



# Pre-service teachers' professional vision of instructional support in primary science classes: How content-specific is this skill and which learning opportunities in initial teacher education are relevant for its acquisition?

Maria Todorova<sup>a,\*</sup>, Cornelia Sunder<sup>a</sup>, Mirjam Steffensky<sup>b</sup>, Kornelia Möller<sup>a</sup>

<sup>a</sup> University of Muenster, Institute for Teaching and Learning Primary Science and Technology (DdSU), Leonardo-Campus 11, D-48149, Muenster, Germany

<sup>b</sup> IPN Kiel, Olshausenstraße 62, D-24118, Kiel, Germany

## H I G H L I G H T S

- Structure and predictors of candidate science teachers' professional vision are examined.
- CFA fit the data best for a content-specific model oriented on the instruction topics.
- A focus in science during ITE predicted pre-service teachers' professional vision.
- How intelligence and internships impact professional vision is still to be explored.

## A R T I C L E I N F O

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## A B S T R A C T

Professional vision of instructional support in primary science was investigated with respect to its content-specificity and to learning opportunities in initial teacher education (ITE) which are presumably relevant for the acquisition of this skill. Data from 196 primary pre-service teachers were used. Confirmatory factor analyses suggested pre-service teachers' professional vision of instructional support to be a content-specific skill rather than a general homogeneous or a content-independent one. MIMIC model results revealed that pre-service teachers' general cognitive ability and the attendance of an ITE program with a focus on science were most significantly related to their professional vision of instructional support in science classes, whereas practical experiences were not.

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## 1. Introduction

Initial teacher education (ITE) aims to develop professional knowledge and skills, both of which are deemed to be relevant for professional practice (Baumert et al., 2010; Borko, 2004; Darling-Hammond, 2010; Grossman, Hammerness, & McDonald, 2009). Research on teaching competence provides insights into teachers'

professional knowledge as one of the most important cognitive dispositions that impacts teaching quality and student learning (Baumert et al., 2010; Hill, Rowan, & Ball, 2005). Among the many theoretical concepts of knowledge put forth by general psychologists and educational researchers (e.g., conceptual vs. procedural knowledge by Anderson, 1983; formal vs. practical knowledge by Fenstermacher, 1994), professional knowledge in the domain of teaching is mainly related to Shulman's typology (1987), which includes, among others, the categories of content knowledge (CK), pedagogical content knowledge (PCK), and general pedagogical knowledge (GPK). Pre-service teachers acquire a substantial amount of these types of knowledge during the course of their ITE training (Cheang, Yeo, Chan, & Lim-Teo, 2007; Kleickmann et al.,

\* Corresponding author. Present address: University of Muenster, DdSU, Leonardo-Campus 11, D-48149, Münster, Germany.

E-mail addresses: [maria.todorova@uni-muenster.de](mailto:maria.todorova@uni-muenster.de) (M. Todorova), [cornelia.sunder@uni-muenster.de](mailto:cornelia.sunder@uni-muenster.de) (C. Sunder), [steffensky@ipn.uni-kiel.de](mailto:steffensky@ipn.uni-kiel.de) (M. Steffensky), [moelleko@uni-muenster.de](mailto:moelleko@uni-muenster.de) (K. Möller).

2013; König, 2013). However, beginning teachers often struggle with the high demands in the classroom during their first years in school and often report difficulties in transferring what they have learned into practice (Klusmann, Kunter, Voss, & Baumert, 2012; Tynjälä & Heikkinen, 2011).

Research on teaching competence as well as on teacher education has recently begun to investigate aspects of teacher cognition that account for the situatedness of most teachers' classroom activities (Blömeke, Gustafsson, & Shavelson, 2015; Borko, 2004; Santagata & Yeh, 2016) by adopting the concept of professional vision from expertise research (Goodwin, 1994). Professional vision in the domain of teaching consists of situation-specific processes and skills for selectively noticing and interpreting relevant events in the classroom (Sherin & van Es, 2009). According to a recent model of "competence as a continuum" (Blömeke et al., 2015), professional vision may be viewed as the missing link between teachers' cognitive dispositions (i.e., their professional knowledge, beliefs and motivation) and their classroom activities; for noticing and interpreting in the classroom, professional knowledge is assumed to be subject to transformation, integration, and/or restructuring by teachers' practical experiences. In this way, professional knowledge is made usable in the classroom, enabling teachers to act professionally and to ensure instructional quality (Kersting, Givvin, Thompson, Santagata, & Stigler, 2012). Thus, measures of professional vision appear to be valid tools for assessing teachers' abilities to integrate and apply professional knowledge in multiple, fuzzy instructional contexts (Blömeke et al., 2015; Kersting et al., 2012; Meschede, Steffensky, Wolters, & Möller, 2015; Stürmer & Seidel, 2015). In addition, measures of professional vision are predictive for instructional quality in classrooms (Jamil, Sabol, Hamre, & Pianta, 2015; König & Kramer, 2016; Sun & van Es, 2015). In ITE, professional vision measures can therefore be used, for example, to assess the development of teaching competence (Admiraal, Hoeksma, van de Kamp, & van Duin, 2011; Bakker et al., 2011; Bannink, 2009; Hodge & Carbonara, 2015; Wiens, Hessberg, LoCasale, & DeCoster, 2013).

However, to date, little is known about which factors in ITE explain differences in pre-service teachers' professional vision (Blömeke, Busse, Kaiser, König, & Suhl, 2016; Stürmer, König, & Seidel, 2015). This information is necessary to assess whether certain ITE programs in general or their specific elements contribute more to the development of this important skill than others. Research in this regard could improve ITE in developing professional vision. A further research gap is the question of whether or not this skill is content-specific or more general in its nature (Blömeke et al., 2016; Steffensky, Gold, Holodyski, & Möller, 2015). Knowledge about the specificity of professional vision is important, especially when the objective is to assess ITE outcomes with an appropriate measure. If professional vision is a general, content-independent skill, then already developed instruments can be used successfully to assess the various teaching domains and grade levels; but, if not, certain effects of ITE could be underestimated when applying these types of general measures in the assessment of professional vision.

The objective of this study was to explore the following two research questions: 1) how content-specific is pre-service teachers' professional vision of instructional support in the domain of primary science; and 2) which individual prerequisites and learning opportunities, both within and outside of ITE, are related to this skill. This work aims to contribute to existing research by examining the structure of professional vision in the domain of primary science, and the role of individual prerequisites, structural differences, and other factors in primary science ITE in Germany in acquiring professional vision.

### 1.1. Professional vision – conceptual framework

In the research on teacher cognitions and skills, the processes of perception and interpretation of important classroom events are sometimes framed as professional vision or 'noticing' (Star & Strickland, 2008; van Es & Sherin, 2008), procedural knowledge (König et al., 2014), analysis skills (Jacobs, Lamb, & Philipp, 2010), situation-specific skills (Blömeke et al., 2015), or as a part of a shared model on teacher competence (Brovelli, Bölsterli, Rehm, & Wilhelm, 2014; Knievel, Lindmeier, & Heinze, 2015). In our study, we use the term and definition of professional vision (Sherin & van Es, 2009; Seidel & Stürmer, 2014). The noticing of crucial classroom events, as one component of professional vision, involves processes of selective attention which enable teachers to detect information relevant for students' learning in the classroom. During the process of perception, prior knowledge is applied to generate mental representations of the classroom situation (König, Blömeke, & Kaiser, 2015). This knowledge is organized into knowledge structures such as schemata and scripts that summarize information about particular cases and experiences (Borko, Livingston, & Shavelson, 1990; Leinhardt & Greeno, 1986).

Knowledge-based reasoning – the other component of professional vision – involves processes of interpretation such as describing, explaining, and predicting the events identified by the teacher (Seidel & Stürmer, 2014). All these processes require relevant professional knowledge to be retrieved from long-term memory, reframed, and transformed for application to the particular classroom situation. Thus, knowledge-based reasoning delivers insight into the quality of teachers' mental representations of knowledge and its application within classroom instruction (Borko, 2004; König et al., 2015; Seidel & Stürmer, 2014).

In order to distinguish clearly between teachers' knowledge and their situation-specific skills such as professional vision, we refer to Blömeke et al. (2015). They view teacher knowledge as stable cognitive resources that are universally represented in the long-term memory irrespective of different teaching situations on the one hand, and cognitive skills such as professional vision on the other hand, which help teachers juggle the situated aspects of teaching. During the processes of noticing and interpretation, different dispositional facets, of which professional knowledge is just one example, "have to be integrated, perhaps to be transformed and/or restructured through practical experience" (p. 7). Thus, professional knowledge seems to be an important prerequisite, but it is not sufficient in itself to provide for the development of professional vision. In the discussion about what kind of knowledge has relevance to professional vision, schemata theories (Bransford, 1979) are also often emphasized (König et al., 2014; Meschede, Fiebranz, Möller, & Steffensky, 2017; Steffensky et al., 2015). With increasing experience, schemata tend to become more elaborate because the repeated activation of them seems to reinforce the connection between the various elements, which facilitates in turn the future activation of knowledge when new information needs to be processed (König et al., 2014). Experienced teachers tend to have this kind of elaborated and strong, interrelated knowledge represented in schemata (Borko & Livingston, 1989; Leinhardt & Greeno, 1986). In contrast, the low professional vision of pre-service teachers may be associated with fragmented and, to a certain extent, less flexible and less functional schemata (Seidel & Stürmer, 2014). A high level of experienced teachers' professional vision also seems to require more integrated and differentiated knowledge structures that allow them to perceive and interpret precisely and quickly various teaching situations (Bromme, 2001). For the development of expertise in the domain of teaching, many years of training, practical experience and deliberate practice are required (Ericsson, 2006).

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