the various theoretical stances (Clarà, 2015; Van Beveren et al., 2018). Experts identified framing, interpreting and conclusion-drawing processes as useful and mostly essential aspects of reflection viewed from the deliberate, aware, and united perspectives. Even though it previously has been argued that there is not sufficient evidence to conclude that reflection should be regarded as a sequential process (Clarà, 2015), the results do suggest that having a beginning, middle, and an end are important aspects of reflective talk, even when approached from various perspectives. The stance taken, that is, whether reflection is a descriptive/organic or prescriptive/structured process (Clarà, 2015; McKenney & Reeves, 2019) might influence how this is viewed, as spontaneous reflection is not as structured by nature. However, a structured reflection approach does not have to be linear. Hence, the process can still be dynamic, and it is in fact likely that teachers are going back and forth between the various behaviors during reflection (van der Linden & McKenney, 2020), for instance, by reframing reflection when new understandings are gathered that have sparked new questions.

In addition, experts identified four aspects of knowledge development that warrant particular attention in instrument development. For a deliberate perspective, knowledge consists of commonly accepted truths within and across teaching domains, and verified in various contexts (Carlson & Daehler, 2019), and this common knowledge serves as a lens for developing practice. Emphasis on these aspects signals the importance of the teaching effectiveness standards as a lens for making sense of one's own practices (van der Linden & McKenney, 2020). For an aware perspective, the emphasis on knowledge development through planning, enactment, and reflection (Carlson & Daehler, 2019) and that knowledge is developed through interaction (Brown et al., 1989; Lave & Wenger, 1991) signal explicit attention to the surroundings in which teaching takes place and one's own place in it. These findings are in line with the idea that there are many different sources that are used as evidence to inform teaching practices (Ferguson et al., 2012).

With regard to the results from the second round, experts strongly agreed that there is a genuine need for an instrument that serves formative purposes. This finding highlights the need for tools to improve teachers' reflective talk. As mentioned previously, we know of no standardized instruments available for this purpose. Experts agreed that all reflection phases were essential for assessing reflection with a formative purpose. This finding seems to align with understandings in the formative assessment literature of the type of information needed to make a formative judgement, such as data about the learner's procedural steps and/or cognitive processes (van der Kleij et al., 2015). In addition, more than half of the experts said that an instrument with a descriptive purpose was needed; this aligns with the need for a research instrument to investigate the relationships of reflection and (teacher) outcomes, as argued throughout this article and elsewhere (e.g., Van Beveren et al., 2018; van der Linden et al., 2021). With regard to descriptive purposes, this study showed that experts found all reflection phases useful, but only preparation was essential. The fact that most reflection phases were deemed useful can be understood through the various specific uses of descriptive instruments determined by the nature of the research. In some instances, the objective might be more exploratory and instruments might be used to discover what the reflective talk looks like, while in other instances, specific hypotheses might steer the research and the inclusion of all or some reflection aspects as detailed in this study.

With regard to the results from the third round, experts agreed that the all indicators developed as operationalization of the united reflection model were clear enough to be used in their current form. This operationalization is the first step in the development of a widely applicable instrument to be used to formatively assess teachers' video-rich conversations, which is currently not present in the scientific literature, to our knowledge. This framework complements the existing instruments that are focused on assessing reflective writing, developed by Nagro et al. (2017), Nagro (2020), and Ward and Cotter (2004), and provides a new addition to prevailing approaches for analyzing reflective talk that are mainly characterized by coding (e.g., Lee, 2005). As such, this framework consists of a first step in the development of more practical formative instruments that can be used to improve teachers' video-rich reflective talk that should be further explored in practice.

Limitations

As with any study, this one also has its limitations. First, the attrition during this study was quite high (losing 14 experts, 51.8%, between rounds 1 and 3), but this is not uncommon in Delphi studies. For example, Alake-Tuenter

et al. (2013) reported a difference of 23 respondents (69.7%) between rounds 1 and 3. The attrition can be explained by the long duration of these studies and the infrequent request for input in general, as well as the extra work pressures due to the COVID-19 pandemic. Second, it is recommended that participants in Delphi studies form an international group to include a variety of perspectives. The research expert group consisted of researchers from North America, Europe, and Asia, while the practitioner expert group consisted of participants working in the Netherlands only. Insofar as the views expressed in the study were not fundamentally different between the scientific and practitioner experts (see Tables S1-S5), it seems unlikely that the selection introduced bias into the data. However, it must be noted that experts working in South America, Australia, and Africa were not represented in this study. Finally, reliability is uncertain in Delphi studies, as there is no evidence on how consistent the results are when conducting a Delphi study with two similar panels (Hasson et al., 2000). In our case, the practical and scientific panels did not differ substantially, but replication studies with different respondents would be required to see if other panels would come to the same consensus.

Implications for Further Research, Practice, and Policy

This study points to important implications for further research, practice, and policy. Experts identified framing, interpreting, and conclusion-drawing processes as mostly essential aspects of deliberate, aware, and united forms of reflection on and for action, but understanding how these interact during reflective talk is still lacking. Developing insight into the interplay between these behaviors could support understanding about the way various teacher outcomes can be supported through reflection. In addition, this study showed a clear expert consensus regarding the need for an instrument with a formative purpose. This seemed like a promising approach, and the study resulted in a modest framework that can serve as a basis for the development of formative assessment tools for evaluating teacher video-rich reflection. More research is needed to understand what features should be included in such tools to add value, be clear and be compatible with the target user's practices. Moreover, this study holds implications for practice. Coaches and teacher educators who aim to improve video-rich reflection should pay attention to all phases of reflection (preparation, image forming, and conclusion drawing) and to the role of the learner, that is, the teacher who is reflecting. Finally, this study has implications for policy and the way funding is allocated. How to assess teachers' reflective talk in naturalistic settings with standardized instruments is an important direction for research that deserves attention, as this article aims to illustrate. Funding efforts in this direction could help to build under-

standing of what productive teacher reflective talk looks like, how this type of talk relates to other teacher outcomes, and how to support it.

Conclusion

This Delphi-inspired study gathered expert views on what constitutes important aspects of teacher reflection, as well as how to operationalize key aspects of reflective talk. The results of this study make two main contributions. First, the results show that experts deem framing, interpreting, and conclusion-drawing processes important when assessing reflection from the deliberate, aware, and united perspectives, and all phases of reflection were seen as essential and useful when observing reflective talk with a formative purpose. Second, the results provide the foundation for an initial observation instrument that can be used to improve teachers' video-rich reflective conversations. This is important because, to our knowledge, no standardized observation instruments on this topic have been reported in the scientific literature. This is surprising, because teacher reflection in teacher development settings often occurs in conversations with knowledgeable others (e.g., Gregory et al., 2014; Sherin & van Es, 2009; Taylor et al., 2017). The lack of instruments suggests a gap that should be addressed, and the need for a tool to improve teacher reflection was clearly expressed by the experts in this study. As such, the indicators developed (including their inherent focus on specific aspects of reflection) constitute a modest but useful framework that can be used by teacher educators and coaches to better support teachers during video-rich reflection.

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Table S4.1

Useful and Essential Reflection Aspects

		Expert agreement that a reflection behavior is essential and useful to assess reflection (frequency)		
		RE	PE	TE
Deliberate reflection on action	Preparation: Teachers look back on their own existing teaching practices and identify behaviors that align with evidence-based norms.	9	9	18
	Image forming: Teachers use collective knowledge on effective teaching behaviors to interpret their own existing practices.	9	8	17
	Conclusion drawing: Teachers interpret their performance in reference to evidence-based norms to gain insight into implications for their own practice.	10	12	22*
Aware reflection on action	Preparation: Teachers look back on their own existing teaching practices and identify salient moments in the classroom.	9	14	23*
	Image forming: Teachers use knowledge about their classroom and school contexts and their place in it to make sense of their existing practices.	10	10	20*
	Conclusion drawing: Teachers interpret salient moments to gain insight into implications for their own practice.	11	13	24*
United reflection on action	Preparation: Teachers use both perspectives to frame their existing practices.	7	13	20*
	Image forming: Teachers use both perspectives to make sense of their existing practices.	9	13	22*
	Conclusion drawing: Teachers compare findings from both perspectives during the consideration of their existing practices to gain insight into implications for their own practice.	10	10	20*
Deliberate reflection for action	Preparation: Teachers use an explicit frame of reference to look forward to their own future teaching practices.	9	8	17
	Image forming: Teachers generate evidence-based ideas to support their potential future teaching practices.	10	5	15
	Conclusion drawing: Teachers anticipate how performance could be improved, and consider the implications for their own future teaching practices.	11	11	22*
Aware reflection for action	Preparation: Teachers use salient moments in practice in looking forward to their own future teaching practices.	8	14	22*
	Image forming: Teachers generate potential solutions to support their own future teaching practices, based on their contexts.	10	13	23*
	Conclusion drawing: Teachers decide how implementation should be improved, and consider the implications for their own future teaching practices.	10	13	23*
United reflection for action	Preparation: Teachers use both perspectives to guide the framing of their future practices.	9	10	19*
	Image forming: Teachers use both perspectives to consider potential future practices.	10	11	21*
	Conclusion drawing: Teachers compare and contrast their conclusions about future practices from both perspectives.	11	11	22*

Note. *Sufficient number of experts agree that the behavior is useful and essential. RE = research experts, PE = practitioner experts, TE = total experts. $n_{RE} = 12$, $n_{PE} = 15$, $N = 27$. Total needed to agree item is useful and essential: $N_{critical} = 19$, Total $CVR_{critical} = .407$, $p = .026$, based on Ayre & Scally, 2014.

Table S4.2

Useful and Essential Reflection on Action Aspects in Light of Instrument Purposes

	Expert agreement that reflection phase is essential and useful in light of instrument purposes (frequency)								
	Formative			Summative			Descriptive		
	RE	PE	Total	RE	PE	Total	RE	PE	Total
Preparation phase: Coachees detail the reflective question and collect facts related to it from recent practice.	6	9	15*	4	6	10	8	7	15*
Image forming phase: Coachees investigate the phenomena identified during the preparation phase to interpret the recent teaching situation. **	6	8	14*	7	5	12	6	7	13
Conclusion drawing phase: Coachees contrast their findings from image forming and consider the implications for practice.	8	8	16*	7	8	15*	6	6	12

Note. *Sufficient number of experts agree that the phase is useful and essential. RE = research experts, PE = practitioner expert, TE = total experts. $n_{RE} = 9, n_{PE} = 10, N = 19$. Total needed to agree phase is useful and essential: $N_{critical} = 14$, Total $CVR_{critical} = .474, p = .032$, based on Ayre & Scally, 2014. **One response is missing.

Table S4.3

Useful and Essential Supports for Reflection on Action

		Expert agreement that support is essential and useful for reflection on action (frequency)		
		RE	PE	Total
Materials and resources	Artifacts of practice	7	6	13
	Priming tools	5	3	8
	Examples of practice	4	3	7
Participation and practices	Facilitator role	7	6	13
	Coordinator role	2	2	4
	Curator role	3	1	4
	Learner role	8	9	17*

Note. *Sufficient number of experts agree that the support is useful and essential. RE = research experts, PE = practitioner experts, TE = total experts. $n_{RE} = 9, n_{PE} = 10, N = 19$. Total needed to agree item is useful and essential: $N_{critical} = 14$, Total $CVR_{critical} = .474, p = .032$, based on Ayre & Scally, 2014.

Table S4.4

Useful and Essential Reflection for Action Aspects in Light of Instrument Purposes

	Expert agreement that reflection phase is essential and useful in light of instrument purposes (frequency)								
	Formative			Summative			Descriptive		
	RE	PE	Total	RE	PE	Total	RE	PE	Total
Preparation phase: Coachees detail the reflective question and look forward to future practices.	8	7	15*	6	5	11	7	5	12
Image forming phase: Coachees investigate the phenomena identified during the preparation phase to anticipate the future teaching situation.	7	7	14*	8	5	13	6	5	11
Conclusion drawing phase: Coachees contrast their findings from image forming and consider the implications for practice.	7	10	17*	4	8	12	5	6	11

Note. *Sufficient number of experts agree that the phase is useful and essential. RE = research experts, PE = practitioner experts, TE = total experts. $n_{RE} = 9, n_{PE} = 10, N = 19$. Total needed to agree phase is useful and essential: $N_{critical} = 14$, Total CVR $_{critical} = .474, p = .052$, based on Ayre & Scally, 2014.

Table S4.5

Useful and Essential Supports for Reflection for Action

		Expert agreement that support is essential and useful for reflection for action (frequency)		
		RE	PE	Total
Materials and resources	Artifacts of practice	7	3	10
	Priming tools	5	6	11
	Examples of practice	7	4	11
Participation and practices	Facilitator role	7	6	13
	Coordinator role	4	2	6
	Curator role	2	3	5
	Learner role	8	9	17*

Note. *Sufficient number of experts agree that the support is useful and essential. RE = research experts, PE = practitioner experts, TE = total experts. $n_{RE} = 9, n_{PE} = 10, N = 19$. Total needed experts to item is useful and essential: $N_{critical} = 14$, Total CVR $_{critical} = .474, p = .052$, based on Ayre & Scally, 2014.

Table S4.6

Indicators that are Clear Enough to be Used

			Indicator is clear enough	
			Total	%
Deliberate reflection on action	D1	identify the reflection goal and connect this to teaching effectiveness standards.	11	84.6
	D2	recognize the relevant teaching behavior using teaching effectiveness standards.	13	100
	D3	interpret the teaching behavior based on teaching effectiveness standards and provide evidence to justify the claims.	11	84.6
	D4	evaluate the alignment between teaching effectiveness standards and the teaching behavior.	12	92.3
	D5	summarize the teaching behaviors from teaching effectiveness standards that were present.	13	100
	D6	list potential growth areas related to teaching behaviors based on the comparison to teaching effectiveness standards.	10	76.9
Deliberate reflection for action	D7	identify the gap between current and desired teaching behavior and connect this to the teaching effectiveness standards.	13	100
	D8	describe what the desired teaching behavior(s) might look like according to the teaching effectiveness standards.	12	92.3
	D9	predict how changes in teaching behavior will contribute to student outcomes using the teaching effectiveness standards.	11	84.6
	D10	determine what is needed to perform the envisioned teaching behaviors from the teaching effectiveness standards.	12	92.3
	D11	summarize which teaching behaviors from the teaching effectiveness standards are in reach and the needed support.	12	92.3
	D12	conclude whether the plan closes the gap between current and desired teaching performance based on the teaching effectiveness standards.	12	92.3
Aware reflection on action	A1	specify the reflective question and connect this to the teaching context.	12	92.3
	A2	recognize salient student behavior based on contextual knowledge.	10	76.9
	A3	explain the student behavior using contextual knowledge and provide evidence to justify the claims.	13	100
	A4	evaluate whether the student behavior is matching the learning expectations.	9	69.2
	A5	summarize the evidence that showed that students were learning and compare this to the lesson objectives.	13	100
	A6	list potential growth areas related to student learning based on the lesson objectives.	12	92.3

Aware reflection for action	A7	identify the gap between the current and desired student behavior and connect this to the teaching context.	12	92.3
	A8	describe difficulties that the students could encounter within this context	13	100
	A9	predict how instruction could support student learning within this context.	12	92.3
	A10	determine what is needed to implement instruction to support student outcomes within this context.	13	100
	A11	summarize which responses to support student outcomes are in reach within this context and what support is available.	10	76.9
	A12	conclude whether the plan will close the gap between the current and desired student outcomes within this context.	12	92.3
United reflection on action	U1	specify the reflective goal based on the context and teaching effectiveness standards.	11	84.6
	U2	describe the teaching behavior as well as the salient student behavior using context knowledge and teaching effectiveness standards.	10	76.9
	U3	interpret the teacher and student behavior using teaching effectiveness standards as well as contextual knowledge.	12	92.3
	U4	evaluate the impact of teaching on student behavior using teaching effectiveness standards and what worked for whom, why and how in this context.	10	76.9
	U5	summarize the evidence that showed that the teaching behavior had the envisioned effect on student behavior within this context and using teaching effectiveness standards.	11	84.6
	U6	list potential growth areas related to the impact of teaching behavior on student behavior within this context and based on teaching effectiveness standards.	13	100
United reflection for action	U7	specify the gap between current teaching performance and envisioned student outcomes within this context and using teaching effectiveness standards.	12	92.3
	U8	describe the envisioned teaching performance using teaching effectiveness standards and difficulties that the students could encounter within this context.	13	100
	U9	predict how the envisioned instructional responses from teaching effectiveness standards might support student learning within this context.	13	100
	U10	determine what is needed to adapt the envisioned instructional responses to this context to support student outcomes.	13	100
	U11	summarize which teaching behaviors from the teaching effectiveness standards and student outcomes are in reach within this context and what support is available.	10	76.9
	U12	conclude whether the adapted instructional response will close the gap between the current and desired student outcomes within this context.	13	100

Chapter 5

Evaluation

This chapter is based on:

van der Linden, S., Papadopoulos, P., Nieveen, N., & McKenney, S.
(under review). Computer-Supported Formative Assessment of Teacher
Reflection in Video Coaching Settings: A Proof-of-Concept Study.

Abstract

Video coaching appears to be a promising approach for teachers' professional development, but is not automatically productive. To our knowledge, there are few tools available to guide teachers' reflective conversations during video coaching, and none to formatively assess the quality of those talks. Such a tool is needed to help coaches realize the potential of reflective video-coaching conversations. Key features of a minimally viable prototype were explored through a mixed-methods proof-of-concept study, focusing on (user perception of) four major factors, namely added value, compatibility, clarity, and tolerance. A total of 17 participants from Europe, North America, and Asia with insight into teachers' reflective practices gained through research, coaching expertise, or experience as teacher educators participated in an online study. Data were collected through think-aloud protocols, interviews, surveys, and use logs. Findings showed modest, yet concrete evidence that the tool would be viable and is worth developing further. First, users indicated that it could add value in terms of development of coaching practices and calibration that outweighed the associated costs. Second, the tool was deemed compatible with existing or arising needs for improving reflective conversations, though respondents pointed out that attention should be paid to differences between users, and to strengthening familiarization opportunities. Third, seven sub-factors were identified that need to be explained in order to increase the tool's clarity. Finally, the tool appeared tolerant of various modalities of use, but needs to adhere tightly to supporting reasoning processes related to the nature of the reflective conversations. Together, the results yield quality criteria that can be used for development and evaluation of this and other tools supporting formative assessment of reflective video coaching conversations.

Introduction

Computer use has a longstanding tradition in teacher video coaching, but there appears to be a lack of tools to support formative assessment of teacher reflection in video coaching settings. While there is a myriad of technologies available to support formative assessment of student learning or behavior (e.g., Faber et al., 2017; van Leeuwen & Rummel, 2020), technology-supported formative assessment of teacher reflection in video coaching settings has not been adequately discussed in high-impact educational technology journals in recent years, to our knowledge. Video coaching is a professional development approach in which teachers and their coaches record instances of classroom practice and engage in video-rich discussions in a sustained manner (van der Linden & McKenney, 2020). While accumulating evidence has suggested that video, together with coaching, can be a promising approach for supporting teacher development (Gaudin & Chaliès, 2015; Kraft et al., 2018; van der Linden, et al., 2021), it has also become apparent that watching a video does not automatically lead to productive reflection (e.g., Sherin & van Es, 2009). Tools that offer coaches guidance on how to improve teachers' reflective conversations in video coaching settings (i.e., with a formative purpose) are genuinely needed (van der Linden et al., (submitted)), and the present lack of such technologies is indeed surprising.

Coaches (in schools and teacher education settings) need insight into what productive reflection looks like and how to improve it. Teacher reflection is an important component of professional development (Darling-Hammond et al., 2017), and an important process during video coaching (van der Linden et al., 2021). Reflection is the careful consideration of actions, of how one has come to know what is known, and of the implications these insights hold (Dewey, 1933). For teachers, it can be focused on past teaching experiences, that is reflection *on* action (Schön, 1983), or future teaching experiences, that is reflection *for* action (van der Linden & McKenney, 2020). During reflection on action, teachers do not always focus on important aspects of practice (Sherin & van Es, 2009), and need a "knowledgeable other" to help them focus on teaching and learning processes (Gefulso & Dennis, 2014). In a similar vein, during reflection for action teachers tend to focus on practical rather than substantive issues (Voogt et al., 2016). The coaching role (knowledgeable other) can be fulfilled by different people depending on the context (e.g., teacher educators, or teacher leaders such as facilitators, coaches, and trainers). While research offers some guidance in terms of facilitator moves and frameworks for supporting teachers' learning (Coles, 2013; Tekkumru-Kisa & Stein, 2017;

van Es et al., 2014), tools that support coaches in identifying (un)productive aspects of reflection and offer advice on how to improve its quality, do not appear in the scientific literature. Consequently, this study fills that gap by exploring the potential of technology for supporting formative assessment of teacher reflection in video coaching settings, through a proof-of-concept study.

Concept: Computer-supported Formative Assessment of Teacher Reflection

Previous research has articulated critical aspects and phases of reflection (van der Linden & McKenney, 2020). Reflection can be approached from a more deliberate perspective, where common knowledge of teaching is used as a frame of reference to develop practices, or a more aware perspective, where knowledge is developed within practice through reflection, enactment, or planning and in interactions with others. Uniting these perspectives can support understandings of what works, when and why (van der Linden & McKenney, 2020; Witherspoon et al., 2021). Next to reflection types, that is reflection on and for action, reflection can be split into phases, namely, preparation, image forming, and conclusion drawing (Reymen et al., 2006).

Technology may well support coaches in attending to these aspects and phases of teacher reflection through formative assessment. During formative assessment, evidence is gathered and used to guide learning (Schildkamp et al., 2020). Three types of evidence are emphasized to support learning, namely information to help understand (1) where one is now, (2) where one wants to go, and (3) how to get there (Hattie & Timperley, 2007). Technology can support gathering this type of information regarding teachers' reflective talk. First, technology could potentially support coaches by helping them to identify what important aspects of reflection are (not yet) present in the conversation. Video technology can be leveraged to make recordings of reflective conversations (instead of the classroom), and thus capture evidence of the current situation. Second, technology can provide an environment to easily compare the current situation, that is, a video of the reflective conversation, to the desired situation, which can be operationalized through an observation framework. This observation framework can illustrate what productive reflection looks like and what elements should ideally be present. Third, technology can also offer programmed advice on how to improve the next video coaching conversation, based on the observation scores provided. A tool that provides these types of supports could help with identifying and improving teacher reflection in video coaching settings.

Proof-of-concept: Viability

While proof-of-concept studies generally aim to explore the potential of an idea or product, the goals and methods of such studies are highly varied (Kendig, 2016). The present study explores the viability of computer-supported formative assessment of teacher reflection. Even though (new) tools can very well be implemented on a limited scale in specific user settings, research on educational design is grounded in the question as to whether such a tool could be used by other user groups (McKenney & Reeves, 2019), and to develop knowledge about “what works when, how, and for whom” (Penuel et al., 2011, p. 335). Thus, attention should be paid to implementation and spread early on (McKenney & Reeves, 2019), as even effective designs are difficult to scale up (Penuel et al., 2011). Designs do not scale up for various reasons, for instance, because they utilize emerging technologies or theories and insufficient attention has been paid to how the design would be used in practice (McKenney et al., in press). Implementation problems can arise through changes made by coaches that can influence effectiveness (cf. Berman & McLaughlin, 1975, in Penuel et al., 2011), or because the characteristics of the contexts where a design is implemented differ greatly (McLaughlin, 1987, in Penuel et al., 2011). Thus, during investigations of viability, attention should be paid to implementation. Four factors concerning the attributes of a tool play important roles in the success of its implementation: perceived added value, compatibility, clarity, and tolerance (McKenney & Reeves, 2019), which will be discussed in more detail hereafter.

Added Value

First, it is necessary to understand whether and in what way a tool for formative assessment of teachers' reflection could *add value* to existing coaching practices, because this will influence its implementation success (cf. McKenney & Reeves, 2019). It goes without saying that if a tool does not have the potential to add value, then there is no reason to explore the concept further. Kirschner (2019) defined three criteria for adding value, namely, in terms of effectiveness (learning), efficiency (learning with less time or less effort), and enjoyability (self-efficacy and feelings of accomplishment). Whether a tool is perceived to add value depends on whether the associated costs are acceptable (Doyle & Ponder, 1978) compared to its benefits (Rogers, 2003). A formative assessment tool could add value in terms of effectiveness by providing information that helps coaches to identify aspects of reflection that are present, show coaches what productive reflection looks like, and provide guidance on how to close the gap between the current and desired level of reflection. In addition, a tool could add value in terms of efficiency by making it

easier or less time-consuming to formatively assess coaching conversations, for example, by providing a structure. Finally, a tool could add value by increasing the enjoyability of the formative assessment task, for instance, by helping coaches to build up their self-confidence to formatively assess the qualities of reflective conversations in video coaching contexts.

Compatibility

Second, understanding is needed regarding the aspects that could influence the *compatibility* of a tool with existing contexts. This is important because the extent to which a tool for formative assessment of teacher reflection is perceived to be *compatible* with the needs and context where it is implemented will influence the success of its implementation (cf. McKenney & Reeves, 2019). Users might be especially quick to resist a tool when they feel that its design does not meet their needs or is not aligned to their specific context (McKenney & Reeves, 2019). Compatibility focuses attention on where a design is implemented and for whom, and what considerations are important for both. Thus, understanding what types of needs provide a suitable situation for implementation of such a tool could be helpful in planning for use in practice.

Clarity

Third, insight is needed into what aspects of *clarity* can influence understanding of the formative assessment task that is laid out by the tool. The extent to which coaches can clearly see their involvement with a tool could influence the success of its implementation (McKenney & Reeves, 2019). Involvement means that users understand the purpose of the tool and understand how to execute the tasks that the tool lays out for them. Thus, explorations of clarity are needed to understand what information needs to be made explicit for users to be able to formatively assess a reflective conversation between a teacher and a coach with a tool designed for that purpose. For instance, the factors that can influence clarity related to the identification and judgment of productive aspects of reflective conversations between a teacher and a coach are currently not clear, nor what additional information would be needed to support such understanding.

Tolerance

Finally, the *tolerance* of a tool to formatively assess teachers' reflective talk needs to be explored. Tolerance is the ability of a tool to remain true to its goal notwithstanding adaptations in its use, and thus will influence implementation and spread (McKenney & Reeves, 2019). When a tool is used in practice, variations in enactment will arise over time (McKenney, 2013). Designs that

allow for variations in enactment while staying true to their goals are highly tolerant, whereas designs that require the design to be enacted in a way that is very close to the designers' original intentions have low tolerance (McKenney & Reeves, 2019). For viability purposes, it is not desirable that a tool have low tolerance overall, because that would mean that implementation across contexts would be likely to cause difficulties. Scholars have argued that to scale professional development productively, a combination is needed, where on the one hand, the enactment needs to be close to the tool's theory of action, but on the other hand, variation in enactment to meet contextual needs and constraints must be possible; this is called a tight-but-loose framework (Thompson & Wiliam, 2008). During this proof-of-concept study, it is worthwhile to explore how coaches (would want to) use a tool for formative assessment of teacher reflection in their contexts, because this can help to develop understanding of when the design needs to be enacted as intended (i.e., there is a higher risk of changes that do not meet the goal), and when there can be variation (i.e., there is a lower risk of changes that do not meet the goal). The clarity of the tool can also influence its tolerance, because if users understand what is expected, then it is less likely that changes will be made that do not align with the tool's intended uses (McKenney & Reeves, 2019). Consequently, insight is needed into the (envisioned) enactment of formative assessment with a tool, in order to be able to predict when changes will be made in practice, and to plan for those accordingly.

Research aim and questions

Based on the above, it can be gathered that video coaching is a promising approach for teachers' professional development, but there are no tools available to guide the formative assessment of teachers' reflective conversations in video-coaching contexts. Such tools are needed to help coaches (learn to) identify (un)productive aspects of reflection, and can provide guidance on how to close the gap between the current and desired quality of the reflective conversations. In order to gain insight into the potential of such a tool, the viability of a prototype was explored. This study was guided by the following research question:

RQ: What factors influence the perceived viability of a tool for coaches to formatively assess teacher reflection, in terms of (RQ1) added value, (RQ2) compatibility, (RQ3) clarity, and (RQ4) tolerance?

Material and Methods

Study Design

A mixed-methods proof-of-concept study was conducted, using a minimally viable prototype of a web-based reflective teacher coaching performance support tool. This study aimed to explore the potential viability of such a tool to ascertain the potential of the concept, taking the four viability factors into account. An exploratory approach was taken to identify important factors that could influence how successfully the prospective tool is implemented. A comparative approach was applied to understand what participants currently did to improve teachers' reflection (i.e., 'business as usual'), and in what way the tool could add value, if any. Qualitative data were foregrounded in this study to provide a rich understanding of the topic under investigation and integrated, where applicable, with quantitative data. As described subsequently, data from multiple sources and participants were triangulated to enhance the trustworthiness of the findings.

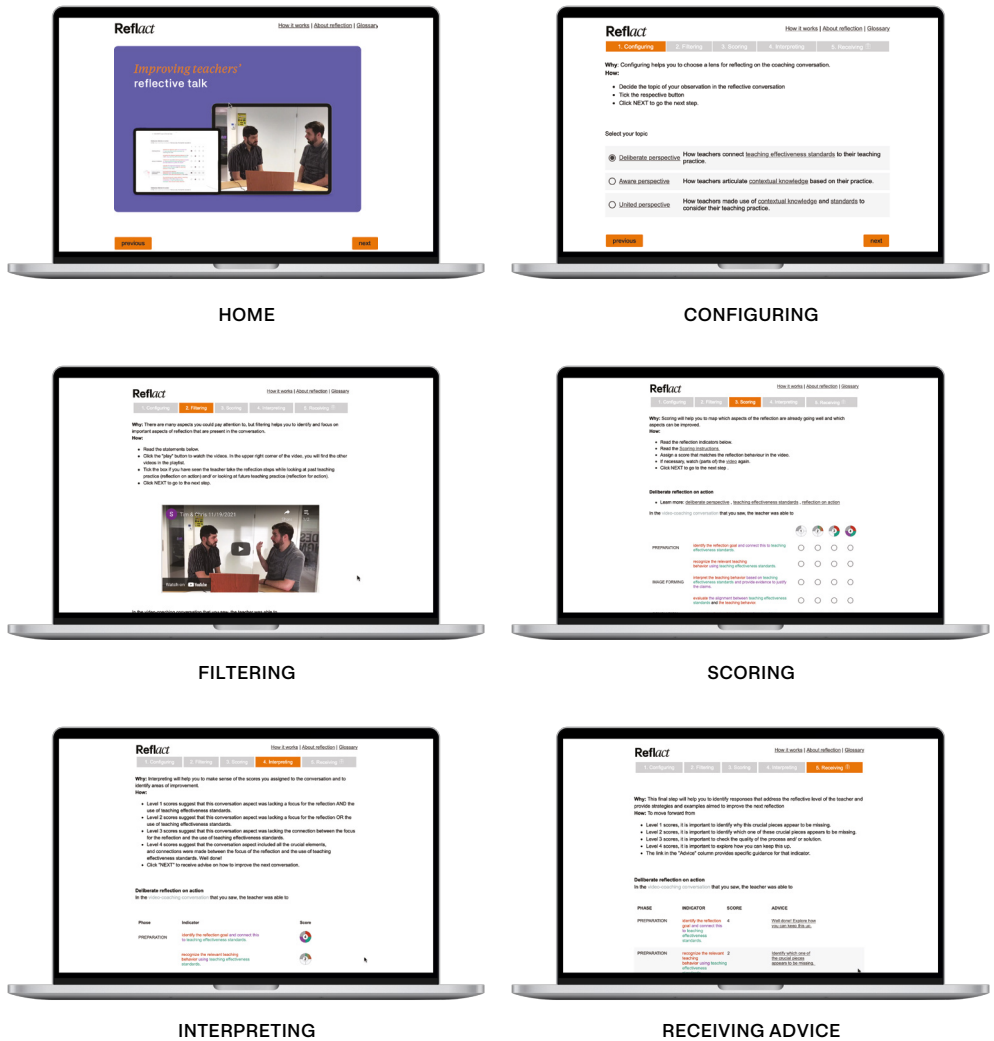
Participants

A total of 17 participants (6 male, 11 female) from North-America, Europe, and Asia with various insights into coaching teachers, who were from 14 different organizations (university, polytechnic, and secondary education) were purposefully selected for the study. These participants were selected because they have insight into the environments where teachers' reflective conversations take place, either through their research activities (based on relevant teacher reflection publication history), expertise facilitating teacher reflection in practice (5-26 years of experience), or experience through their work as teacher educators. Their backgrounds made them able to reflect on the potential of this tool based on their own experience of coaching teachers, or based on their knowledge about situations where teacher reflection takes place, or both. All of these were considered relevant for investigating factors that could influence the potential viability of the tool to support formative assessment of teacher reflection. When quotes are given in the results section, participants are numbered P1-P17.

Formative Assessment Tool for Teacher Reflection: ReflAct

ReflAct is the name of the English formative assessment tool for teacher reflection used in this study. ReflAct is a prototype web-based performance support tool that helps teacher reflection coaches gain understanding of the current situation, the desired situation, and how to close the gap between those two. As shown in Figure 5.1, the web-based tool consists of a home page and five task pages, namely, configuring, filtering, scoring, interpreting, and receiving (advice). Larger images of the screens are provided in the appendix (Figure S5.1 – S5.3). On the *configuring* page, coaches select their lens for formatively assessing the reflective conversation (e.g., deliberate, aware, united). On the *filtering* page, coaches watch video clips of a coaching conversation and select what phases of reflection they have noticed per reflection type (i.e., reflection on action and reflection for action) by checking the respective boxes. Based on their selection, the corresponding reflection indicators are displayed on the *scoring* page, illustrating the desired situation during those phases. There, coaches can score the quality of the reflection indicators as seen in the video of the coaching conversation, using the scoring information. There is also the option to replay the video. On the *interpreting* page, an overview of the assigned scores is displayed along with information on how to interpret each of the scores, and what important aspects of reflection were missing, illustrating the current situation. Finally, on the *receiving* (advice) page, the assigned scores are displayed again alongside pre-entered advice based on assigned scores, meaning that different advice is given per reflection phase and per score, providing the means to close the gap between the current and desired situation.

Figure 5.1
ReflAct Tool



Data Collection Procedures and Instruments

The participants took part in an online study via Microsoft Teams that was recorded on video, after providing informed consent. Before and after their tool use, the participants answered semi-structured interview and survey questions. Before the use of the tool (ReflAct), *interview* questions focused on understanding their business-as-usual practices regarding current formative assessment. An example question included: "Can you describe one important thing you are doing to improve the future reflective conversations of teach-

ers in your regular practice?” A business-as-usual situation was included to explore how the tool can add value to existing practices. Afterwards, questions were directed towards understanding sub-factors influencing added value, compatibility, clarity, and tolerance. For the last, an example question included: (thinking about use in your context) “Are there aspects of the tool that were especially unpractical or practical?” The questionnaire was completed before and after the use of the tool; participants first rated their efficiency (i.e., time and effort) and enjoyability (i.e., enjoyment and confidence) on a scale from 1 (low) to 5 (high) formatively assessing reflection in their business-as-usual. After using ReflAct, participants were given the ratings from their business-as-usual and were asked to rate the efficiency and enjoyability of the tool, keeping the scores from their business as usual in mind. During ReflAct use, participants were asked to share their screen and were instructed to *think aloud* and share comments and questions, using the tool with a specific scenario in mind: as if they had just completed a video-rich coaching conversation with a teacher and were formatively assessing this particular talk. At the end, participants had the opportunity to share remaining comments and questions regarding the study. The *use log* recorded all choices that the participants made during the use of the tool, and was inspected only to verify the results of the think-aloud protocol and interview. Figure 5.2 presents an overview of the data collection methods, related viability factors, and triangulation.

Figure 5.2
Data collection methods and related viability factors

	Added value	Compatibility	Tolerance	Clarity
Questionnaire				
Use log				
Think aloud				
Interview				

	Primary data source
	Secondary data source
	Verification data source

Data Analysis

Data analysis was first focused on exploring participants’ business as usual and on identifying sub-factors influencing added value, compatibility,

clarity, and tolerance. The participants were analyzed as one group, because the goal was to identify sub-factors that influence viability of implementation across contexts, and the limited number of participants did not reasonably allow for groupwise comparisons. To prepare the qualitative data, the think-aloud and the interview recordings were transcribed using Amberscript transcription software, exported to Word, and then all Word files were imported into Atlas.Ti. Think-aloud and interview transcripts were segmented per speaker turn and topic. During the first round of inductive coding, segments were coded using in vivo and evaluation coding (Miles et al., 2020). In vivo coding was used as an overall approach to understand how participants described their business-as-usual practices and perceptions regarding ReflAct by staying close to the data in the coding. Segments could be given multiple codes if multiple topics were present. Evaluation coding was then used to understand how participants attributed value to the tool, such that a "+" signaled a positive evaluation, whereas a "-" signaled a negative evaluation; these were added to the in vivo codes. During the second round of coding, after coding approximately half of the data saturation started to occur, and the initial in vivo codes were grouped into sub-factors, and descriptions were created based on the data. If new sub-factors emerged, then codes for them were added along the way. These were discussed within the research team to fine-tune the codes for the sub-factors and descriptions; see Table S5.1 for an example of a description of a sub-factor with supporting quotations. To be included in the analysis, the codes had to occur across at least three different participants, for triangulation purposes. To establish consistency in the coding process, half of the coded data was reviewed by different coders, and differences were discussed until 100% agreement was reached. For instance, for the code regarding "scoring" clarity, it was decided that only quotations that referenced specific issues were included, and not quotations that required higher-level inference, that is, interpretation from the coder. During these discussions, the codebook was refined, and changes made were discussed within the research team. Then the whole set of data sources was coded using the finalized codebook.

To gain insight into whether and how particular sub-factors are related to each other (e.g., sub-factors of clarity and tolerance) and to ReflAct (e.g., places where clarity is needed), data visualizations were used to explore the relationships between sub-factors through co-occurrences. Sub-factors were first mapped onto the different pages of the tool, and co-occurrences between sub-factors were explored using matrix tables. Co-occurrences of sub-factors were counted once per participant; to enhance the credibility of the results, triangulation was sought by only including co-occurrences in the analysis that were reported across a minimum of three respondents. The quantitative data from the questionnaires were explored for potential added value of this tool

with regard to efficiency (i.e., time and effort, which are negative indicators of efficiency when rated higher than business-as-usual) and enjoyment (i.e., enjoyment and confidence). The business-as-usual ratings were compared to the ReflAct ratings to determine if a tool would add value, that is save time and effort (efficiency), and/or increase enjoyment and/or confidence (enjoyability), or at least does not negatively impact these as compared to business-as-usual. In the results section, the most salient findings (i.e., for which the most evidence was found across respondents) are reported, and quotes are given to illustrate the findings.

Results

In this section, the potential viability of ReflAct for formatively assessing teachers' video-rich reflection is described. It was found that the tool could add value in terms of development and calibration that could outweigh the associated costs (i.e., effort). In addition, participants felt that it was compatible through contextual alignment, that is, by fulfilling an existing or arising need to improve reflective conversations, but that attention should be paid to differences between users, and opportunities for familiarization should be included. Further, seven sub-factors were identified that need to be explained in ReflAct to support understanding. Finally, the tool appeared tolerant of various modalities of use, but needs to be tight when it comes to reasoning processes based on the reflective conversations. An overview of the identified subfactors is provided in Tables 1 - 4, which will be described in more detail in the text thereafter.

RQ1: Added value

The descriptions of participants' business-as-usual practices illustrated attention to improving reflection during coaching itself, and somewhat during preparation, but less so after the reflective conversation, and none of the participants reported using tools to formatively assess the reflective conversations of teachers. Most respondents mentioned taking a united perspective, meaning that they pay attention to common knowledge about effective teaching and its integration with contextual knowledge during teachers' reflective practices. In addition, reflection opportunities were said to be included in education, training, or internship programs; these can be individual or collaborative, and are focused on practice. Moreover, most participants reported that

reflection is facilitated through providing questions or feedback. In addition, respondents mentioned that they prepare for the reflection by framing or providing input. Finally, a few respondents mentioned that they formatively assess coaching conversations, where they gather information to understand and improve their practices during or sometimes after the conversation took place. In some instances, it was mentioned that this occurs when there has been a negative experience and information is needed to improve these practices. However, use of tools to do this was not reported. It is also worth noting that some respondents mentioned that they do not specifically pay attention to the improvement of teachers' reflective talk.

To support the formative assessment of teachers' reflection, ReflAct could add value that would outweigh its associated costs, and an overview of the sub-factors influencing added value is provided in Table 5.1.

Table 5.1
Added Value

Added Value Sub-Factors		
Effectiveness	Efficiency	Enjoyment
Development	Effort	Enjoyment
Calibration	Return of investment	Confidence
Mirroring	Time	
Advising		

First, participants mentioned four sub-factors through which the formative assessment tool for teacher reflection could add value in terms of effectiveness. ReflAct could support *development*, meaning that it could lead to improvements in coaching practices. Respondent P14 mentioned regarding *development*: "I think that [it] can give a lot of insight and indeed it can greatly improve the reflective conversation that you have with the students." In addition, the tool could help to *calibrate* practices, by offering an explicit framework to help align practices to standards and/or could help to align team efforts:

What I often notice in myself, in colleagues too, is something like: yes, I [think I] do it right and then calibrating with each other, talking about that is very, very useful. But such a tool as this, I give that a lot of direction and framework for how you approach it and how you do not tackle [these tasks]. Yes, I think it could help me a lot to be alone, but also to look with colleagues at how do we actually do that? These kinds of coaching conversations. (P1)

Mirroring, meaning that the tool provides insight into the current state of teachers' reflection, could also be valuable: "Yes, what [aspects of reflection] do you have to look at and how can you then mirror your own actions to what is in it and what is not yet in it" (P1). In addition, participants mentioned the value of receiving *advice*, that is, guidance on how to improve the current state of teachers' reflection: "So I think that here that the advice boxes are really, really good and useful. ...I think that these are questions to consider are really good. So that they are presented, so they advise you further" (P17). These last two functions were mentioned during the interpretation and receiving phases of the tool, and first during their reflection on their use of the tool.

Inspection of co-occurrences revealed a number of potential relationships regarding the added value of ReflAct. Participants mentioned that *development* can occur in various ways. It could be a result of *calibration*:

And also in collaboration with colleagues. Yes, how we judge things and how we handle those conversations. These are all different aspects for which you would in principle expect different tools to be needed. But I think this tool can practically have value in all situations there. (P14)

Development is supported by *mirroring* because this provides insight into the teacher's current state of reflectiveness:

I thought the example was very nice and then I think: well, we already have a lot of good things going. But if you look at what could be in it [i.e., the reflective conversation] ..., then that also means: yes, that too, so there is a lot to learn. (P1)

In addition, development is supported by advice functions because they help to provide concrete next steps:

Of course, the final piece of advice provided. I feel that, yeah, that entire process had set a reward at the final page and the advice can be used immediately. I can refer to it otherwise. I know where I make progress and so on. (P7)

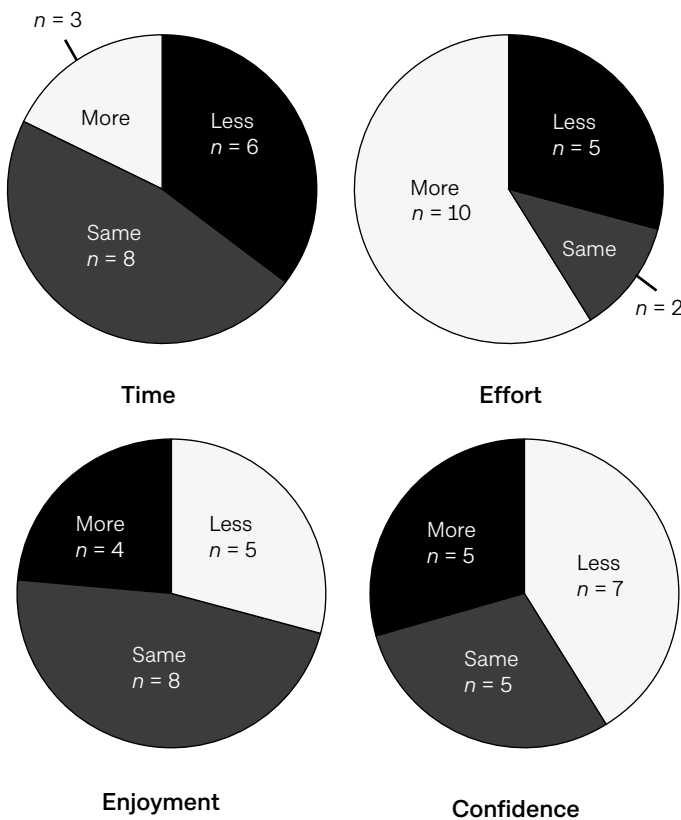
Second, the results regarding added value in terms of enjoyment and efficiency indicated overall limited negative costs. The majority of the participants perceived that their level of *confidence* and *enjoyment* was the same or higher with ReflAct compared to their business-as-usual practices (see Figure 5.1). Regarding the amount of time spent with the tool compared to business as usual, more than three quarters of the participants indicated that time spent would be the same or less. However, the majority of the participants indicated

that the use of the tool would take more *effort* compared to business as usual. At the same time, some participants mentioned that even though the effort was high, such a tool could provide a positive *return on investment*, meaning that the required exertion of mental power is justified for the expected outcome:

I think that it's really good that it has the video component and has a clear structure and is actually quite demanding, so that it really pushes you to not only look at the surface, but really, really try to interpret what is going on and try to understand and try to find. And how would I say the deeper a phenomena is in the teachers' practice, not only like this like surface, as I said, is it ok. (P17)

Figure 5.1

Added Value: Efficiency (Amount of Time, Effort) and Enjoyment (Level of Enjoyment and Confidence) With ReflAct Compared to Business as Usual.



Note. Total N = 17. Negative results are colored white (i.e. time and effort are reversed)

RQ2: Compatibility

According to the participants, compatibility could arise through contextual alignment by fulfilling an existing or arising need, but attention should be paid to differences between users, and familiarization opportunities should be included; see Table 5.2.

Table 5.2

Compatibility

Compatibility Sub-Factors
Contextual alignment
User background
Familiarization

First, participants mentioned various ways *contextual alignment* can arise, meaning that there is a fit with users' practices and they can envision using the tool (to fulfill a need) within their context. The contextual alignment can arise due to an explicit need within the organization:

Okay, and then I think it's good for us, yes, for a quality improvement and certainly because we at our beta department, it's growing a lot. So we are now more and more concerned with how do we do that [support reflection]? especially the question of mine is: how do you do that without loss of quality. (P3)

Or the need can surface by using such a tool:

I think it fits very well, ...of course we have a whole group of teacher educators walking around here and every teacher educator, just like every student, is different. So you get many different approaches and therefore many different forms of feedback that the students receive after a group video coaching session, after the conversation about the internship report et cetera. ...And by using a tool like this, there is a little more focus on which aspect you want to name, [and] how that can be done. (P14)

Second, participants highlighted the importance of paying attention to *user background*; in particular, the extent to which the alignment of ReflAct with the user is influenced by experience and background requires this. It could align well:

I have the feeling that it changes from person to person. So how much background information I have about reflection and different types of reflection, how much I read about it, how much I wrote about it makes a big difference in understanding the items on the tool. (P8)

Or it could align less well: “I think what was difficult about it, I have no training as a coach... I’m not very familiar with the terminology and the perspectives that you take there or that you distinguish” (P15).

Finally, participants mentioned that *familiarization* opportunities can support better alignment, meaning that it is important to include opportunities to help users get acquainted with the tool and to include practice to help users to orient themselves to the task and build scoring accuracy:

“Suppose you would have an example video, with a few example questions, with [an] example [of] context or [an] example [of teaching] effectiveness [standards]. That you can practice what the intention is, actually how you score...” (P17).

RQ3: Clarity

The participants’ responses also revealed seven sub-factors in terms of clarity that need to be made explicit in a tool to formatively assess teacher reflection, because these can influence users’ understanding of the tasks; see Table 5.3.

Table 5.3
Clarity

Clarity Sub-Factors
Lens selection
Subject
Judgment
Scoring
Explicitness of the standards
Contextual information
Language

First, users need to be clear about the *lens selection*, meaning that they need to understand on what grounds the frame for the formative assessment should be chosen: “Yes, and what do I base that [the lens selection] on? Because I thought I would now see a conversation between a teacher trainer

and a student, but I don't know the context of that" (P2). Such a lack of clarity was mentioned mostly during the configuration of ReflAct. Second, users need to be clear on the *subject* of the formative assessment, that is, understanding of who is being observed in the video: "I'm just doubting what the teacher was, able to. By that we mean in this case the teacher in training or the teacher trainer?" (P2). Third, users should understand what *level of judgment* is required, that is, whether the conversation needs to be assessed on the attempts versus the successful attempts to engage in reflection:

He does this in consultation with his supervisor. Do I check it or not? That? That is my question, because he does not get it clear himself and he does that in consultation with him, in my opinion, with his supervisor. (P4)

Fourth, participants also mentioned issues related to the *scoring*, that is, the judgment of the qualities of the reflective conversation using the scoring specifications. Fifth, clarity should be provided on the *explicitness of the standards*, that is, how fully and specifically standards of effective teaching should be referred to in the reflective conversation: "Based on the text of teaching effectiveness standards, I'm not very sure about the teaching effectiveness standards. Behind the video" (P7). Sixth, participants also mentioned the need for *contextual information*, referring to understanding of what has happened before the coaching conversation: "So because I was not very clear that the context of this video like what happened before the video" (P7). Finally, the *language* needs to be clear, meaning that users should understand terminology and vocabulary used in the tool: "For example, it's again, it's again, the wording. For example, the difference between deliberate and aware is again looking at a very subtle difference. So I am, I have question marks, whether everybody will understand the same things" (P8).

RQ4: Tolerance

Finally, the tool appears tolerant of various modalities of use, but needs to be tight (i.e. much support) when it comes to interpretation of the filtering and scoring of the reflective conversations. In total, seven sub-factors influencing the tool's tolerance were identified (see Table 5.4), of which three arose during the enactment of formative assessment of teacher reflective talk with ReflAct.

Table 5.4

Tolerance

Tolerance Sub-Factors
Procedural reasoning
Substantive reasoning
Re-watching for understanding
Iterative use
Individual use
Collaborative use
Student use

Participants engaged in *procedural reasoning*, meaning that they argued about which reflection steps and types were present in the conversation: “But that teacher trainer says: no, let’s first see what happened. I think I would say, is it mainly that reflection on action and then all three of those things” (P2). Participants also engaged in *substantive reasoning*, arguing about which reflection elements were present in the conversation and which score should be assigned accordingly:

And now I score this based on the two videos I just saw. OK. In the video and those the two videos of that conversation, the teacher was able to. That’s the other phrase there right. The teacher with the coach’s guidance is, I think, maybe part of what I’m seeing too. So specified, the teacher was able to specify the reflective goal. ...Our goal here is to think more about why the students weren’t engaged. But OK, yes, he specified the reflective goal, both based on the context. (P5)

Inspection of the co-occurrences revealed that these reasoning processes had specific clarity issues that showed up simultaneously. During *procedural reasoning*, clarity issues that were mentioned concerned the *judgment* required and *language* issues, whereas during substantive reasoning, clarity issues that were mentioned concerned *scoring* issues and questions regarding the *explicitness of the standards* to be observed. In addition, it was mentioned in interviews that *contextual information* could be useful in understanding how the *standards* need to be applied:

Within the institute we now use [ICALT], and before that we had the DOT Digital Observation Tool, that you also let that [what tool is used] be very visible. From okay on this basis, the reflective conversation has taken place. (P11)

Moreover, participants mentioned *re-watching for understanding*, that is, the (envisioned) need to view the video several times in order to be able to

analyze its contents: “I might have to watch it three or four times back would I really be so, really convinced of how I judge” (P4).

In addition, envisioned enactment was explored to understand foreseen variations in enactment that could influence the tool’s tolerance, which revealed four additional sub-factors. Participants mentioned *iterative use*, that is, repeated encounters with the tool to support development:

Then I think it is very good to fill that in a few times in the beginning, to, yes, to think critically again about how you yourself are in such a conversation. Because you are then guided by the questions to aspects that you might otherwise step over more easily, just less likely to think about. (P17)

Next, participants mentioned *individual use*, that is, the envisioned use of the tool by oneself:

In those teaching cycles, I could say two to three per semester, you would use it just after that first teaching cycle. So I’d have video of the reflective conversations I was having with each teacher to use this scoring guide as I’m watching those videos, as I’m preparing for their second round. (P5)

They also mentioned *collaborative use*, that is, the envisioned use of the tool together with others, such as colleagues or peers: “You could very well go through such a tool as a team” (P2). Finally, participants mentioned that this could also be used by (*preservice*) *teachers*: “...I might be willing to if I were a student teacher using or teacher using this, I might be willing to first look at the video only. And then when I look it again several times and then do the scoring” (P13).

All of the envisioned modalities of use (*collaborative, individual, and student use*) were mentioned together with development as added values (co-occurrences), signaling the potential for various use paths. Calibration was mentioned together with *collaborative use* as well as *individual use*, which illustrates that this process can occur as an internal process, but probably mostly as a team learning process.

Discussion

Conclusions

This study set out to understand what factors influence the perceived

viability of a tool for coaches to formatively assess teacher reflection, with particular attention to added value (RQ1), compatibility (RQ2), clarity (RQ3), and tolerance (RQ4). It provides modest yet concrete proof that such a tool could support formative assessment of teachers' reflection and is worth developing further, and gives recommendations for enhancing such a tool. In that light, this study makes two small but important contributions; First, it provides a theoretical contribution by identifying the relevant sub-factors that influenced perceived added value, compatibility, clarity, and tolerance that hold relevance for viability. Second, the quality criteria inductively developed in this study for assessing viability of formative assessment tools of teachers' reflective talk for coaches, constitute a practical contribution (Table S5.2). Following the limitations, the results will be discussed in light of the relevant scientific literature, and important directions for future development and evaluation of such tools will be addressed.

Limitations

The present study took place in a lab-like setting rather than a naturalistic one, which limits its ecological validity. This does not mean to imply that the coaching context does not matter, rather the opposite. Exploration of the tool in actual contexts is an important direction for further research. In so doing, important questions to ask include: How could a formative assessment tool be productively integrated in a video coaching cycle? How do prior coaching sessions inform the formative assessment task? Subsequent coaching sessions? How does the expertise of the coach influence the formative assessment task? The nature of the coaching offered? Future studies should explore use of the tool in authentic practice to gain deeper understanding of its usability. Even though implementation in actual coaching contexts was not explored through this study, the participants did represent a varied group with relevant and different backgrounds concerning (coaching of) teacher reflection, which helped to explore the potential viability of the tool. It is worth noting that the results of participants were not compared groupwise, because their numbers were too small for reasonable comparisons. Future research involving representative samples of relevant groups (teacher educators, researchers, and reflection coaches) might test if differences in tool use or preferences could be explained by user group type. Finally, the proof-of-concept study was executed over a short timeframe, and therefore might not be exhaustive, meaning that if users had been observed for a longer time in their own setting then more or other adaptations in use might have been revealed.

Reflections

First, this study provides initial empirical evidence for the proof-of-concept of a tool in terms of added value for individual and team learning, but questions regarding the nature of the required effort persist. This study sheds light on perceived effectiveness, and participants mentioned development and calibration through mirroring and advising as added values of this tool, providing directions for further exploration. In the context of the teaching effectiveness literature, calibration is sought in order to align conceptions of effective instruction with standards and is thought to improve the quality of the reflection (Kraft & Hill, 2020), but it can also be understood as developing shared understandings in team learning contexts, a learning scenario that was put forward in this study. In developing shared understanding, standardization is not the goal, but rather gaining understanding of practices for adaptation to one's own context (cf. Grossman & Dean, 2019). Specifications of practice, in this case through a formative assessment tool for teachers' video-rich reflection, could help to resolve tensions caused by differences in experience and context, and act as boundary objects (cf. Grossman & Dean, 2019). Understanding not only how such a tool could potentially support alignment of conceptions of productive reflective talk and subsequent behavior of individual teacher educators or coaches with the tool, but also how it could support team learning through development of shared understandings, appears to be a worthwhile and novel line of research. In terms of efficiency, most participants mentioned that the effort was high (overall, the most negative finding), but it was also mentioned that this could have a positive return on investment. This raises the question whether the effort is always experienced as negative, like a strain, or more like cognitive demand. It would also be worth investigating whether the high effort is caused by the tool or whether it is inherent in the task itself. A comparison between paper-based and tool-based observation could provide insight as to whether there is a confounding variable at play.

Second, this study has provided initial insights into the sub-factors influencing the compatibility of a formative assessment tool of video-rich teacher reflection, and these should be further fine-tuned into design guidelines taking specific contextual differences into account. A tool needs to be perceived as compatible with the users' context and needs (McKenney & Reeves, 2019), and the results showed that this tool aligns with existing contexts, especially by fulfilling an existing need within the organization, (i.e., a need to improve coaching conversations), or by exposing a need in the organization through using the tool, (i.e., sparking questions about how teacher coaching conversations are enacted across the faculty). This finding is promising in light of

implementation and spread, because this could facilitate adoption, that is, the decision to use the tool (McKenney & Reeves, 2019). In addition, this study suggests that familiarization supports should be included in formative assessment tools for teacher reflection, and this raises questions about how much and what type of familiarization is needed, especially since relatively little has been published regarding the training of teacher leaders, who often have coaching roles (Wenner & Campbell, 2017). As user background will influence alignment, it seems prudent to further develop design specifications for familiarization, paying attention to contexts that differ in education level, subject matter, and coach experience. As coaches work within and across subject levels and grade levels, it appears worth investigating how closely aligned materials need (not) to be with their practices in order to connect with their knowledge, for instance, the examples given. In a similar vein, investigating differences between new, experienced, and expert coaches and their needs can be informative about design features that cater to all levels and those that are specific to certain ones.

Third, this study has identified sub-factors that need to be clear, thus supporting understanding of *what* information needs to be explicitly included. Background information or theory can help users to orient themselves to the task, which could help them to select a relevant lens for their formative assessment, and to pay attention to the subject who is being formatively assessed, in this case, the teacher. Moreover, examples can help users to better understand the intention of the design and illustrate expert approaches to the task (van Merriënboer & Kirschner, 2017) and these illustrations are especially relevant for the tasks in places where the tool needs to be less tolerant in order to support consistency in the scoring of reflective conversations. It can be helpful to engage users during design to clarify language and/or develop a common language together that resonates well with practitioners during (re)design. Since coaches work within and across subjects and grade levels, it seems prudent to include a varied group for co-design efforts to enhance chances of viability. Finally, working together with practitioners could help designers to understand what contextual information needs to be gathered in order to have sufficient input to observe a reflective conversation between a coach and teacher(s), through observation in varied contexts where reflection is approached from different angles.

Fourth, this study has identified sub-factors that are relevant for tolerance, and this provides guidance for exploration in various contexts. The findings from this study have supported understanding of *how* formative assessment is enacted with this tool and where variation could arise that is potentially more/less productive. Participants engaged in procedural and substantive reasoning regarding the qualities of the reflective talk, which is a

promising finding because it signals deep engagement with the task. However, this study also suggests that clarity issues regarding the nature of the judgment and the explicitness of the standards could influence the quality of the procedural and substantive reasoning, respectively. Further investigation of the quality of the reasoning could help to identify where a lack of clarity could potentially lead to counter-productive uses, that is, so-called “lethal mutations” that no longer align with goals of the tool (cf. Brown & Campione, 1996). Finally, the results suggested the need to watch (parts of) the conversation multiple times, and this is in line with findings from video-rich reflection that viewing videos multiple times helps to deepen understanding (e.g., Zhang et al., 2011), but also suggests that video data can be overwhelming (cf. Chen, 2020). There seems to be a trade-off here between using video data that allow for deep analysis, but also require an investment in terms of effort. It might be that if coaches become more familiar with the tool over time, their attention can become more focused on the video, instead of on remembering the scoring instructions, thus reducing the perceived effort. That is not to say that the tool should be used in every coaching session with every coach. In fact, the formative assessment tool would ideally act as a scaffold that slowly fades as coaching quality (and reflection quality) increases, and remains available in the organization when needed. Further exploration should support understanding of how such a tool can be embedded in a coaching context.

Closing Remarks

This study provides modest initial empirical evidence for the proof-of-concept that a tool to support formative assessment of teachers’ reflection is worth developing further, and provides concrete guidelines for such tools. Specifically, the study provides insight into important factors for the viability of ReflAct, a formative assessment tool for teacher reflection, as well as a practical framework for (formative) evaluation. In future studies, attending to the interplay between the identified sub-factors and how they influence implementation and spread could support theoretical understandings about these types of tools and their practical value. In addition, investigating the efficacy of such a tool in controlled environment is needed, as well as its the effectiveness in varied contexts in order to better understand what works about technology-supported formative assessment of teacher reflection, how, and for whom. The evaluation framework can be used to guide these evaluation efforts and to help further elaborate design guidelines for features that need to be included in tools to formatively assess teacher reflection across teacher coaching contexts, and the features that support such assessment within subject areas or grade levels.

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Table S5.1

Sample Codebook

SUB-FACTOR	Description	Quotation
+ AV ADVICE	The tool provides guidance on how to improve the current state of teachers' reflection	<p><i>4:38 ¶150 in P3 Interview Yes, I don't know that just like that. I think it's very good that you get an advice if a certain score comes out that that, that is still a qualitative specification behind it. That. I think that's very good.</i></p> <p><i>14:9 ¶38 in P13 Think aloud So I think that here that the advice boxes are really, really good and useful. Yes, I'm here, I think that these are questions to consider are really good. So that they are presented, so they advise you further.</i></p> <p><i>11:27 ¶141 in P27 Interview And then with those advices. It is clear which list of questions belongs to, for example, identify the crucial pieces, or check, the quality of reflection process. Check the quality of the reflection process, I found that very clear guidance of, what kind of questions can you ask or what can you pay attention to to make it better. With this identify why the crucial pieces are missing also which I think, which pieces are missing, there it would also be nice to have some examples</i></p>

Table S5.2

Quality Criteria for Teacher Reflection Formative Assessment Tools

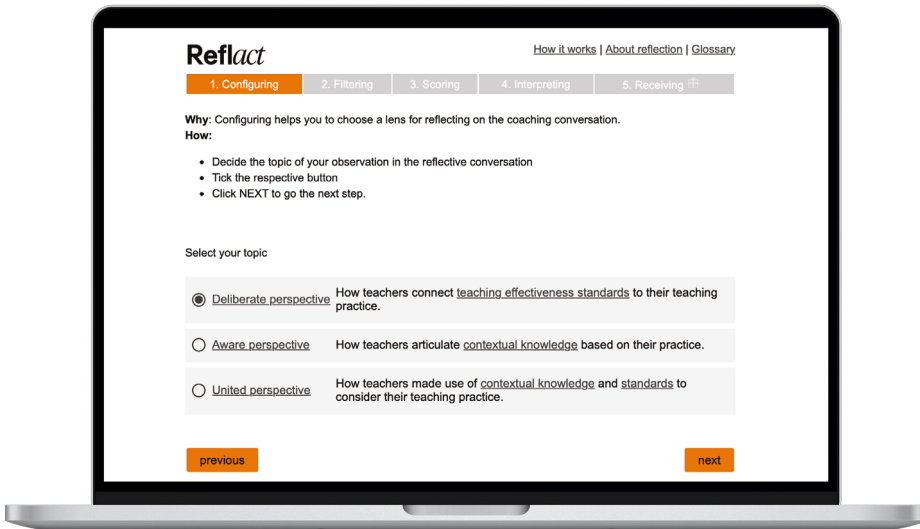
Factor	Sub-factor	During routine (not initial) use, the tool...	
Added value	Effectiveness	Development	supports the development of coaching practices
		Calibration	offers an explicit framework to help align practices to standards
		Mirror	provides insight into the current state of teacher reflection
		Advice	provides guidance how to improve the current state of teachers' reflection
	Efficiency	Effort	requires a low(er) amount of effort to formatively assess teacher reflection compared to business as usual
		Time	requires a low(er) amount of time to formatively assess teacher reflection compared to business as usual
		Return of investment	requires an exertion of mental power that is justified for the expected outcome
	Enjoyment	Enjoyment	provides a high(er) level of enjoyment to formatively assess teacher reflection compared to business as usual
		Confidence	provides a high(er) level of confidence to formatively assess teacher reflection compared to business as usual
Compati- bility	Contextual alignment	fits with participants' practices, meaning that the participants can envision using the tool (to fulfill a need) within their context.	
	User background	accommodates the user's experience and background in reflection.	
	Familiarization	include opportunities for familiarization to help users get acquainted with the it, to help users to orient themselves to the task, and to build scoring accuracy	
Clarity	Lens selection	supports understanding on what grounds the frame for formative assessment needs to be chosen	
	Subject	supports understanding whom is being observed in the video during formative assessment	
	Judgment	supports understanding whether the reflection aspects simply need to be present or need to be judged on quality (is there an attempt vs a successful attempt)	
	Explicitness standards	supports understanding how fully and specifically teaching effectiveness standards should be referred to in the reflective conversation	
	Scoring	supports understanding of the judgment of the qualities of the reflective conversation using the scoring specifications	
	Language	supports understanding of terminology and/ or language used in the tool	
	Contextual information	supports understanding of what has happened before the coaching conversation	
Tolerance	Procedural reasoning	requires high support (tight) for argumentation regarding the reflection steps and types that were (not) present in the conversation	
	Substantive reasoning	requires high support (tight) for argumentation about the reflection elements that were present in the conversation and which score should be assigned accordingly	
	Rewatching for understanding	supports replay of the video to analyze its contents	
	Iterative use	support frequent use of the tool	
	Individual use	supports use by one-self	
	Collaborative use	supports use together with others, like colleagues or peers	
	Student use	support use by students (preservice teachers)	

Note. The grey cells were pre-determined (sub)factors which are defined in the introduction, the white cells were inductively identified in this study.

Figure S5.1
ReflAct Home and Configuration Screens

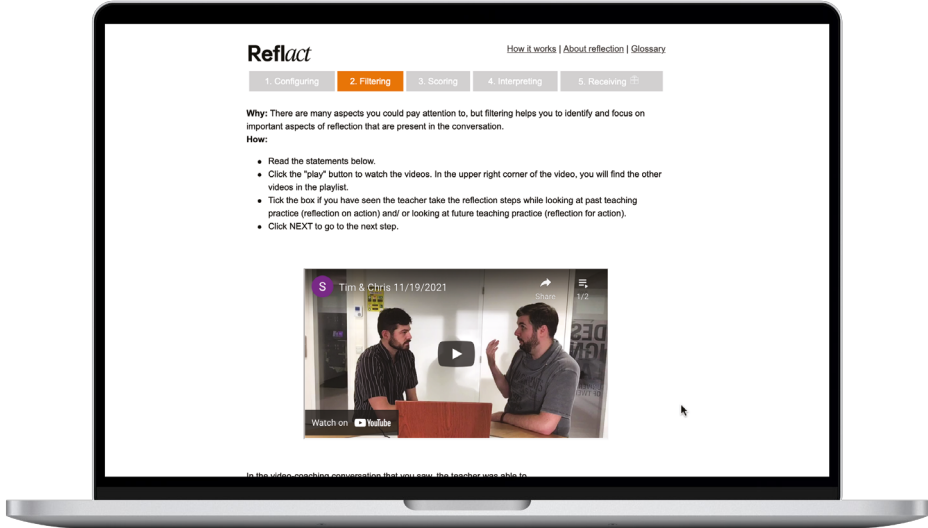


HOME

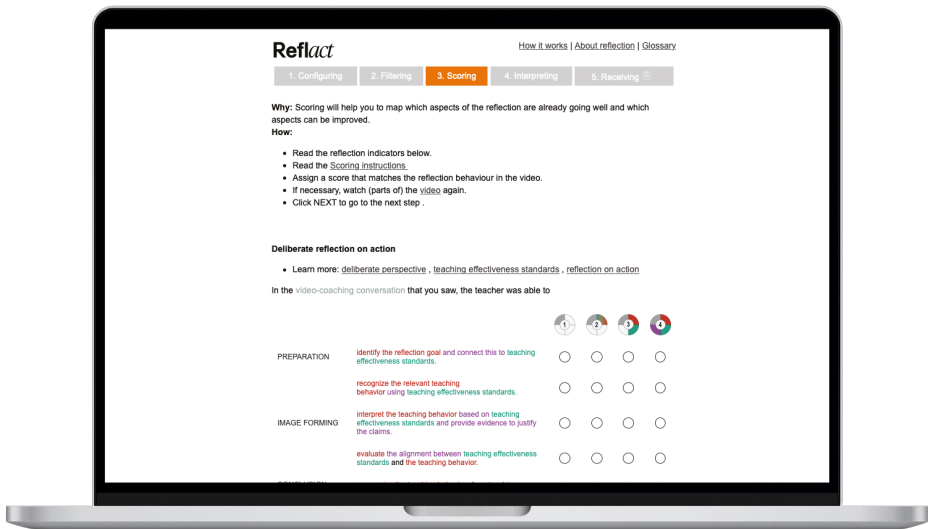


CONFIGURING

Figure S5.2
 ReflAct Filtering and Scoring Screens

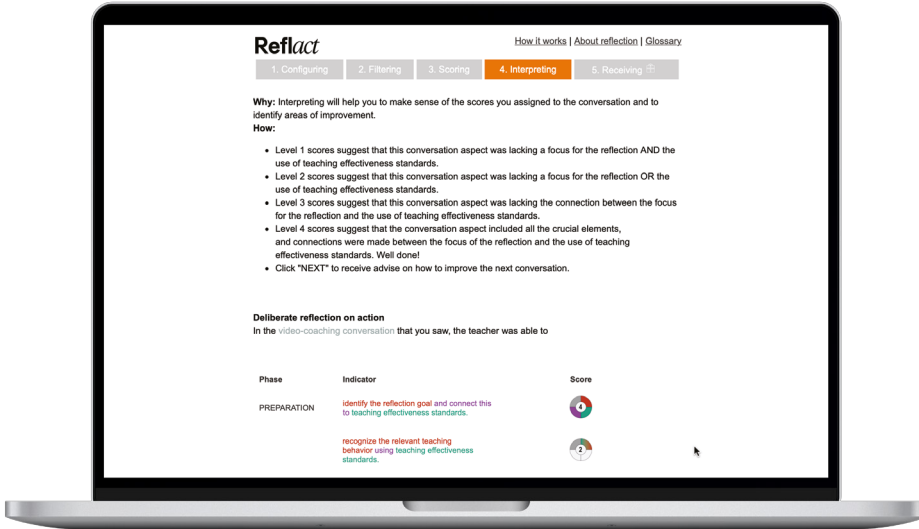


FILTERING

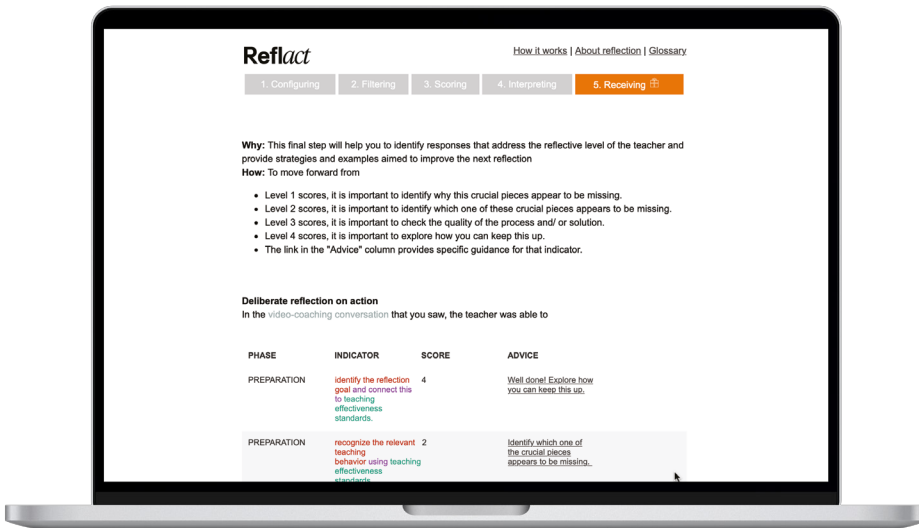


SCORING

Figure S5.3
 ReflAct Interpreting and Receiving Advice Screens



INTERPRETING



RECEIVING ADVICE

Chapter 6

Conclusion

Abstract

This last chapter revisits the purpose of the study and the research approach, and describes the results from each of the sub-studies. Hereafter, the results are presented in relation to the research objectives, that is to conceptualize teacher reflection in video-coaching settings (RO1), to articulate supports to improve teacher reflection in video-coaching settings (RO2), to reify the articulated support in a tool to improve teacher reflection in video-coaching settings (RO3). The chapter describes how this study found that teacher reflection in video coaching settings can be conceptualized around four key aspects, articulated two approaches to help coaches improve teacher reflection in video coaching settings, and described the characteristics of a tool for that purpose. Reflections on the research process and quality, as well as recommendations for future research, practice, and policy are presented. Final remarks on the contribution of the study are given.

Revisiting the Purpose of this Study

As described in Chapter 1, video coaching holds promise for teacher development and coaches have a crucial role in this, yet little is known about how to support these coaches. This is important to address, because coaches can play a large role in the development of teachers, especially early on (Dutch Ministry of Education, Culture, & Science, 2022; Podolsky et al., 2016), and the combination of coaching with video seems especially advantageous. Doing so with classroom video allows for close analysis of practice, supports teacher discussions, and illustrates situations that are difficult to put into words due to their complexity (cf. Marsh & Mitchell, 2014). While coaches' roles vary within and across schools, districts, and states, (Deussen et al., 2007; Mangin & Dunsmore, 2015) and potentially countries, there has been consensus on the importance of developing more high-quality coaches (Marrongelle et al., 2013). Given that the research base on how to support coaches is limited (Tekkumru-Kisa & Stein, 2017; Wenner & Campbell, 2017), three research objectives were formulated to guide the dissertation, namely:

- To *conceptualize teacher reflection* in video-coaching settings;
- To *articulate supports* for teacher reflection in video-coaching settings;
- To *reify the articulated supports in a tool to improve* teacher reflection in video-coaching settings.

To achieve the research objectives, an educational-design-research approach (McKenney & Reeves, 2019) was chosen. All three phases of educational design research (analysis and exploration, design and construction, evaluation and reflection) were attended to in this study. The first phase serves to gain insight into the existing situation, the second phase serves to develop solutions, and the third phase serves to evaluate solutions. In each phase implications for theory and practice are gathered. Specifically, through attention to processes of analysis, design, construction, and evaluation, this study aimed to develop both theoretical knowledge on teacher reflection in video-coaching settings and ways to support it, as well as practical outputs to support coaches in improving teachers' reflective practices. This study was undertaken through four sub-studies, and each research objective was supported by two or more sub-studies (see also Figure 1.1 for an overview). Next, the key find-

ings will first be summarized per sub-study, after which they will be integrated per research objective and discussed in light of the scientific literature.

Key Findings

Overview per Sub-Study

Sub-study A (Chapter 2) reported on a systematic literature review of video-coaching literature, specifically looking into the observed design features, enactment processes, outcomes for teachers and their students, and possible relationships between them. The corpus consisted of a total of 59 studies from North America, South America, Europe, Asia, and Australia. The following findings were reported most often:

- Design features: artifacts of practice, examples of practice (materials and resources), exploration of practice tasks, presentation of information activities, goal-setting tasks, practice tasks (activities and tasks), and an input and facilitator role (participation and practices).
- Enactment processes: reflection on action, PCK discussions, a focus on student behavior, use of reasoning based on evidence, and the (re)creation of curriculum materials.
- Teacher outcomes: positive changes in teachers' pedagogical behavior, PCK and domain-specific instruction.
- Student outcomes: little evidence.

In addition, the corpus showed that there is evidence (though limited) for possible video-coaching theories of action for (1) teachers' domain-specific instruction, (2) teacher pedagogical content knowledge, (3) teachers' beliefs. The results indicated that there is a gap in understanding of the enactment of video coaching in studies that reported positive changes in teachers' pedagogical behavior.

Sub-study B (Chapter 3) reported a theoretical synthesis where it was argued that uniting deliberate and aware epistemological perspectives during reflection is beneficial for teachers' contextualized knowledge development. Uniting deliberate and aware perspectives was argued to be beneficial for developing teachers' contextualized teaching knowledge throughout their teaching careers, and especially early on. In so doing, action and reflection were positioned as central to the development of teachers' knowledge,

and affordances from both the deliberate and the aware perspectives were articulated. Specifically, this article explained why uniting the two perspectives supports better sense-making, more refined instructional planning, and more responsive teaching, before offering a united reflection model. These processes were then discussed in the context of video-coaching interventions for early-career teachers. After presenting a blueprint for video-based reflection and key design features that could support teachers' learning, important differences compared to other reflection models were discussed and implications for (the design of) teachers' professional development based upon this united perspective were offered.

Sub-study C (Chapter 4) investigated how to describe teachers' reflective conversations in general, and with regard to instruments having formative, summative, or descriptive purposes. In a three-round, Delphi-inspired, mixed-methods study, teacher reflection expert views from research and practice were gathered through open- and closed-ended survey questions and interviews ($N = 27$). Experts validated the fit of the united reflection model for assessing teachers' reflective conversations in general, agreed that an observation instrument focusing on formative assessment would be most useful, and recommended that all phases of teacher reflection should be foregrounded in such an instrument. Based on these inputs, instrument indicators were drafted and reflection experts evaluated the clarity of the indicators in the initial instrument. All indicators were considered clear enough to be used in practice. The study resulted in a modest but practical framework for assessing teachers' reflective conversations in video-coaching contexts.

Sub-study D (Chapter 5) reported on a proof-of-concept study to explore the viability of a formative assessment tool to improve teacher reflection. Participants used a prototype of a teacher reflection formative assessment tool while thinking aloud. Their use data were logged, and they responded to interview and survey questions before and afterwards ($N = 17$). Findings showed that the tool would be viable and is worth developing further. First, users indicated that it could add value in terms of development of coaching practices and calibration to align practices, with the benefits outweighing the associated costs (e.g. time, effort). Second, the tool was deemed compatible with existing or arising needs to improve reflective conversations, though respondents pointed out that attention should be paid to differences between users and to strengthening opportunities for learning to use the tool. Third, seven sub-factors were identified that need to be explained in order to increase the tool's clarity (lens selection, subject, judgment, explicitness standards, scoring, language, contextual information). Finally, the tool appeared tolerant of various modalities of use, but should adhere tightly to supporting reasoning processes about the nature of the reflective conversations. In all, this sub-study yielded

quality criteria that can be used for future evaluations of this and other tools supporting formative assessment of reflective video-coaching conversations. Next, the results from the various sub-studies are synthesized to address the research objectives.

RO1: Conceptualization of Teacher Reflection in Video-coaching Settings

Findings related to RO1

Sub-studies A, B, and C contributed to RO1, which was to conceptualize teacher reflection in video-coaching contexts. Sub-study A contributed to this goal through mapping teacher video coaching in the empirical literature and identifying relevant reflection types and processes. Sub-study B contributed to this goal by synthesizing insights from the literature in a united reflection model for video-coaching settings. Sub-study C contributed to this goal through validation of the united reflection model with reflection experts. The remainder of this section discusses how altogether, four dimensions of teacher reflection in video-coaching settings have been elucidated.

First, three types of reflection were identified as central to teacher video-coaching. Sub-studies A and B described *reflection on action* as a retrospective process, where teachers considered (teaching) practices that have already occurred. Both studies also described *reflection for action* as an anticipatory process, where teachers considered future teaching scenarios. Sub-study A found that, according to the literature, reflection on action supported positive changes in teachers' pedagogical content knowledge, beliefs, and domain-specific behavior, and the combination of reflection on and for action was found in studies that reported positive changes in domain-specific behavior as a result of video coaching. In terms of design features, all outcomes were supported by artifacts of practice, an exploration of practice task, and an input role. Changes in pedagogical content knowledge were also supported by a facilitator role for the coach. Changes in beliefs were further supported by design, enactment, and presentation of information tasks. Changes in domain-specific instruction were additionally supported by design, goal setting, presentation of information tasks, and a coach facilitator role. Finally, sub-study B also emphasized a third type of reflection, that is, *reflection in action* as knowing-in-action, where teachers consider salient moments as well as triggered responses.

Second, the literature and the expert insights emerging from sub-studies B and C yielded two perspectives on knowledge development, which can be combined and help to show that reflective talk suitable for teacher video coaching can be based on:

- a *deliberate perspective*, which foregrounds attention to (1) collective knowledge on teaching, and (2) the use of that knowledge as a frame of reference, as well as
- an *aware perspective*, which foregrounds attention to (1) knowledge development within practice through reflection, planning, and teaching, and (2) knowledge development in interaction with others.

Further, in sub-study C, reflection experts agreed that equal attention should be paid to these four aspects in an instrument to assess video-rich reflective talk and that this remains constant across differing instrument purposes (descriptive, formative, summative). Finally, study B argued that these two seemingly opposing perspectives can be productively *united*, and that this adds value by supporting teachers' contextualized knowledge development in video-coaching settings, specifically by supporting better understanding (reflection-on-action) and planning (reflection-for-action), as well as more responsive teaching (reflection-in-action).

Third, recurrent aspects of reflection, that is the phases of reflection, were described based on the literature, and situations where these require attention were identified. Sub-study B distinguished three phases of reflection, namely, (1) preparation, (2) image forming, and (3) conclusion drawing, as follows:

- *Preparation* requires practitioners to detail the reflective question and to collect facts related to it.
- *Image forming* requires practitioners to investigate the phenomena identified during the first step and interpret (or anticipate) the teaching situation.
- *Conclusion drawing* requires practitioners to contrast their findings from image forming and consider the implications for their practice.

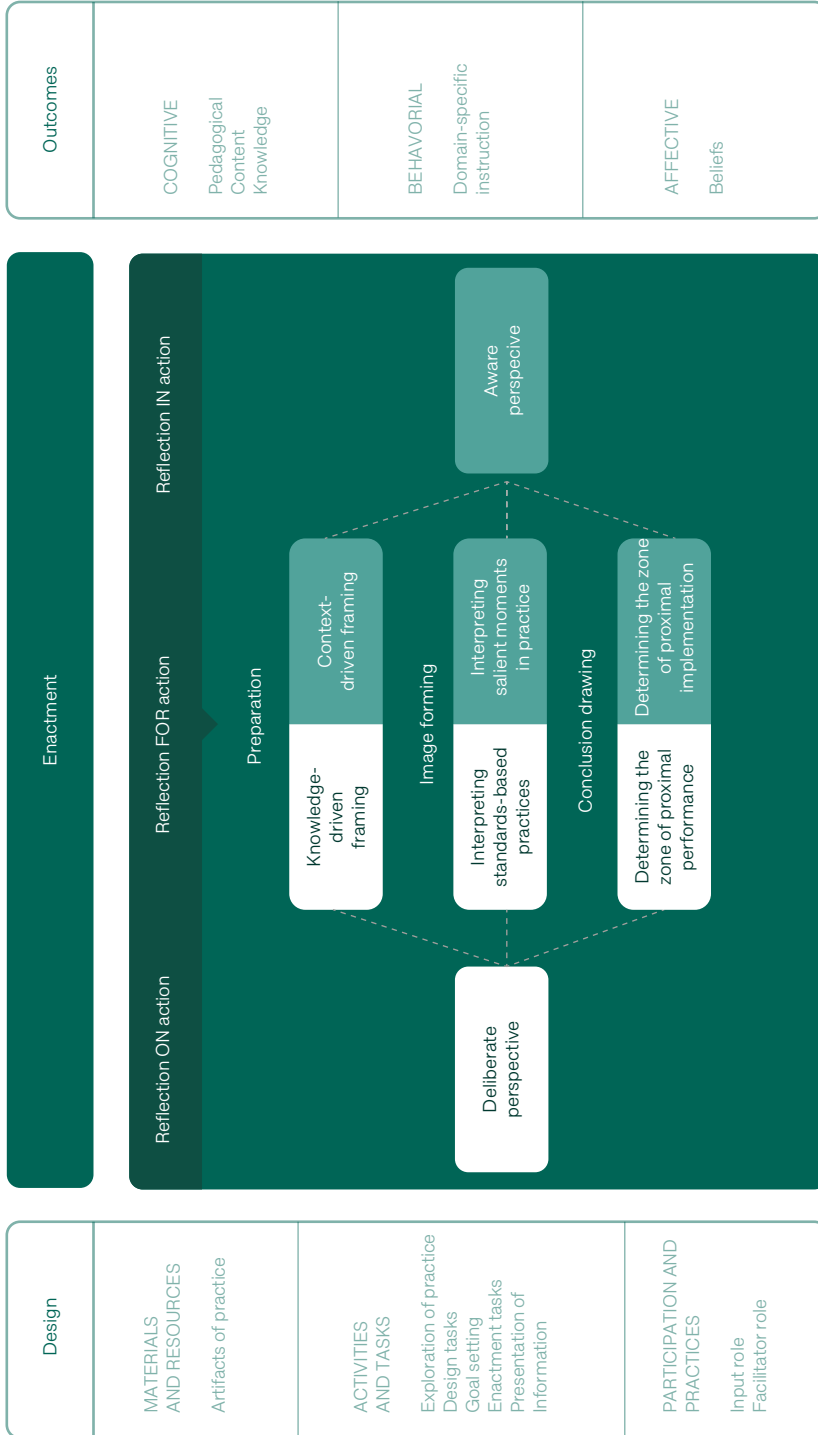
Sub-study C illustrated that attention to phases differed based on the purpose for assessing reflective talk, according to reflection experts. Specifically, whereas attention should be paid to all phases when assessing reflection with a formative purpose, attention to conclusion drawing and preparation is required for observing reflection-on-action with summative and descriptive purposes, respectively.

Finally, the non-recurrent aspects of reflection, that is, the cognitive processes, were described. Sub-studies A and B both considered "attention" (i.e., what teachers focus on) and "reasoning" processes (i.e., what teachers talk about and how) as part of reflection, and sub-study B added "determining" as a concluding process. Sub-study B described these processes based on the united reflection model:

- During preparation, teachers engage in *framing* of the situation, which is an attention process.
- During image forming, teachers *interpret or anticipate* the teaching situation in order to make sense of it.
- Finally, during conclusion drawing, teachers *determine* where they are now, and/or where they can go, and how to get there.

All of these processes could be driven by frameworks of teaching knowledge (deliberate), the teaching context (aware), or the integration of both (united). Study C revealed that, according to reflection experts, all of these processes are useful, and most are essential for assessing reflective talk in general. Figure 6.1 synthesizes the conceptualization of teacher reflection in video-coaching settings.

Figure 6.1
 Conceptualization of Teacher Reflection in Video-coaching Settings



Discussion of ROI

Current debates in educational research question the usefulness of focusing solely on core practices or standards during teacher education (Kennedy, 2016; Philip et al., 2019; Zeichner, 2012), and have called for approaches that pay less attention to bodies of knowledge and teaching behaviors, and give more attention to how to use these to address important problems of practice, such as presenting the curriculum and eliciting student thinking, amongst others (Kennedy, 2016). Whereas the debate focuses mostly on teacher education, it can be argued that the issues that are raised also hold equal relevance (if not more) for coaching novice teachers, as the need for responsive teaching, which can only be learned in context, becomes even greater for early career teachers (Feiman-Nemser, 2001). Each of the reflection types could support attention to problems of practice, because it allows for questioning:

- how core practices *have served* the specific student population and the teacher (united reflection-on-action),
- how core practices *will serve* the specific student population and the teacher (united reflection-for-action), and
- how core practices *are serving* the specific student population and the teacher (united reflection-in-action).

Attending to problems of practice requires consideration of what works, for whom, why, and how. Although individual preferences will likely vary, the need for support to help teachers to engage in meaningful reflection is broadly prevalent. While the deliberate and aware perspectives are expected to hold relevance across subjects and grade levels, it seems plausible that disciplinary habits of mind or teacher preferences for teacher-centered or student-centered classroom activity could influence or otherwise relate to the perspectives to which participants gravitate. This might have implications for how easily deliberate and aware perspectives are adopted. Still, there remains value in uniting perspectives for attending to problems of practice. Part of the criticism in the current debate concerns the focus on the enactment of visible behaviors in teacher education (Kennedy, 2016), instead of supporting thinking about the reasons *why* these behaviors are enacted. In video coaching, visible behaviors are front and center due to the type of representations that are used, but as argued in this study, the focus can be on specific teaching behaviors as well as on the context (e.g., student needs, available resources), and even better, on the interplay between both. As such, the united reflection model aligns with the views of scholars who deem core practices useful, but also acknowledge the importance of thoughtful reasoning about when and

how to use core practices (Kavanagh et al., 2020). Perhaps the consideration of how to unite deliberate and aware perspectives is a way to address these tensions, especially if the use of certain core practices is not taken for granted, but questions are formulated as to why and in what way they can (or whether they can) serve the student population that is being taught. This would require serious consideration from both the deliberate and aware perspectives during reflection, to unite these perspectives in such a way that application of the practices meets contextual needs and constraints. This is especially relevant because interventions do not produce the same effects in every classroom (Penuel et al., 2011). Implementation matters, and teachers should be supported to see how they can utilize core practices in varying conditions. Not using the research on core practices would be like throwing out the baby with the bathwater; instead, more nuanced studies are needed that help coaches and teachers understand what works, for whom, why, and how.

Finally, it is important to note that cognitive processes of framing, interpreting, and determining could serve teachers' considerations of what works, for whom, why, and how. Namely, while reasoning processes are seen as important to support these considerations (Kavanagh et al., 2020), it can be argued that the framing and reframing of teaching practices is crucial for video-coaching novices. As framing determines how the situation will be interpreted (Berland & Hammer, 2012), new frames need to be applied in order to be able to see the same situation from different angles. This is necessary to investigate differences in what works for whom. Thus, by framing and reframing practice, the complexity of teaching practices could come to light, as well as the insight that there is not one single way to approach or resolve a problem of practice. This could support teachers' ability to become attuned to the context and considerate of its needs, constraints and possibilities, while taking into account what is known about teaching well, and to apply that knowledge in ways that serve the teaching population, which is needed to support high-quality teaching.

RO2: Articulate Support for (Improving) Teacher Reflection in Video-coaching Settings

Findings related to RO2

To achieve RO2, two approaches to support the improvement of teacher reflection in video-coaching contexts were put forward. The four-components-instructional-design model (4C/ID; van Merriënboer & Kirschner, 2017) was selected to support the complex learning of united reflection in sub-study B, and formative assessment strategies were used to support teacher reflection in sub-studies C and D. Central to both 4C/ID and formative assessment

was the idea of professional learning that one could complete on one's own or with the help of a knowledgeable other (Vygotsky, 1978).

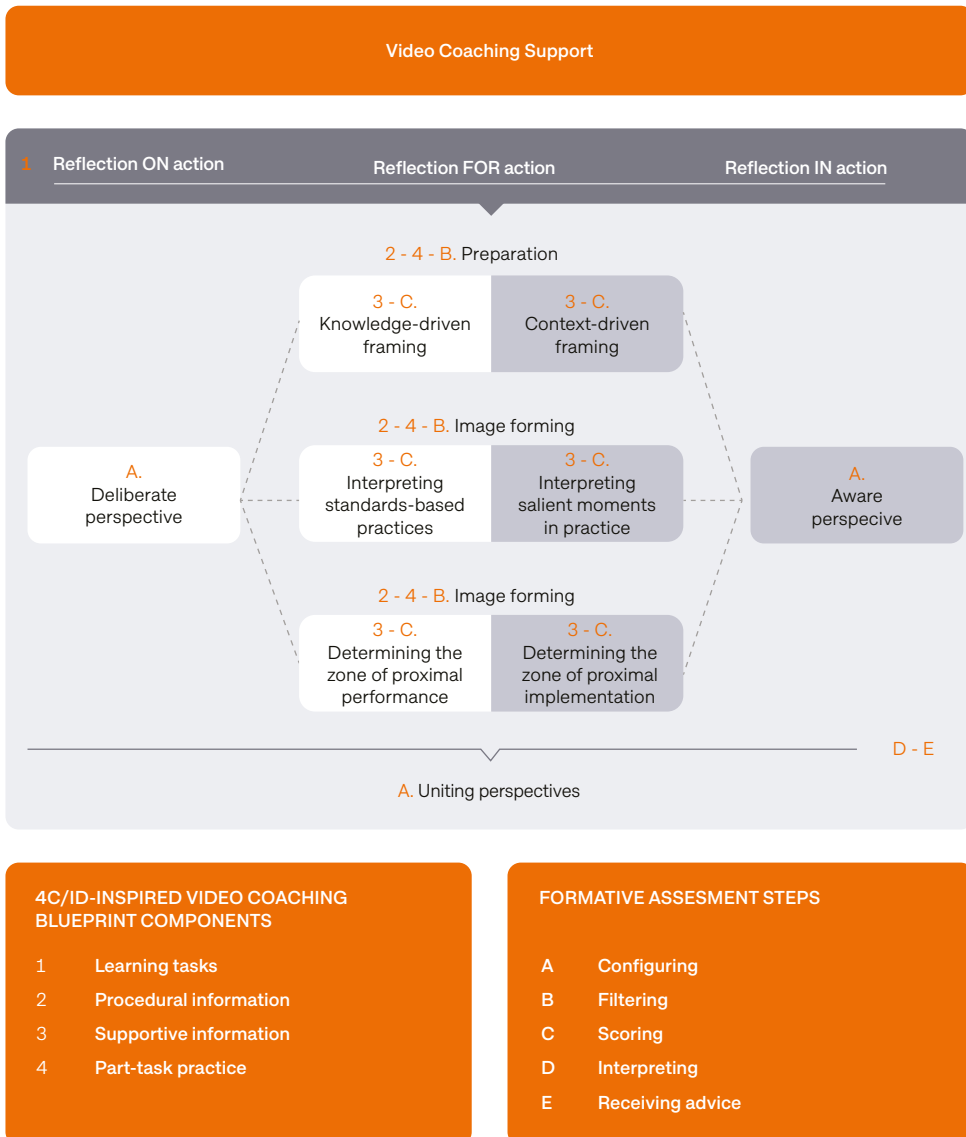
Using instructional design principles, sub-study B illustrated how reflection from the deliberate and aware perspectives and their integration could support consideration of current and desired teaching practices regarding teaching performance and implementation in context. The 4C/ID model was deemed useful for designing support for such a complex task, distinguishing four important components, namely, the learning task, procedural information, supportive information, and part-task practice (4C/ID 1–4 in Figure 6.2). First, the learning tasks need to be provided in a way that shows an increase in their complexity: reflection-on-action is the least complex (rendering insight into current practices), reflection-for-action is of medium complexity (rendering ideas to close the gap between current and desired practices), and reflection-in-action is the most complex (executing actions to close the gap between current and desired practices). The levels of complexity were hypothesized based on the expected underlying cognitive processes for each of the types of reflection. Second, procedural information needs to be provided just-in-time to support the execution of preparation, image forming, and conclusion drawing within and across perspectives. This information can direct explicit attention to determining what a teacher can perform on their own or with the help of a coach (the zone of proximal performance; ZPP) and what a teacher can implement on their own or with the help of a coach (the zone of proximal implementation; ZPI). Third, supportive information needs to be constantly available to support cognitive processing during reflection on, for, and in action. Guiding questions or cognitive feedback obtained through artifacts could support attention to drawing conclusions about the ZPP and ZPI, especially during the conclusion drawing phase. Finally, part-task practice was deemed useful to automate recurrent aspects of the task.

In addition, this study described how formative assessment can be used as a complementary approach to close the gap between current and desired teacher reflection. In sub-study C, experts found that there is a genuine need for tools to improve teacher reflection in video-coaching settings, that is, with a formative purpose. In addition, they found that all phases of reflection, that is, preparation, image forming, and conclusion drawing, need attention in a tool with such a purpose. Subsequently, sub-study D described how technology can support closing the gap between current and desired reflective practices, and it was found that such a tool could add value. First, technology could support the gathering of information to help understand teachers' current level of reflection by leveraging video recordings of coaching conversations. Second, technology could provide environments that make it easier to compare the teachers' current level of reflection to where they want to go through

providing an observation framework (Formative assessment A–D in Figure 6.2). Third, technology could support insight into how to get the desired level of reflection through the provision of tailor-made advice based on the scoring (Formative assessment E in Figure 6.2). Figure 6.2 synthesizes the articulation of support for improving teacher reflection in video-coaching settings.

Figure 6.2

Articulation of Support to Improve Teacher Reflection in Video-Coaching Settings



Discussion of RO2

In schools, coaches often find themselves in intermediary positions between administrators and teachers, and between evaluation and development (Woulfin & Rigby, 2017). This means that coaches are often concerned with the individual development of teachers, but they are also involved with development on an institutional scale (e.g., through reform), and can broker ideas both ways (Woulfin & Rigby, 2017). By engaging in video-coaching activities as well as formative assessment, as put forward in this study, the coach is able to gather information about the developmental needs of teachers as well as their level of reflection, which in turn can be used to set the agenda for institutional development. Recently, scholars have argued for new forms of accountability that not only pay attention to outcomes, but also attend to developing teachers' critical reflection and subsequent action to support more equitable learning (Cochran-Smith, 2020). If reflection is considered central to developing teachers who are more responsive to their contexts, then teacher reflection should become the focus of coaching activities. Both approaches in this study (i.e., 4C/ID and formative assessment) align with these aims by enunciating support for coaches to improve video-rich reflection for teachers, while uniting the deliberate and aware perspectives.

In comparing the 4C/ID-inspired video-coaching blueprint with other 4C/ID-based instructional approaches, a different position for reflection can be observed. The 4C/ID model was created to generate reflective expertise as a solution to the transfer problem (van Merriënboer et al., 1992). This reflective expertise is understood "as the ability to solve new problems on the basis of two highly interrelated cognitive processes [i.e., rule automation and schema acquisition]" (van Merriënboer et al., 1992, p. 34), and here reflection is positioned as supportive information, which can be guided by cognitive feedback (van Merriënboer & Kirschner, 2017). Surprisingly, there are limited examples of 4C/ID applications specifically for the design of teachers' professional development, but an example can be observed in the study by Frerejean et al. (2021), where reflection is positioned as supportive information. In comparison, the current study positioned united reflection itself as a complex task, while also including cognitive feedback as support. Thus, whereas 4C/ID generates reflective expertise to support performance, the 4C/ID-inspired video-coaching blueprint could be able to generate reflective expertise about reflection itself. Productive reflection now often depends on the coach (Gelfuso & Dennis, 2014), but in order to become responsive to problems of practice, coaching approaches are needed that support teachers to become reflective practitioners themselves. More research is needed if the 4C/ID-inspired approach can indeed develop this reflective expertise on reflection, and how this in turn can support other teacher outcomes.

This development of reflective expertise about reflection is related to the other approach put forward in this study, namely, formative assessment of teacher reflection. Formative assessment is nothing new; rather, it has been around for half a century (see Black & Wiliam, 2003), and has been used in combination with coaching programs such as the Texas School Ready Model (Crawford et al., 2017) and the Classroom Strategies Coaching Model (Reddy et al., 2017). In these programs, the formative assessment is focused on evaluating teachers' instructional behavior and/or student progress. As such, they can provide valuable information that can be used to improve teaching and student learning behaviors. In comparison, the current study articulated a formative assessment approach focused on teacher reflection. If the goal of teacher development is to focus not only on outcomes, but also on processes, then approaches are needed to support coaches to learn to recognize and adjust these reflective processes. Together, the 4C/ID-inspired video-coaching blueprint and the formative assessment approach provide an extension of the existing knowledge bases on 4C/ID and formative assessment of teachers' practices, respectively, in the context of video coaching, and offer opportunities for further research.

RO3: Reify the Articulated Support in a Tool to Improve Teacher Reflection in Video-coaching Settings

Findings related to RO3

Sub-studies C and D contributed to RO3. Both studies showed that no formative assessment tools are currently used in coaching contexts to improve teachers' reflective talk. This means that there are no supports for coaches, despite the fact that steering these conversations is difficult for coaches, and teachers need guidance on reflection. Both studies contributed to quality criteria for a viable tool to improve teacher reflection in video-coaching settings. Sub-study C did this through expert recommendations, whereas sub-study D did so through a proof-of-concept study. Sub-study D found that a formative assessment tool for teacher reflection has the potential to provide added value in terms of effectiveness through coach development and calibration, through mirroring (i.e., providing insight into the current state) and advising (i.e., providing guidance on next steps). The results indicated overall limited negative costs with regard to enjoyment and efficiency.

Sub-studies C and D contributed to developing quality criteria for *clarity*, that is, to what extent users can see their involvement in the tool (see Figure 6.3). Sub-study C yielded a set of 36 indicators (12 deliberate, 12 aware, 12 united) that experts deemed sufficiently clear to use in an instrument to

formatively assess teachers' reflection. Building on these indicators, sub-study D focused on features that a tool should incorporate to support understanding of reflection tasks. The findings from sub-study D provided additional criteria for tool clarity:

- During configuration, the tool supports lens selection, by providing understanding of what grounds on which the frame for formative assessment needs to be chosen.
- During filtering, the tool supports attention to the subject, by providing understanding of who is being observed in the video during formative assessment, as well as supports judgment, by providing understanding of whether the reflection aspects simply need to be present or need to be judged on quality.
- During scoring, the tool supports understanding of how fully and specifically teaching effectiveness standards should be referred to in the reflective conversation, as well as supporting understanding of the judgment of the qualities of the reflective conversation through the scoring specifications.
- Overall, the tool supports understanding of terminology and/or language used, and provides contextual information to support understanding of what has happened before the coaching conversation.

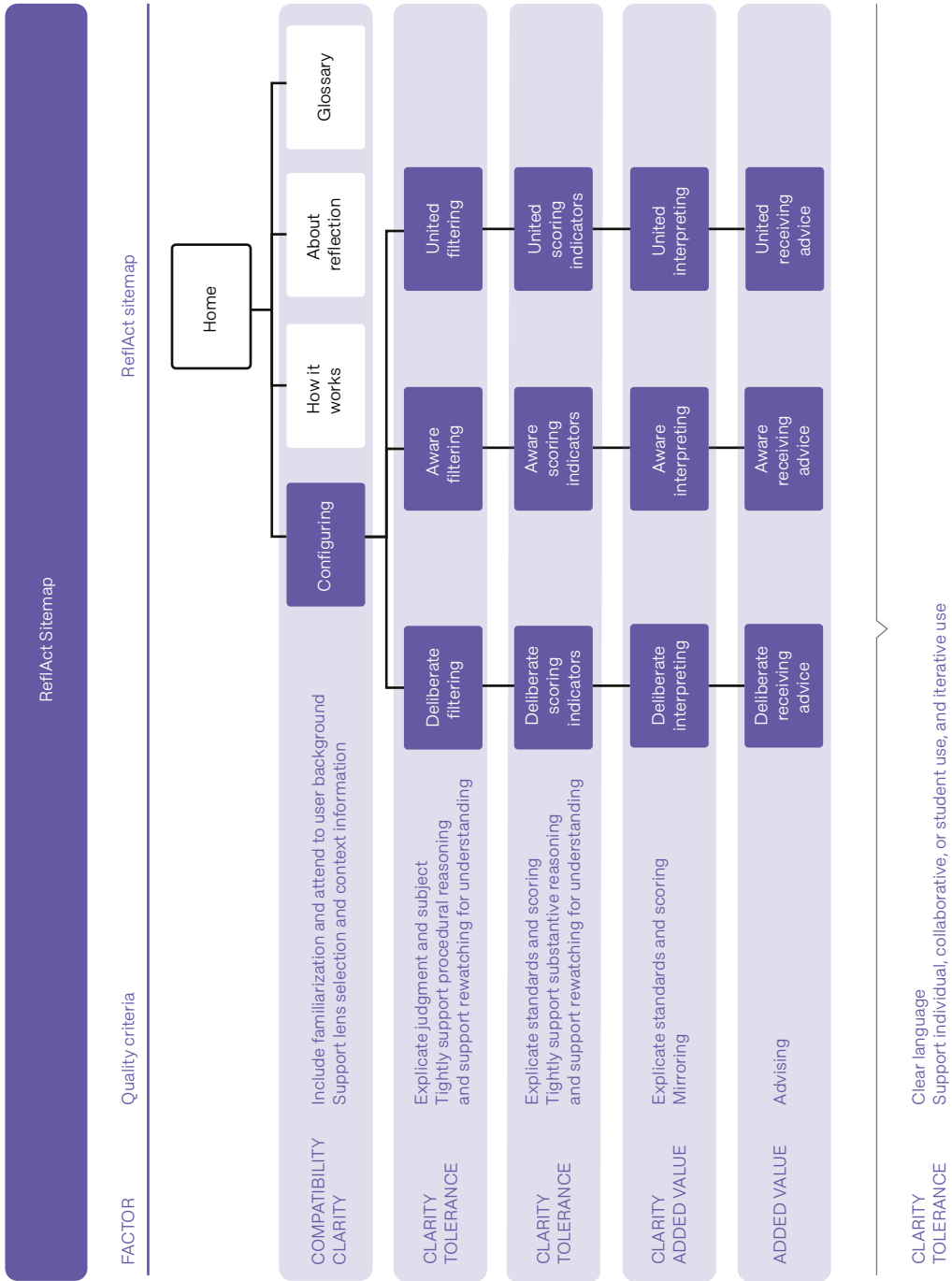
Sub-study D also provided quality criteria for the *compatibility* of a tool:

- The tool aligns to the context where it is implemented. This is likely when a tool fulfils a need within the organization, or when a need surfaces through use of such a tool.
- The tool accommodates variation in user background, because coaches' expertise on teacher reflection can vary.
- Familiarization opportunities are included that help users to orient to the task and build scoring accuracy.

With regard to *tolerance*, sub-study D showed that the design needs to tightly support reasoning processes, that is, procedural and substantive reasoning. However, the design needs to be loose when it comes to the modality, i.e. flexible enough to be used by individuals or teams, with practicing or student teachers, and to support iterative use, as well as options to rewatch for understanding. Figure 6.3 describes the reification of support in ReflAct, the tool for improving teacher reflection in video-coaching settings that was developed and tested in this study.

Figure 6.3

Reifying the Articulated Support in ReflAct, a Tool to Improve Teacher Reflection in Video-coaching Settings



Discussion RO3

Prior to this study, few (if any) practical tools were available to assess video-rich reflective talk in an ecologically valid way. Ecological validity is “the degree of correspondence between the research conditions and the phenomenon being studied as it occurs naturally or outside of the research setting” (Gehrke, 2018, p.564). Here, the phenomenon that is being studied is teachers’ video-rich reflective talk, and the proof-of-concept study explored the viability of a tool to assess this talk as it would occur in a natural setting. To this end, video recordings of the coaching conversation were put forward as input in order to assess teacher reflection as it occurred in the video-coaching conversation. Compared to other instruments that measure teachers’ video-based reflection, the input was different, because these instruments are focused on assessing teachers’ reflective writing (Nagro, 2020; Nagro et al., 2017; Ward & Cotter, 2004). These instruments appear very well suited to teacher education where reflective writing takes place, for instance, through portfolios (e.g., Toom et al., 2015), but not as well to video coaching in schools, where the reflection occurs naturally in conversation. Compared to coding, which is often used for assessing reflection in video-coaching settings (e.g., Gelfuso & Dennis, 2014), both methods have high ecological validity, but coding is not very suitable for use in practice, because it is very time-consuming. Development of tools that meet the needs of practice is especially important; this study aimed to develop a tool that can be used in line with the video-coaching cycles that will be less time-consuming than coding, and in which the information gathered from the assessment can serve as input for subsequent conversations. It is worth acknowledging that more needs to be done to make sure that the tool is actually ecologically valid. Scholars practicing various forms of design research in education have called specific attention to the ecology in which a design is implemented, because of its impact on change (McKenney, 2018; Penuel et al., 2011). Because school contexts vary considerably, it is of interest to understand not only if such a tool works, but even more so if such a tool works, for whom, why, and how, which is an important direction for further research. But the results of this study showed that a tool that offered support for observing and improving unified reflection could have added value and could be viable in practice. It is expected that the indicators of the tool will apply well across grade levels and subjects, and seems plausible that teachers’ preferences for student-centered or teacher-centered instructional methods might influence the choice for the perspective taken on reflection (deliberate versus aware). But regardless of contextual differences or variety in personal preferences, uniting perspectives is expected to be beneficial because understanding the interaction between teacher actions and student (learning) behaviors is sensible either way. Formative assessment tools of teacher reflection thus

have the potential to support the context-specific considerations that have been central to this discussion, that is, how to use core practices productively to support specific student populations, taking into account the opportunities and constraints of the context where teaching is taking place.

Reflections on the Study

This section reflects on the experience of conducting educational design research in the midst of a global pandemic. It also considers the quality of the methods and limitations of the study, as well as recommendations for further research, practice, and policy.

Revisiting the Process

The global COVID-19 pandemic affected this study's educational design research process considerably, and sparked questions about when to use video for professional development. In educational design research, theoretical and practical outputs are ideally shaped by successive iterations of analysis and exploration, design and construction, and evaluation. Under normal circumstances, much of the work takes place in schools, often in collaboration with practitioners (McKenney & Reeves, 2019). Considering the core processes of educational design research, it is easy to imagine that evaluation was much affected, as many activities could not take place due to school closures or needed to take place online. In this study, it also caused a shift in focus. After the outbreak of the pandemic, it soon became clear that planning for fieldwork that would not directly serve the schools' immediate needs to provide education in the midst of tremendously challenging circumstances was undesirable, and in fact, not even possible. Moreover, informal communications with coaches and teachers soon indicated that the circumstances did not provide a safe enough environment for video coaching, and both teachers and coaches were reluctant to continue or take on additional tasks, as they were already stretched thin. As a consequence, research efforts were refocused toward gathering expert insights on how to measure video-rich reflection processes, and subsequently on the development of a tool that can be used in practice. Interestingly, these extreme circumstances also raised questions about the applicability of video-coaching professional development to situations that are characterized by high levels of uncertainty. On the one hand, one might argue that video coaching is especially suitable to support

online teaching; on the other hand, the shift to online teaching might have made teachers feel too vulnerable to be recorded. While the need to establish a safe learning environment in learning with video has been underscored by other scholars (e.g., Borko et al., 2017), it might be worth considering that in some situations the use of classroom video might be too intrusive (for some), and other professional development are more suitable.

Limitations of the study

While this study involved carefully planned resource selection and participant recruitment strategies to increase the validity of the results, as well as measures taken during the analyses to enhance reliability, it is important to address the limitations as well. This section reports on limitations of the overall study, because the those of the individual sub-studies have already been discussed in their respective chapters. Specifically, it focuses on the lack of field testing, the number of participants, and the role of the researcher.

Throughout the duration of this study, schools were forced to close on multiple occasions due to the COVID-19 pandemic, and needed to focus all their resources on supporting student learning in extremely challenging circumstances. While extensive field testing was desirable and originally planned, these circumstances did not allow for it to occur; therefore, it was simply not possible to field test the formative assessment tool or its underlying ideas (e.g., 4C/ ID blueprint for united reflection). This is unfortunate, because observing use in schools would surely have contributed to greater understanding of whether and how this work could support coaching practices, impact the quality of teachers' reflections, give greater insight into how coaches perform, or be improved.

While great efforts were undertaken to include as many participants as possible, the total number of participants was relatively small. And even though the recruitment strategies were carefully planned to increase the validity of the study, one consequence of the smaller number of participants is that the findings might have limited generalizability. While this study did include participants from different continents as well as from research and practice, it did not include participants from all continents, nor did it inspect differences between the video-coaching contexts specifically, or differences between the participants based on their characteristics. As such, it was not comprehensive in terms of representation, nor can it speak to how the findings apply to various contexts. Consequently, studies that compare different contexts within or between countries are of interest, and future research should involve more participants, especially including coaches working in schools and their teachers, as well as the teachers' students, when investigating impact.

Finally, the author of this dissertation acted as researcher and designer in this study. Even though this has its advantages for design, combining the roles of designer/developer and researcher in one and the same intervention could pose threats to objectivity (McKenney & Reeves, 2019). In order to mitigate this potential researcher bias, a number of measures were taken; in qualitative data analysis, triangulation was sought between respondents and data sources, and coding of data was discussed with the research team until sufficient reliability was reached and/or full consensus was reached. Moreover, where possible, intermediate results were shared with participants and the explicit opportunity was provided to share comments or questions regarding those results before moving further with the study. Future research could further address this concern by separating the roles of designer and researcher where possible and desirable. This would be especially desirable when conducting summative evaluations (effectiveness/impact), because then the benefits are not present of combining roles for consideration of implications for design.

Recommendations

Further Research

While this study conceptualized a model for unified teacher reflection, articulated ways to support the improvement of reflection, and provided an initial proof of concept for a formative assessment tool, many questions remain with regard to supporting teacher reflection in video-coaching settings. This is especially the case when considering that the ultimate goals are to improve teacher outcomes and student impacts. Moreover, there is limited insight into features of video-coaching interventions and the organizational structures can support sustainability of these interventions or scaling up. Therefore, further research should be focused on investigating local viability and institutionalization further, as well as effectiveness and impact.

More field testing is needed to further investigate the local viability of video-coaching interventions that focus on developing teacher reflection. An example of a research question that could be of interest in this regard is: *What aspects of the video-coaching intervention support or hinder change in various school contexts?* Quasi-experimental mixed-method studies that focus on understanding differences between settings, with high versus low teacher reflection measured through quantitative pre-post comparisons with an observation instrument measuring important aspects of reflection such as

ReflAct, combined with qualitative investigations of compatibility, clarity, and tolerance through interviews and observations could support theory development regarding this topic.

Moreover, attention should be paid to the way video-coaching interventions can become embedded in the institution and how this can be supported (McKenney & Reeves, 2019). An example of a research question that could be of interest in this regard is: *What organizational structures and conditions support the sustainability of video-coaching interventions?* While quasi-experimental mixed-methods studies could also serve this goal well, here, the focus shifts from the intervention to the (required) structures surrounding it. Attention should not only be paid to settings in which video-coaching interventions are successful versus not successful; comparisons of settings where video coaching is sustained over time to settings where video coaching is not sustained are also needed to develop theory on this topic. Attention to school cultures that support teacher buy-in could be of interest here (i.e. feedback culture present). Qualitative investigations should be focused on gathering data through interviews and observations of the conditions, such as time and resources for video coaching, as well as on the way leadership is organized within the organization. These should be combined with quantitative pre-post comparisons of reflection quality, e.g. using ReflAct, to support understanding of the success of the intervention.

Finally, the effectiveness and impact of teacher reflection in video-coaching settings needs to be established, especially in relation to teacher and student outcomes. An example of a research question that could be of interest in this regard is: *What is the effect of teacher video coaching on teacher outcomes and impact on student outcomes?* Multilevel analyses can support understanding of the effect and impact of video-coaching interventions, taking into account the nested structures in which video coaching takes place: coaches are nested within schools, teachers are nested with coaches, and students are nested within classrooms/teachers. Here, testing the argumentative grammar of video coaching would be interest; that is, video coaching supports teacher reflection, which in turn supports teacher outcomes, which in turn support student outcomes. The development of this argumentative grammar sparks questions for further research on how to measure the teacher and student outcomes resulting from unified reflection. Such questions include: How should assessment methods be designed that are flexible enough to investigate responses to different situations between participants? What teacher outcomes should be observed when measures of teaching effectiveness or core practices would tell only one side of the story? How should it be determined if the adaptations that were made in planning or enacting instruction based on reflection actually respond to problems in practice?

In order to support research activities in this regard, evidence of the reliability as well as further evidence of the validity of the instrument that has been developed in sub-study C needs to be collected. Validity evidence is “an explicit justification of the degree to which accumulated evidence and theory support the proposed interpretation(s) of test scores for their intended uses” (American Educational Research Association [AERA] et al., 2014, p. 224). Other sources of validity evidence are needed to build further argumentation for interpretation of the scores, such as the response processes, the internal structure, and the relationships with other variables, as well as the reliability (AERA et al., 2014). Technology may be able to play a role here. For example, text mining could offer possibilities for automatic classification, though research would be needed to ascertain if and how the required high-inference judgements regarding reflective talk can indeed be made in reliable and valid ways. If possible, it could offer affordances for large-scale measurement of reflective talk in video-coaching settings. Moreover, it could potentially support coaches to judge conversations correctly using their own videos in tools like ReflAct. However, as with other advances in artificial intelligence in education, there are ethical issues to consider especially related to the quality of the underlying algorithms.

Implications for Practice

This study also yields important recommendations for practice. As argued throughout this dissertation, coaches are needed to support teacher reflection in video-coaching contexts, because there is high risk that reflection will not be productive otherwise. In order to lead professional learning within their institutions, it is advised that coaches have a clear understanding of what is meant by teacher reflection in video-coaching contexts, and how learning ensues. This study has conceptualized models for that purpose based on the literature and expert insights that are believed to be broadly usable. It has also demonstrated how coaches can unite the deliberate and aware perspectives during reflection, which aligns with the brokering roles that coaches so often fulfil. As Kraft and Blazar (2018) rightly noted, structures are needed that allow for differentiation and are flexible for coaches and their judgement. Two approaches to support coaches’ instructional leadership that can be used flexibly across institutions have been articulated. These are the 4C/ID-inspired video-coaching blueprint to support the complex learning of teachers’ unified reflection and formative assessment of teachers’ video-rich reflection, which are based on learning as well as instructional theory. It is important that coaches attend to all phases of reflection, especially during the formative assessment of teachers’ video-rich reflection. This means that coaches should

pay attention to preparation of the reflection and how teachers form an image of practice, as well as how teachers draw conclusions. Taking a unified approach to reflection can serve different goals during a teacher's career. During teacher education, unified reflection can be especially productive by focusing on developing good teaching practices, that is, core practices (deliberate), while exploring how these practices affect student learning and/or behavior (aware). During the early teaching years, unified reflection can be especially productive by developing more responsive practice and by maintaining core practices (deliberate), but also by considering how these practices serve the student population in the school context (aware), or how these need to be adapted in order to do so.

Recommendations for Policy

Based on this study, recommendation for policy can be given, focused on the shaping of teacher education, the allocation of research funding, and the allocation of school funding. Unified teacher reflection stands to be an important mechanism for developing teachers who are responsive to their contexts, and who are able to adapt core practices to respond in meaningful ways to problems of practice. Consequently, it is recommended that the development of these reflective abilities be embedded in the teacher education curriculum. Further, there are recommendations concerning the allocation of research funds. Studies are especially needed that aim to: (1) gather further reliability evidence for measures of teacher reflection in video-coaching settings, as these are a prerequisite for gathering evidence as to how teacher reflection can support other outcomes in video-coaching settings; (2) further develop and test argumentative grammars regarding how video coaching can support teacher outcomes and student impacts; (3) develop supports for coaches; and (4) investigate scaling-up of video-coaching programs, since effects diminish in larger teacher-coaching programs (Kraft et al., 2018). Finally, there are recommendations for the allocation of school funds. As argued, coaches are very important for teacher development in schools. These coaches need the time and resources to provide meaningful and sustained professional development to colleagues. For example, if coaches are allowed so little time that they can engage in only one video-coaching session with a teacher, this is likely going to have a very limited effect on the quality of the teacher's reflection and, in turn, the teacher's instruction. Structures that provide regular time and access to expertise can maximize the potential benefits of video coaching.

Contributions

This study aligned with previous calls in educational research to focus on more meaningful teaching instead of core practices only (Kennedy, 2016; Zeichner, 2012). It also responded to calls to support coaches' practices (Marrongelle et al., 2013) by developing a model that unites deliberate and aware perspectives during reflection. Moreover, this study responded to the call "to think critically how they [coaching program developers] can implement organizational structures and systems that provide scaffolded supports to individual coaches without restricting their judgment and flexibility" (Kraft & Blazar, 2018, p. 9).

The two approaches articulated in this study (i.e. 4C/ID and formative assessment) provide guidance on where to place specific supports to facilitate coaches' judgment and improve the unified reflection of teachers, while also accommodating local adaptations. Further, by making qualities of video-rich reflective talk concrete, and identifying features that support computer-supported formative assessment tools' viability, this study has launched a new line of research that has the potential to further support coaching of teachers' reflective practices. As such, this study has made a small, but noteworthy contribution to supporting the practices of coaches who want to use video for teacher reflection in meaningful ways.

John Dewey once wrote, "We do not learn from experience. We learn from reflecting on experience" (1933, p.78). As argued in this dissertation, the second part of the quote might be extended to say that "we learn from reflecting on, for, and in experience." But more importantly, we must keep in mind that teachers' reflections are as good as the frames that they select, the depth of their sense-making, the grounds that support their knowledge and beliefs, and the conclusions that they draw from this. Thus, in order to learn to teach, it is critical that teachers learn *how* to reflect on, for, and in their teaching experiences, as this will set them up for continued development of their teaching practices throughout a teaching career. Coaches have a critical role to play in this part, and this study contributes to helping them equip teachers with the tools they need to not just teach well, but to teach in a mindful way.

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Nederlandse Samenvatting

Introductie

Het leren lesgeven is complex, zeker in het begin van een carrière, maar coaches kunnen hierbij een cruciale rol spelen. Het leren lesgeven begint (voor velen) formeel in de lerarenopleiding, gaat verder in de inductiefase, en wordt vervolgd via diverse vormen van docentprofessionalisering binnen en buiten de school. Coaching is een professionaliseringsaanpak die bestaat uit cycli van lesobservaties en feedback daarop, gegeven door een deskundige. Coaching zou goed aangevuld kunnen worden met video-opnames van lessen. Deze lesopnames maken het namelijk mogelijk om de lespraktijk nauwkeurig te analyseren, discussies tussen leraren op gang te brengen, en complexe situaties (zoals lessituaties) over te brengen. Onderzoek laat echter zien dat het leren aan de hand van lesopnames lang niet altijd productief verloopt en dat dit deskundig begeleid moet worden, bijvoorbeeld door een coach. In deze studie wordt de combinatie van de twee (lesopnames en coaching) – video-coaching – beschouwd als een specifieke aanpak binnen een breder repertoire van coachingsactiviteiten. Video-coaching is binnen deze studie gedefinieerd als een professionaliseringsaanpak waarbij lesopnames worden gemaakt en aan de hand van deze lesopnames discussies worden gevoerd tussen een individuele docent en een coach of in groepsverband, op een duurzame wijze. Duurzaamheid verwijst hier naar de notie dat coaching idealiter uit meerdere coaching-cycli uitgevoerd tijdens een schooljaar bestaat om het leren te bevorderen. Zowel coaching als het gebruik van lesopnames hebben in de loop van de jaren veel aandacht heeft gekregen in onderwijs-onderzoek, maar naar de combinatie – video-coaching – is slechts beperkt onderzoek uitgevoerd.

Probleemstelling

Hoewel er een dringende behoefte is om meer coaches op te leiden die kwalitatief goede coaching kunnen bieden aan leraren, is de kennisbasis over de ondersteuning voor coaches beperkt. Coaches van buiten de school maken vaak deel uit van de staf van coaching-programma's, en beschikken meestal over een hoge mate van coaching-expertise. Maar veel scholen werken met interne coaches, en die hebben lang niet altijd toegang tot deze hoogwaardige coaching-expertise. Deze studie richt zich daarom op de ondersteuning van

interne coaches. Deze coaches zijn vaak zelf ook leraren. Onderzoek wijst uit dat nieuwe coaches het moeilijk vinden om productieve discussies te begeleiden tijdens video-coaching, terwijl het belang van productieve reflectie van leraren bij het leren met video wordt benadrukt in onderzoek. In deze studie wordt reflectie gedefinieerd als het in overweging nemen van wat men weet of vindt, de bewijslasten of gronden die dit ondersteunen, en de gevolgen dat dit heeft. Het vinden van aanknopingspunten voor het ondersteunen van reflectie wordt bemoeilijkt doordat reflectie in diverse studies verschillend is ingevuld. Het ontwikkelen van ondersteuning voor coaches is verder complex omdat de invulling van de coach-rol verschilt tussen scholen. Coaches moeten vaak behoeften van individuele leraren afwegen tegen de behoeften van de school, wat het werk bovendien gedifferentieerd en gesitueerd maakt. De huidige kennisbasis over ondersteuning voor video-coaching is klein, waardevol, en vooral gericht op acties die coaches tijdens een coachingsgesprek kunnen uitvoeren. Maar er zijn aanvullende inzichten nodig om coaches te helpen om video-coaching binnen de eigen school vorm te geven. Bovendien zijn er geen hulpmiddelen beschikbaar die coaches ondersteunen om de kwaliteit van de docentreflecties tijdens video-coaching te beoordelen en te verbeteren, terwijl dit aspect juist goed begeleid moet worden. Vanwege de diversiteit aan taken en gebruikcontexten zouden schoolinterne coaches gebaat zijn bij kennis, ondersteuning, en hulpmiddelen die breed toepasbaar zijn en tegelijkertijd ook aanpasbaar zijn aan de eigen context.

Doelen van de studie

Deze studie heeft als doel om een bijdrage te leveren aan de ondersteuning van schoolinterne coaches die lesopnames inzetten bij het coachen van docenten. Hiervoor is het nodig om zowel theoretische kennis als praktische ondersteuning te ontwikkelen. Hiertoe zijn de volgende drie onderzoeksdoelen (OD) opgesteld:

- OD 1: *Conceptualiseren* van docentreflectie binnen video-coaching
- OD 2: *Articuleren* van benodigde ondersteuning om de docentreflectie tijdens video-coaching te verbeteren
- OD 3: *Concretiseren* van hulpmiddelen om de docentreflectie tijdens video-coaching te verbeteren

Onderzoeksaanpak

Om zowel de theoretische als de praktische doelstellingen van deze studie te dienen, is gekozen voor "educational design research" als onderzoeksaanpak. Educational design research bestaat uit fasen van (1) analyse en verkenning, (2) ontwerp en constructie, en (3) evaluatie en reflectie, waarbij steeds expliciet aandacht wordt besteed aan de implementatie en verspreiding van de (tussen)opbrengsten. De analyse- en verkenningfase heeft als doel om inzicht te verkrijgen in de bestaande situatie, de ontwerp- en constructiefase heeft als doel om oplossingen te ontwikkelen, en de evaluatie- en reflectiefase heeft als doel om oplossingen te testen. Elke fase genereert implicaties voor zowel theorie als de praktijk.

In deze studie zijn vier deelstudies (A, B, C, en D) uitgevoerd, elk met de nadruk op een andere fase van een educational-design-research proces (analyse, ontwerp, constructie, en evaluatie, respectievelijk). Elke studie is op zichzelf staand waardevol en tevens ook ondersteunend aan meerdere onderzoeksdoelen. De bijdragen van elke deelstudie aan de onderzoeksdoelen zijn weergegeven in Figuur 1. In de volgende paragraaf worden de resultaten per deelstudie gepresenteerd en vervolgens gekoppeld aan de onderzoeksdoelen.

Figuur 1

Afstemming tussen de deelstudies en de onderzoeksdoelen

		DEEL-STUDIES			
		Analyse (A)	Design (B)	Constructie (C)	Evaluatie (D)
ONDERZOEKSDOELEN	Conceptualiseren (OD1)	van Leraar-Reflectie Tijdens Video-Coaching			
	Articuleren (OD2)		van Ondersteuning voor het Verbeteren van Leraar-Reflectie Tijdens Video-Coaching		
	Concretiseren (OD3)			van Hulpmiddelen voor het Verbeteren van Leraar-Reflectie Tijdens Video-Coaching	

Resultaten

Deelstudie A, *Video Coaching from Design Features to Student Impacts. A Systematic Literature Review*, rapporteert over een systematische literatuurstudie, waarin gedetailleerd wordt beschreven wat er bekend is uit de empirische studies over video-coaching voor leraren. Zowel video als coaching hebben veel aandacht gekregen in onderwijsonderzoek, maar de combinatie, video-coaching, was tot nu toe niet of nauwelijks onderzocht. Deze literatuurstudie onderzoekt wat er bekend is over video-coaching wat betreft het ontwerp, de uitvoering, de opbrengsten voor leraren en leerlingen, en de relaties hiertussen. De artikelen zijn via vijf stappen geselecteerd. Terwijl alle geselecteerde artikelen ($N = 59$) informatie bevatten over de ontwerpkenmerken van video-coaching, rapporteerde slechts ongeveer de helft van de artikelen over de uitvoering van video-coaching in de praktijk. De opbrengst van de literatuurstudie laat zien dat video-coaching een aantal positieve opbrengsten

voor leraren teweeg kan brengen, zoals veranderingen in pedagogisch gedrag, maar er werd geen consistent bewijs gerapporteerd voor alle verschillende typen opbrengsten. Binnen slechts enkele studies werd onderzocht wat de impact van video-coaching was op leerlingen of studenten. Naast de inzichten over de opbrengsten van video-coaching, leverde deze studie ook initiële theorieën op voor de wijze waarop video-coaching ondersteuning kan bieden aan de ontwikkeling van de vakdidactische kennis, vakdidactische aanpakken, en overtuigingen van leraren.

Deelstudie B, *Uniting Epistemological Perspectives for Contextualized Knowledge Development*, rapporteert over een theoretische synthese van docentreflectie-literatuur en hoe deze inzichten kunnen worden toegepast op video-coaching. Twee relevante perspectieven op kennisontwikkeling komen in de literatuur aan de orde. Een *doelbewust* perspectief benadrukt het gebruik van collectieve kennis over lesgeven en het gebruik van die kennis als referentiekader. Een *bewustzijns* perspectief benadrukt kennisontwikkeling in de praktijk door reflectie, planning en het lesgeven, evenals kennisontwikkeling in interactie met anderen. In deze studie wordt beargumenteerd dat het verenigen van beide schijnbaar tegengestelde perspectieven op kennisontwikkeling tijdens reflectie voordelen kan hebben, zoals een betere betekenisgeving, meer verfijnde planning van de les en adaptief lesgeven. Deze bevindingen zijn samengevat in een model voor verenigde reflectie. Deze ideeën zijn vervolgens toegepast op een video-coaching-context en samengevat in een blauwdruk voor het ondersteunen van docentreflectie tijdens video-coaching aan de hand van het "four-components-instructional-design" (4C/ID)-model. Deze deelstudie leidde tot implicaties voor de vormgeving van video-coaching van leraren gedurende hun onderwijscarrière.

Binnen **deelstudie C**, *Portraying the Qualities of Teachers' Video-Based Reflective Conversations: Expert Views and an Initial Instrument*, werden inzichten van reflectie-experts verzameld over de wijze waarop video-rijke reflectiegesprekken tussen coaches en leraren geëvalueerd kunnen worden. Er bleken nog geen instrumenten beschikbaar om de kwaliteit van dergelijke video-rijke reflectiegesprekken op praktische manier te meten. Via een mixed-methods Delphi-geïnspireerde studie, bestaande uit drie rondes, werden belangrijke beoordelingscriteria geïdentificeerd. Data zijn verzameld middels vragenlijsten en interviews. Reflectie-experts uit onderzoek en praktijk ($N = 27$) waren het erover eens dat de meeste reflectieprocessen uit het verenigd reflectiemodel (zie deelstudie B) essentieel zijn voor het beoordelen van reflectieve gesprekken van leraren in het algemeen. Ook gaven ze aan dat een observatie-instrument dat gericht is op de formatieve evaluatie van reflectiegesprekken (met als doel de reflectie te verbeteren) het nuttigst zou zijn. Daarnaast waren ze het erover eens dat het instrument aan alle reflec-

tiefasen aandacht zou moeten besteden. Vervolgens hebben de experts een initieel instrument beoordeeld op duidelijkheid van de gehanteerde beoordelingscriteria voor het meten van video-rijke reflectiegesprekken. Deze deelstudie leverde een initieel instrument op voor het formatief evalueren van reflectie van leraren tijdens video-coaching, met als doel deze reflectie te verbeteren.

Met **deelstudie D**, *Computer-Supported Formative Assessment of Teacher Reflection in Video Coaching Settings: A Proof-of-Concept Study*, werd via een "proof-of-concept" studie onderzocht of een digitaal hulpmiddel om video-rijke reflectiegesprekken formatief te evalueren levensvatbaar kan zijn in de praktijk. Deelnemers, die bekend zijn met situaties waarin reflectie door leraren plaatsvindt ($N = 17$), testten het digitale hulpmiddel tijdens een online evaluatie. Data zijn verzameld door respondenten hardop te laten nadenken tijdens gebruik van het digitale hulpmiddel, en via vragenlijsten, logfiles en interviews. Deze deelstudie leverde eerste bescheiden concreet bewijs op dat een dergelijk digitaal hulpmiddel in de praktijk levensvatbaar zou kunnen zijn en gaf duidelijke aanbevelingen voor het ontwerp van een toekomstig hulpmiddel. Deze deelstudie leverde ook praktische kwaliteitscriteria op die kunnen worden gebruikt door ontwikkelaars en beoordelaars van digitale hulpmiddelen voor de formatieve evaluatie van video-rijke reflectie van leraren.

Conclusies

Waar in de voorgaande paragraaf de resultaten per deelstudie werden behandeld, zullen nu de resultaten gekoppeld worden aan de drie overkoepelende doelstellingen van deze studie (conceptualiseren, articuleren en concretiseren).

Ten behoeve van OD1, het conceptualiseren van reflectie tijdens video-coaching, heeft deze studie vier belangrijke componenten geïdentificeerd en beschreven, namelijk: (1) reflectietypes, (2) perspectieven op kennisontwikkeling, (3) reflectiefasen en onderliggende (4) cognitieve reflectieprocessen. Ten eerste, werden drie reflectietypes onderscheiden op basis van hun focus op het verleden, toekomst, of heden. *Reflectie op actie* is een retrospectief proces, waarbij leraren (onderwijs)praktijken die al hebben plaatsgevonden beschouwen. *Reflectie voor actie* is een anticiperend proces, waarbij leraren toekomstige onderwijsscenario's overwegen. *Reflectie in actie* is een proces dat in het moment plaatsvindt, waarbij leraren opvallende lesmomenten en bijbehorende reacties beschouwen. Ten tweede, werden twee perspectieven

op kennisontwikkeling onderscheiden, die relevant zijn voor reflectie.

Een *doelbewust* perspectief benadrukt het gebruik van collectieve kennis over lesgeven en het gebruik van die kennis als referentiekader. Een dergelijk referentiekader wordt hierbij gebruikt om te reflecteren op, voor, en in de lespraktijk. Een *bewustzijns* perspectief benadrukt kennisontwikkeling in de praktijk door reflectie, lesvoorbereiding en het lesgeven, evenals kennisontwikkeling in interactie met anderen. Door deze perspectieven te verenigen ontstaat er een toegevoegde waarde tijdens de drie eerdergenoemde reflectietypes. Ten derde, werden in deze studie drie *reflectiefasen* onderscheiden. Tijdens de *voorbereiding* stellen leraren de reflectievraag en verzamelen daaraan gerelateerde informatie over de lessituatie. Tijdens de *beeldvorming* onderzoeken leraren de lessituatie die tijdens de voorbereiding is geïdentificeerd. Tijdens het *conclusies trekken* vergelijken leraren hun bevindingen vanuit de beeldvormingsfase binnen of tussen perspectieven en overwegen zij de implicaties voor vervolg. Ten slotte, werden de *cognitieve reflectieprocessen* die plaatsvinden tijdens de eerdergenoemde reflectiefasen beschreven, en hoe deze kunnen worden aangestuurd vanuit de verschillende perspectieven. Leraren moeten de situatie *kaderen*, *interpreteren*, en om vervolgens te kunnen *bepalen* waar ze nu zijn in het lesgeven en waar ze naartoe kunnen, zelf en met hulp van een ander.

Ten behoeve van OD2, het articuleren van ondersteuning, heeft deze studie twee benaderingen beschreven aan de hand van het "four-components-instructional-design" model (4C/ID) en formatieve evaluatie. Het 4C/ID model werd gebruikt om te illustreren hoe een complexe taak als een verenigde reflectie op, voor, en tijdens de lessituatie ondersteund wordt. Een blauwdruk voor video-coaching werd aan de hand van de vier belangrijke 4C/ID componenten omschreven, zijnde de leertaak, procedurele informatie, ondersteunende informatie, deeltaakoefening. De leertaken, in dit geval verenigde reflectie, moeten zo worden aangeboden dat ze een toename in complexiteit laten zien. Daarbij werd beargumenteerd dat reflectie op actie het minst complex is, reflectie voor actie gemiddeld complex is, en reflectie in actie het meest complex is, op basis van onderliggende cognitieve processen. De procedurele informatie moet "just-in-time" worden verstrekt ter ondersteuning van de uitvoering van drie eerdergenoemde reflectiefases. De ondersteunende informatie moet constant beschikbaar zijn om cognitieve verwerking te ondersteunen tijdens de reflectie. Vooral tijdens het trekken van conclusies kunnen begeleidende vragen van de coach de groeikansen vergroten. De deeltaken kunnen geoefend worden om terugkerende aspecten van de taak te automatiseren. Met betrekking tot de tweede benadering, gaven experts aan dat er behoefte is aan instrumenten voor de formatieve evaluatie van de reflectie van leraren tijdens video-coaching, met als doel reflectie te verbeteren. Bovendien

vonden experts dat aan alle drie reflectiefasen aandacht besteed moet worden tijdens observaties met een zodanig formatief doel. Deze studie beschreef verder hoe technologie zou kunnen helpen om de kloof tussen huidige en gewenste reflectieve praktijken te dichten. Video-opnames van coachingsgesprekken kunnen de reflectiekwaliteit van de leraar inzichtelijk maken, digitale omgevingen kunnen het eenvoudiger maken om de huidige reflectiekwaliteit te vergelijken met de gewenste reflectiekwaliteit, en technologie kan benut worden om advies op maat te geven op basis van de kwaliteitsmeting, om zo reflectie te verbeteren.

Ten behoeve van OD3, het concretiseren van hulpmiddelen, werden beoordelingscriteria ontwikkeld om reflectiegesprekken formatief te evalueren, en werd de levensvatbaarheid van een digitaal hulpmiddel met dit doel verkend. Uit deze studie bleek dat er op dit moment nog geen (digitale) hulpmiddelen in de praktijk worden ingezet om coachingsgesprekken te verbeteren via formatieve evaluatie. Deze studie leverde een set van 36 beoordelingscriteria op (12 doelbewust, 12 bewustzijn, 12 verenigd) die experts voldoende duidelijk achtten om te gebruiken in een instrument om de video-rijke reflectie van leraren formatief te evalueren. Voortbouwend op deze beoordelingscriteria werd een digitaal hulpmiddel ontwikkeld (ReflAct) en werd onderzocht welke kenmerken een dergelijk hulpmiddel zou moeten hebben om levensvatbaar te zijn in de praktijk. Deze studie leverde bescheiden maar concreet bewijs op dat het ontworpen digitale hulpmiddel levensvatbaar zou kunnen zijn in de praktijk en een toegevoegde waarde zou kunnen bieden vooral voor de ontwikkeling van coaches.. Een digitaal hulpmiddel zou volgens de respondenten vooral goed aansluiten bij situaties waar al behoefte bestaat om reflectiegesprekken te verbeteren, maar kan ook dienen om een behoefte naar verbetering van reflectie naar boven te halen. Respondenten wezen er op dat aandacht moet worden besteed aan verschillen tussen gebruikers en aan het versterken van de mogelijkheden om vertrouwd te raken met de inhoud van de tool. Ook heeft de studie een aantal specifieke helderheidscriteria naar voren gebracht waar soortgelijke digitale hulpmiddelen aan zouden moeten voldoen. Het hulpmiddel zou verder ruimte moeten bieden voor verschillende gebruiksmodaliteiten, maar tevens een hoge mate van ondersteuning moeten bieden voor het redeneren over de aanwezigheid van belangrijke aspecten van reflectie. Als zodanig leverde deze studie ook praktische kwaliteitscriteria die gebruikt kunnen worden door ontwikkelaars of beoordelaars van vergelijkbare digitale hulpmiddelen.

Reflectie

Het uitvoeren van deze “educational design research” tijdens de coronapandemie heeft invloed gehad op het onderzoeksproces en de methodologische keuzes. Hoewel maatregelen om de validiteit en de betrouwbaarheid van de studie te vergroten zorgvuldig waren voorgenomen, heeft de pandemie invloed gehad op de gegevensverzameling en participatiemogelijkheden. Dit heeft gevolgen gehad voor de inzichten die deze studie heeft kunnen opleveren en de mogelijke generalisatie van de resultaten naar verschillende contexten. De pandemie heeft ook vragen naar voren gebracht over de geschiktheid van video-coaching voor de professionalisering van leraren in tijden waarin een hoge mate van onzekerheid geldt.

Verder hebben resultaten van deze studie diverse implicaties voor onderzoek, praktijk en beleid. In termen van onderzoek, kwam onder andere naar voren dat meer inzicht nodig is hoe video-coaching kan bijdragen aan het verbeteren van de leerresultaten van leerlingen. Ten behoeve hiervan moet de betrouwbaarheid van onderzoeksinstrumenten verder geëvalueerd worden. Bovendien is er nog beperkt inzicht in kenmerken van video-coachingsinterventies en factoren binnen de schoolorganisatie die duurzaamheid van deze interventies en/of opschaling ervan kunnen ondersteunen. Ook is nader onderzoek nodig naar de ondersteuning van coaches. Voor de praktijk is het van belang om te benadrukken dat coaches reflectie aan de hand van video-opnames moeten ondersteunen, en deze studie heeft zowel bijgedragen aan inzichten wat video-rijke reflectie inhoudt en concrete benaderingen geschetst voor het ondersteunen en verbeteren van video-rijke reflectie. Beleidsmakers wordt geadviseerd om docentreflectie een plaats te geven binnen het opleidingscurriculum van de lerarenopleiding en deze studie heeft geïllustreerd hoe video-coaching een concrete plaats kan krijgen. Tot slot is het advies om gelden vrij te maken voor onderzoek, maar ook om coaches in de scholen te ondersteunen.

Bijdragen

Door het opleveren van een model dat doelbewuste en bewustzijns perspectieven verenigt tijdens reflectie, sluit deze studie aan bij het advies van experts om onderwijsonderzoek te focussen op meer betekenisvol lesgeven, in plaats van alleen het aanleren van effectieve instructie. Bovendien beant-

wordt deze studie aan de oproep om meer ondersteuning voor coaches te ontwikkelen en hiertoe zijn twee benaderingen (4C/ID en formatieve evaluatie) gearticuleerd. Deze benaderingen geven aan waar ondersteuning voor verenigde reflectie geplaatst moet worden, en ondersteunen het oordeel van coaches, terwijl ze flexibel zijn om verder in te richten op basis van contextuele behoeftes. Verder heeft deze studie een nieuwe onderzoekslijn geïdentificeerd die het potentieel heeft om video-coaching verder te ondersteunen, door de kwaliteiten van videorijke reflectieve gesprekken concreet te maken en kenmerken te identificeren die de levensvatbaarheid van digitale hulpmiddelen voor formatieve evaluatie ondersteunen. Op deze manier heeft dit onderzoek een kleine, maar noemenswaardige bijdrage geleverd aan het ondersteunen van de praktijken van coaches die video op zinvolle manieren willen gebruiken voor reflectie door docenten.

John Dewey schreef, "We leren niet uit ervaring. We leren door te reflecteren op de ervaring" (1933, p.78). Zoals betoogd in deze dissertatie, zou het tweede deel van het citaat uitgebreid kunnen worden door te zeggen: "We leren door te reflecteren op, voor, en in ervaring". Maar nog belangrijker is het gegeven dat de reflecties van leraren enkel zo goed zijn als de kaders die ze selecteren, de diepgang van hun betekenisgeving, de gronden die hun kennis en overtuigingen ondersteunen, en de conclusies die ze hieruit trekken. Om te leren lesgeven, is het dus van cruciaal belang dat leraren leren *hoe* ze moeten reflecteren op, voor en in hun ondervindingen, omdat dit hen in staat zal stellen hun onderwijspraktijken tijdens hun hele ondervinding te blijven ontwikkelen. Coaches spelen hierbij een cruciale rol en deze studie heeft ertoe bijgedragen dat coaches leraren kunnen uitrusten met de tools die ze nodig hebben om niet alleen goed les te geven, maar om juist ook bewust les te geven.

Scientific Output

Peer-Reviewed Journal Articles

- van der Linden, S., van der Meij, J., & McKenney, S. (2021). Teacher Video Coaching, From Design Features to Student Impacts: A Systematic Literature Review. *Review of Educational Research*. <https://doi.org/10.3102/00346543211046984>
- van der Linden, S., & McKenney, S. (2020). Uniting epistemological perspectives to support contextualized knowledge development. *Educational Technology Research and Development*, 68(2), 703-727. <https://doi.org/10.1007/s11423-020-09772-7>
- van der Linden, S., van der Meij, J., & McKenney, S. (2019). Design and Enactment of Mobile Video Coaching. *TechTrends*, 63(6), 693-702. <https://doi.org/10.1007/s11528-019-00413-2>
- van der Linden, S., Anantharajan, M., Nieveen, N., & McKenney, S. (Under review). Assessing Teachers' Video-Based Reflective Conversations: Expert Views and an Initial Instrument.
- van der Linden, S., Papadopoulos, P., Nieveen, N., & McKenney, S. (Under review). Computer-Supported Formative Assessment of Teacher Reflection in Video Coaching Settings: A Proof-of-Concept Study.

Keynote

- van der Linden, S. (2021, April 1). *Verenigde Reflectie*. [United reflection; keynote]. University of Amsterdam. Online.

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- van der Linden, S., & McKenney, S. (2020, November 6). Uniting epistemological perspectives to support contextualized knowledge development. In West, R., Ertmer, P, McKenney, S. (Chairs), *The Role of Theory in Learning Design and Technology Research and Practice* [Symposium on ETR&D Special Issue]. AECT 2020 Virtual International Convention. Online.
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Professional Development Workshops

- van der Linden, S. (2020, September 7). *Leren door te reflecteren met video coaching* [Learning to reflect with videocoaching; webinar]. Academische Opleidingschool Oost-Nederland (AOS-ON). Online.

- van der Linden, S. & Zwarteveen, A. J. (2019, June 5). *(Doel)bewust professionaliseren: Routines voor Video Coaching van Startende Leraren* [Purposeful professional development: routines for videocoaching early career teachers; workshop]. Platform Samen Opleiden & Professionaliseren en het project Begeleiding Startende Leraren, Bussum, the Netherlands.
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Dankwoord Acknowledgements

Sommigen omschrijven promoveren als een weg die grotendeels alleen wordt afgelegd, maar toch heb ik me nooit eenzaam gevoeld. Hiervoor wil ik mijn begeleidingsteam, collega's, en naasten bedanken die me hebben bijgestaan de afgelopen jaren en er mede voor hebben gezorgd dat dit proefschrift er nu ligt.

Allereerst wil ik mijn begeleidingsteam bedanken. Susan, thank you for being my 'knowledgeable other'. You have continuously challenged me to go the extra mile, but also provided the necessary support to do so. While it was certainly not always easy, it was an incredible learning experience for which I am very grateful. Nienke, wat een geluk dat je later aansloot als co-promotor. Jouw scherpe vragen dwongen mij om mijn ideeën helder te formuleren, en als directeur van de lerarenopleidingen zorgde je ervoor dat de coach en de onderwijspraktijk altijd goed in het vizier bleven.

I am also very grateful to Madhu and Pantelis for temporarily joining the team and sharing your valuable expertise, comments, and questions. Jan, ook jij verdient hier een eervolle vermelding, want mede door jouw begeleiding aan de start kreeg het project, en de eerste studie goed vorm.

ELAN-colleagues, thank you for making this such an enjoyable experience, and for the opportunities to discuss my research. Adrie, bedankt voor alle kritische vragen door de jaren heen. Tim, ik heb genoten van onze (online) gesprekken met een kopje koffie of thee erbij, en het was heel fijn om een collega te hebben die ook bezig was met 'educational design research'. Frances and Lucas, I feel lucky to have had you as roommates, thank you for all the well-timed (coffee) breaks and much-needed small talk.

I am also very grateful to the participants in this study. Thank you for your time and your willingness to share your opinions and thoughts on teacher reflection and ways to support it.

Lieve vrienden, jullie brachten de nodige afleiding en ontspanning, die me weer nieuwe energie gaven. Met jullie is het altijd een feestje.

Lieve (schoon)familie, niemand heeft het project zo op de voet gevolgd als jullie. Bedankt voor de constante interesse in de voortgang van het 'boekje'. Marlies en Brigit, bedankt dat jullie mijn paranimfen willen zijn, en mij bijstaan bij de laatste loodjes, ik vind dat heel bijzonder. Pap en mam, jullie hebben me altijd het vertrouwen gegeven dat geen enkele uitdaging te groot is en dat het allemaal wel goed komt. Zonder dat vertrouwen had ik dit avontuur niet aangedurfd.

En als laatste maar zeker niet als minste, Jort, mijn liefste, zonder jouw eindeloze steun was dit nooit gelukt. Samen kunnen we alles. En natuurlijk heb je ervoor gezorgd dat het proefschrift er ook nog eens geweldig uitziet.

Teaching is a complex task that needs to be supported in order to retain high-quality teachers, especially novices. Two forms of professional development that have the potential to be highly effective together are teacher coaching and the use of classroom video. Unfortunately, while each of these has received considerable attention in educational research over the years, investigation of the combination – teacher video coaching – is limited. And yet, many schools invest in personnel and equipment to enable video coaching for teacher professional development, whereby recorded teaching episodes are used to stimulate reflection. The lack of research is unfortunate because an empirical basis is needed to inform and develop supports for teacher coaches.

To address this lacuna, four sub-studies were undertaken within one educational design research project. First, a systematic literature review synthesized video coaching design features, enactment processes, teacher outcomes, and student impacts as reported in empirical studies. Second, by leveraging insights from literature and embracing different epistemological perspectives, a theoretical synthesis was undertaken to develop a model for reflection in teacher video coaching settings. Third, expert opinions were sought on how to assess key aspects of teachers' video-based reflection based on the aforementioned model, in a three-round Delphi-inspired study. Based on these findings, an instrument was constructed to assess teachers' video-supported reflective conversations. Finally, a proof of concept study was undertaken to explore the viability of a computer-supported formative assessment tool based on the aforementioned instrument. Together, these sub-studies contribute to the conceptualization of teacher reflection in video coaching settings, as well as the articulation and reification of supports to improve it.

Sara van der Linden