NAĎA VONDROVÁ ET AL.

VIDEO-INTERVENTIONS

BRIDGES BETWEEN THEORY AND PRACTICE IN PRE-SERVICE TEACHERS' DEVELOPMENT

KAROLINUM

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Bridges Between Theory and Practice
in Pre-Service Teachers' Development

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CONTENT

Introduction

The pupils' task is to find out the reason for the division of placental mammals and what a placenta is. The teacher tries to motivate the children to use the knowledge they already have towards this aim, but she does the same for the new subject matter. Here I would instead use the method of a teacher's exposition combined with the involvement of pupils through questions. (Michelle)

However, in the next part of the lesson, I liked the fact that the teacher forced the children to work and think independently. She asked different questions (such as What's a placenta?), so the pupils had to think and come to some sort of answer. (Anna)

She led the pupils by questions to deduce new information..., mostly successfully. On the one hand, it is necessary to appreciate her persistence in questioning (the mechanism for the operation of the placenta, etc.), which undoubtedly contributed to the pupils' better imaginations. On the other hand, some long moments of silence seemed to me like wasted time, especially as the pupils read the text from which they tried to get information for the answers. (Josh)

The teacher captured in this video is, in my view, an example to be followed, as she is dynamic, asks clear and brief questions and highlights key facts. During the exposition

> of new subject matter, the teacher asks additional questions to make sure the pupils understand all the concepts and can reach a comprehensive understanding of them. In general, she possesses managerial skills and, with her questions, leads the class towards the lesson aims. (Claudie)

The above are quotes from pre-service teachers studying to be biology teachers who are responding to a video of a biology lesson. Despite having a similar background and experience, their view of the same event in the lesson (a teacher leading the pupils towards an independent deduction of a new piece of knowledge) differed vastly. Some other pre-service teachers did not even comment on this important aspect of this lesson. While the difference in views was not unexpected by the course leader, she found the failure to realise the importance of this aspect of the lesson rather worrying. The analysis of the video presented an excellent opportunity to focus the pre-service teachers' attention on the concept of knowledge introduction in biology lessons and to use this concrete realisation as a springboard for more in-depth discussions.

Similar illustrative examples could be drawn from the subject education courses led by the authors of this book. When analysing a video lesson, pre-service teachers did not seem to notice the events deemed important by the course leaders and/or interpreted them in many different ways, some plausible, some not. Thus, it is unsurprising that a couple of years ago, the course leaders responded to the first author's plea for interdisciplinary research on professional vision. This theoretical concept had just begun to emerge as an important research topic across many subjects and seemed to be a unifying concept (*boundary object*)[1] for researchers working in different fields. This assumption was confirmed, and the resulting team indeed started a common project on future teachers' noticing. It has yielded several publications (some referenced in this work) but also evolved into a common interest in the use of video-interventions in teacher education. This book is a product of this strand of our joint work.

Studies on teacher education conducted by researchers from different fields often find common ground in general pedagogical concepts. For research on professional vision, this would mean focusing on concepts such as time and class management, assessment, types of teachers' questions, etc. In our work, we decided to adopt a domain-specific stance. As we are all educating future teachers in courses on both subject and subject education, we were naturally interested in subject-specific phenomena. Thus, the goal in the video-interventions we jointly prepared and conducted was to develop the awareness of such phenomena in pre-service teachers. In addition, the subject-specific phenomena became our focus of attention in pre-service teachers' reflections of lessons.

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1 The existence of *boundary objects* (Freeth & Caniglia, 2020) is seen as a necessary pre-requisite of successful cooperation among professionals.

This book documents the journey we made with our university students on their path towards developing their knowledge and skills. The same attention is devoted to each of the subjects which are our focus here (Elementary Art Education, Elementary Social Studies, Biology, English as a Foreign Language and Mathematics). The book begins with a survey of theoretical considerations concerning the types of knowledge and skills pre-service teachers need and the means of developing them, see Chapter 1. This helped us to design two types of video-intervention, which we describe in detail in Chapter 2. In the 'public video' intervention, the pre-service teachers observed and analysed lessons taught by other teachers, while in the 'own video' one they first prepared and conducted their own lessons, and analysed them during the intervention. Chapter 2 presents the types of tasks used in the video-interventions for the different subjects and provides glimpses of PSTs' work within the intervention.

The ensuing chapters present evidence of pre-service teachers' work and learning in the video-interventions. Chapter 3 focuses on Study 1, which takes the classic form of 'experimental vs comparison group' and investigates what and how the pre-service teachers learnt during the video-intervention by analysing their productions pre- and post-intervention. Taking into account that such an analysis might be too restricted in scope, we also gave voice to the pre-service teachers themselves. In Chapter 4, we present their views of their participation in the video-intervention and how they perceived their own learning.

Chapters 5 and 6 comprise case studies through which we want to provide the reader with in-depth insight into how the video-interventions worked. While Study 1 provided us with two one-time measures of the pre-service teachers' skills and reasoning, these two chapters describe the process of learning. The case studies in Chapter 5 were selected from both types of video-intervention, sometimes to contrast the pre-service teachers' learning in the same situation and sometimes to compare their learning in different situations. The case studies in Chapter 6 concern the 'own video' groups and document how the selected pre-service teachers' reflection skills developed and what (probably) caused the observed changes.

While the results of the studies are discussed in the individual chapters, Chapter 7 brings forward some general conclusions and implications for both the practice of teacher education and its research. We also reflect on our own learning which came about through our long-term cooperation.

We recommend the reader to read Chapter 1 to understand the theoretical background to our work and Chapter 2 for necessary information about the video-interventions. Chapters 3 to 6 are relatively independent and can be read separately.

To sum up, this book is primarily about pre-service teachers and how they learnt in a specific video-intervention. It is aimed at both teacher educators and researchers. The former could find inspiration in our detailed description

of the structure of the video-interventions for use in their own practice. They may also find the information we present about how pre-service teachers learnt (or not) through their participation in the video-interventions of use and interest. Although the book concerns specific groups of pre-service teachers (PSTs), we believe that the characteristics, views and knowledge we uncover in this research are more widely applicable. Thus, teacher educators could find our results useful when planning their university courses. The book also identifies new questions which need to be addressed by future research. Last but not least, the book might be useful for pre-service teachers themselves, as they could read it as a kind of metacognitive study in how they learn.

/Chapter 1/
Theoretical framework

The education of future teachers has received considerable attention. In a seminal work, Shulman (1987) provided a coherent theoretical framework of teacher knowledge. He highlighted the need for teachers to possess sets of knowledge and skills which extend beyond those associated with their academic discipline. He distinguished seven categories in the knowledge base of teachers: content knowledge, general pedagogical content knowledge, curriculum knowledge, pedagogical content knowledge, knowledge of learners and their characteristics, knowledge of educational contexts and knowledge of educational ends, purposes and values. General pedagogical content knowledge includes principles and strategies of classroom management and organization transcending subject matter while pedagogical content knowledge is a "special amalgam of content and pedagogy that is uniquely the province of teachers, their own special form of professional understanding", p. 8).

Shulman's work initiated a wave of interest in the content and pedagogical content knowledge of teachers of different subjects. For example, Grossman and Shulman (1994) focused on the pedagogical content knowledge of English

teachers,[2] emphasising the complexity of teaching English, and its less hierarchical structure in comparison to other subjects. In mathematics education, the framework for mathematics knowledge for teaching (e.g., Ball, Thames, & Phelps, 2008) and the Knowledge Quartet (Rowland et al., 2009) were developed. Similarly, Johnson and Cotterman (2015), building on Ball, Thames and Phelps (2008), addressed science knowledge for teaching.

While older frameworks for examining teacher knowledge mostly pursued a cognitive perspective, they were later enhanced by a situated perspective, which emphasises teachers' professional experience, deliberate practice and ability to perceive and attend to essential classroom situations (Putnam & Borko, 2000). Professional vision is regarded as an additional cognitive aspect of teacher competence which reflects the situated and contextualised nature of teaching (Meschede et al., 2017).[3]

1.1 PROFESSIONAL VISION

Professional vision relates to a set of practices which involve interacting with phenomena in the area of expertise in a different manner than lay viewers of the same phenomena (Goodwin, 1994). While definitions of teachers' professional vision vary across studies, they mostly concern two subprocesses – noticing and knowledge-based reasoning (see, for example, Blomberg, Stürmer, & Seidel, 2011). For Sherin, Russ and Colestock (2011), noticing is "*professional vision* in which teachers selectively attend to events that take place and then draw on existing knowledge to interpret these noticed events" (pp. 80-81). Scholars often draw on Mason's work (e.g., 2002 and 2011) on the *discipline of noticing* as "a collection of practices designed to sensitise oneself to notice opportunities in the future in which to act freshly rather than automatically out of habit" (2011, p. 35).

An influential conception of noticing in teaching is that of van Es and Sherin (2002; cited in Sherin & Star, 2011), which includes three aspects:

> (a) identifying what is important or noteworthy about a classroom situation; (b) making connections between the specifics of classroom interactions and the broader principles of teaching and learning they represent; and (c) using what one knows about the context to reason about classroom events. (p. 573)

Jacobs, Lamb and Philipp (2010) enhanced the concept of noticing with a third related component, *deciding*, which refers to a teacher's responses

2 Teaching English as a mother tongue, but it is also applicable to teachers teaching English as a Foreign Language.

3 In their study with pre- and in-service teachers of science, Meschede et al. (2017) showed that there is a moderate correlation between professional vision and pedagogical content knowledge, confirming that they are positively correlated but distinct constructs.

which are ostensibly built upon interpretations of pupils' activities (see also Fisher et al., 2019). These interpretations are "derived from events and behaviors to which teachers had attended" (Thomas, 2017, p. 508). This cluster of attending, interpreting, and deciding has been referred to as professional noticing of children's mathematical thinking (Jacobs et al., 2010).

Knowledge-based reasoning is the ability to reason about what is noticed based on one's professional knowledge (Meschede et al., 2017). However, Schoenfeld (2011) emphasises that even the processes of noticing are knowledge-based, as observers are influenced by their knowledge, beliefs and orientations when dividing their attention between what they see as noteworthy and what they neglect (see also Stürmer, Könings, & Seidel, 2013). Moreover, noticing phenomena is not a passive process: "it involves more or less conscious decision making about what *not* to attend to as well as what to bring forward for further thought" (Simpson, Vondrová, & Žalská, 2018, p. 609).

Researchers present various differentiations of knowledge-based reasoning. For example, van Es and Sherin (2008) distinguish whether the teacher describes, evaluates or interprets the event (see also Section 3.5.1). Stockero (2008), drawing on the levels of reflection suggested by Manouchehri (2002), adds 'using theory', 'confronting' (i.e., considering alternative explanations for events and/or considering others' points of view, beginning to analyse one's own assumptions about teaching) and 'restructuring' (focusing on how one's own or another teacher's experience can be redesigned to avoid problems and better support pupils in their learning, showing evidence of theory use and confronting and re-examining beliefs and assumptions about teaching and learning). Blomberg et al. (2011) also considered whether pre-service teachers made predictions based on what they see in the classroom.

While teachers' noticing is influenced by their knowledge and beliefs, it is also influenced by classroom teaching (which, in turn, is influenced by noticing). Meschede et al. (2017), drawing on the work of others (Blömeke, Gustafsson, & Shavelson, 2015; Santagata & Yeh, 2016), posit that professional vision can be seen as an in-between process or mediator between teachers' dispositions and classroom practice (Fig. 1.1). In this model, teacher competence is seen as a transformation process on a continuum from disposition to performance.

The literature reveals a pattern in professional vision that transcends subject boundaries, suggesting that professional vision is a generic ability applicable across teaching subjects (e.g., Santagata, Zannoni, & Stigler, 2007; Santagata & Guarino, 2011; Sonmez, & Hakverdi-Can, 2012; Mitchell & Marin, 2015; Pavlasová, 2017; Uličná, Stará, & Novotná, 2017; Waldis, Nitsche, & Wyss, 2019).[4] Thus, when noticing and reasoning about events, teachers are

4 It must be noted, though, that most studies on professional vision are conducted with mathematics teachers and science teachers. Studies involving teachers of other subjects are rare.

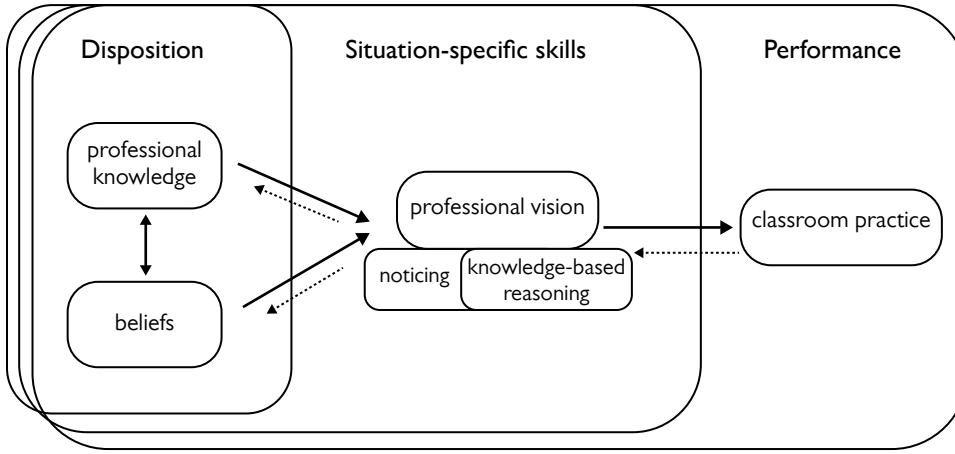

Fig. 1.1: Model of teacher competence according to Meschede et al. (2017, p. 161)

influenced by both their generic and subject-specific knowledge. For example, pre-service teachers tend to focus more on the teacher than pupils in the lesson, and more on pedagogy than the subject and its didactics. They also tend to evaluate rather than interpret, and to make general claims rather than refer to concrete events. On the other hand, Blomberg et al. (2011) found that pre-service teachers' subjects influence their professional vision. In their study, "the social sciences/humanities group outperformed the mathematics/science group even when viewing mathematics/science videos" (p. 1137). One explanation they give for this points to different cultures of subject-specific socialisation in teaching and to the characteristics of pre-service teachers specialising in different subjects.

1.2 PRACTICE-BASED EDUCATION OF FUTURE TEACHERS

Considering the vital place of professional vision in the model of teacher competence (see Fig. 1.1), how do we effectively develop it in pre-service teachers? Taking into account that pre-service teachers do not have advanced knowledge structures and little or no teaching experience, we should, in their case, talk instead about *incipient professional vision* (Stürmer, Könings, & Seidel, 2015) or *pre-professional vision* (Janík et al., 2014).

It is generally acknowledged that in-service and pre-service teachers' learning is most effective when grounded in experience. Situated cognition learning theory posits

> that learning should be rooted in authentic activity; that learning occurs within a community of individuals engaged in inquiry and practice; that more knowledgeable

> "masters" guide or scaffold the learning of novices; and that expertise is often distributed across individuals. (Whitcomb, 2003, p. 538)[5]

In teacher education, the experience provided by an authentic activity can be mediated through well-selected extracts from lessons, written or on video, embedded in reflective tasks. As the focus of this book is video-interventions, we restrict ourselves here to video-extracts. Videos have many advantages over written descriptions and live observation (see, for example, Calandra & Rich, eds., 2014). Video can be paused and re-watched to obtain a deeper insight into such a complex situation as teaching and, at the same time, to reduce its complexity. It can be watched in groups and phenomena can be discussed as they emerge on the video. When discussing a lesson on video in groups, pre-service teachers can exchange ideas, pick up on each other's ideas, consider opposing views, etc. They can also watch and analyse videos of their own lessons.

> The use of preservice teachers' videos brings individualized experiences from local classrooms into a collective learning space, thereby enabling teacher educators to help preservice teachers generate new meanings about their personal teaching experiences through professional conversations with others. (Kang & van Es, 2019, p. 238)

On the other hand, to name just two limitations, the placement of the video-camera within the classroom and the sound-quality of the recording limit the observer's attention and draw it towards particular phenomena (e.g., the teacher's actions are usually seen more clearly than those of pupils).[6]

Video has been used in teacher education for many decades and, as a result, there are several meta-analyses of studies about its use in teacher education, as well as its affordances and constraints (e.g., Janík & Najvar, 2008; Tripp & Rich, 2012; Gaudin & Chaliès, 2015; Hamel & Viau-Guay, 2019). We elaborate here only on aspects of video use in our own field of pre-service education.

Identifying video lessons (or lesson extracts) which would lead to pre-service teachers' learning is a necessary prerequisite for their use in teacher education courses. Videos can be selected as examples of good practice or as representations of ambitious instructional practice (Kang & van Es, 2019). On the other hand, cases depicting teaching that is in some way lacking have their affordances, too (Krammer et al., 2015). To be able to discern such opportunities, we must first specify what we mean by quality teaching.

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5 Cognitive learning theory, on the other hand, postulates that learning is based on the storage and access of knowledge in long-term memory and thus, it is necessary to formulate tasks which would not lead to the overload of the learner's working memory.

6 See also (Šeďová et al., 2016; Kang & van Es, 2019, and others).

1.2.1 THE CONCEPTION OF QUALITY TEACHING

While the different subject-fields which are our focus in this book have their own perspectives on what comprises quality teaching of content, we first turn our attention to generic aspects of quality teaching.

Generic conceptions

An example of a model of quality teaching is that by Killen (2006), which consists of four dimensions: intellectual quality, relevance (or connectedness), a socially supportive learning environment, and recognition of difference. The results of meta-analyses of studies which summarise trends identified in research on what influences teaching effectiveness are particularly relevant for us. Seidel and Shavelson (2007) determined that "the component with the highest effect sizes, regardless of domain (reading, mathematics, science), stage of schooling (elementary, secondary), or type of learning outcome (learning processes, motivational–affective, cognitive)" (p. 483) result from providing opportunities for pupils to engage in domain-specific learning activities. They integrated the effective teaching variables they identified into the five teaching and learning components of a cognitive process-oriented teaching and learning model by Bolhuis (2003): goal setting, orientation (mobilising prior knowledge and investigating possible routes to move towards the goal), execution of learning activities, evaluation of learning processes, and teacher guidance and support. In their meta-analysis of studies conducted in different subjects,[7] Kyriakides, Christoforou and Charalambous (2013) found a moderate association of the elements of a dynamic model of educational effectiveness (Tab. 1.1) with the achievement of pupils, while the factors not included in the model were mostly weakly associated with this achievement.

Tab. 1.1: The dynamic model of educational effectiveness with sample indicators (Kyriakides et al., 2013, p. 146, abbreviated)

Orientation	making explicit the importance of engaging pupils in certain activities; providing them with opportunities to identify the significance of engaging in tasks
Structuring	summarising the main points of the lesson; gradually increasing the level of difficulty of the assigned tasks during the lesson; connecting with previous lessons
Questioning	type and clarity of the questions asked; type of feedback provided
Teaching modelling	strategies for solving problems and for preparing the outline of a summary

7 The studies were conducted during 1980–2010. Their aim was to investigate the contribution of teacher classroom activity to the outcomes of pupils. The studies included explicit and valid measures relating to cognitive, affective, or psychomotor outcomes of schooling.

Application	opportunities to practice a skill or a procedure presented in the lesson, to apply a formula to solve a problem, to transfer knowledge to solve everyday problems
The classroom as a learning environment	opportunities for pupils to interact in different settings; teacher dealing with misbehaviour; interactions between the teacher and the pupil; pupils' perceived treatment by the teacher
Management of time	finishing the lesson on time; minimising transition time; maximising student time on task
Assessment	frequency of administering various assessment forms; formative use of assessment; reporting to parents

Subject-specific conceptions

Naturally, different conceptions of quality teaching in particular subjects have also been developed. In the context of teaching science, Steffensky et al. (2015) highlight two dimensions: generic and content-specific. The former consists of classroom management (monitoring pupils' behaviour and preventing disruptions), managing momentum (organising smooth transitions between activities and maintaining time flow according to the understanding and attention of the class), and applying rules and routines. The latter consists of learning support, which includes cognitive activation and structuring the task to reduce complexity.

In the context of teaching mathematics, Hiebert and Grouws (2007) concluded in their meta-analysis of studies that the types of tasks used by the teacher, and the kind of discourse that they orchestrate when implementing them, profoundly influence pupils' learning. They uncovered two main features of mathematics instruction which promote conceptual development: 'teachers and pupils attend explicitly to concepts' and 'pupils struggle with important mathematics'.

Similarly, Kaiser et al. (2015) emphasise the following prerequisites of quality teaching: demanding orchestration of teaching the mathematical subject matter (which provides opportunities for pupils to acquire competencies and create connections within and outside the subject (Blum & Leiss, 2005)), potential for cognitive activation of the learners (which includes metacognitive activities as well as their self-regulation and independence), individual learning support and classroom management. Schlesinger et al. (2018) claim that these dimensions are generic rather than connected to a particular subject, and add two subject-specific dimensions of instructional quality – subject-related and teaching-related. The former comprises, among others, teacher's correctness (s/he makes no content-related mistakes and uses precise language) and content depth of the lesson (such as work with concepts). The latter comprises, among others, multiple representations and relevance of the content for pupils. These four characteristics are both relevant and applicable to other subjects.

Didactic formalisms

The final conception of teaching quality of interest here is that of Janík et al. (2019), who posit that the quality of instruction is dependent on its integrity, specifically:

> on the quality of functional relationships between (1) teaching and learning content, (2) teaching and learning objectives and (3) the activities of a teacher and students. (p. 189)

Within this conception, the authors consider *participatory (constructing) cognition*, which

> develops in a teaching situation characterised by pupils' cognitive activation. It is characterised (ideally) by pupils heading towards deep understanding of content in connection with the ability to make oneself understood when talking about it and with a high level of cognitive motivation. (Slavík et al., 2017, p. 402)

Investigating lessons in different subjects, the authors distinguished four teaching-learning situations which differ in their contribution to pupils' attainment of learning aims (Slavík et al., 2013; Janík et al., 2019):

1. *failing situation:* there is no learning going on; alterations (alternative courses of action) are essential,
2. *undeveloped situation:* pupils only learn basic concepts and skills; alterations are needed,
3. *enabling situation:* pupils learn basic concepts and skills; they learn with understanding, alterations are possible,
4. *supportive situation:* pupils gain knowledge and skills with understanding and develop their metacognitive skills, too; no alteration is needed.

Some deficiencies can be found in the deep structure of the teaching-learning situations, which corrupt the quality of instruction. Within the above conception, they are called *didactic formalisms*.[8] One such didactic formalism is *stolen cognition*. It prevents the activation of pupils' cognition because the teacher over-reduced the space available for their cognitive work with the content.

> [In a situation of stolen cognition,] learners are rather passive in relation to the content because the content is too remote from their cognitive and motivational states, and the learning environment cannot give them sufficient insight into the content. (Janík et al., 2019, p. 192)

8 Examples of didactic formalism will be provided in the following chapters, which present videos used in the video-intervention.