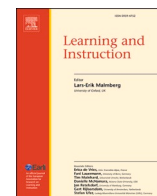


Beyond analysing frequencies: exploring teacher professional vision with epistemic network analysis of teachers' think-aloud data

Rebekka Stahnke, Andreas Gegenfurtner

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Beyond analysing frequencies: Exploring teacher professional vision with epistemic network analysis of teachers' think-aloud data

Rebekka Stahnke^{a,*}, Andreas Gegenfurtner^b

^a IPN Leibniz Institute for Science and Mathematics Education, Hausvogteiplatz 5-7, 10117, Berlin, Germany

^b University of Augsburg, Universitätsstraße 10, 86159, Augsburg, Germany

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ABSTRACT

Background: Teacher professional vision describes how teachers perceive classroom events, interpret these events, and form decisions about next strategies. As indicators of visual expertise, noticing, and reasoning, analyses of think-aloud protocols can offer useful insights into novice and expert teachers' mental models of observed classroom management events.

Aims: Informed by the cognitive theory of visual expertise, the study compared two methods—a standard frequency-based approach and epistemic network analysis (ENA)—for analysing think-aloud data from novice and expert teachers. The aim was to illustrate the potential of both methods in revealing how teachers integrate noticed visual information and classroom management scripts into elaborate mental representations of classroom management events.

Sample: Participants were 19 pre-service and 20 in-service teachers.

Methods: Teachers' think-aloud data after watching a video with critical classroom management events were coded and analysed using a standard frequency-based approach and epistemic network analysis.

Results: The frequency-based approach counted the number of codes, indicating that experts verbalized student learning, teacher behavioural management, and alternative management strategies more frequently than novices. In comparison, ENA visualized the temporal co-occurrences of codes within event-related utterances, indicating that novices struggled to make sense of events while experts were able to integrate information and scripts into more elaborate and well-structured mental models.

Conclusions: When compared to a frequency-based approach, ENA can provide deep insights into teachers' mental representations of classroom management events. ENA is thus a useful novel method to examine teachers' integration of information into mental models as indicators of professional vision and expertise.

1. Introduction

How teachers perceive important classroom events, interpret these events, and form decisions about next strategies has been studied under the terms professional vision, noticing, or situation-specific skills (Blömeke, 2024; Daumiller et al., 2025; Jacobs et al., 2010; Sherin & van Es, 2009; van Es & Sherin, 2002). These skills of perception, interpretation, and decision-making are predictors of instructional quality, which in turn supports student learning (Blömeke et al., 2022). Consequently, there is consensus that teacher professional vision is a central element of teacher expertise that is based on teachers' professional knowledge (for systematic reviews, see Keskin et al., 2024; König et al.,

2022; Santagata et al., 2021; Stahnke et al., 2016).

With respect to classroom management as one important dimension of instructional quality, research revealed that experts and novices differ in their professional vision of classroom management (PV-CM; Stahnke & Blömeke, 2021a,b; van den Bogert et al., 2014; Wolff et al., 2021). Such findings predominantly relied on teachers' think-aloud and eye-tracking data. Studies using think-aloud data to analyse PV-CM focused on either the occurrence or the frequency of elements in teachers' verbalizations. For instance, they revealed that experts talk *more frequently* about student learning or alternative management strategies than novices when they think-aloud about noticed classroom events (Gegenfurtner et al., 2020; Stahnke & Blömeke, 2021b; Wolff

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* Corresponding author.

E-mail addresses: stahnke@leibniz-ipn.de (R. Stahnke), andreas.gegenfurtner@uni-a.de (A. Gegenfurtner).

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et al., 2015, 2017).

However, such a frequency-based approach can only reveal isolated elements of teachers' mental representations. Thus, little is still known about the *structure* of novice and expert teachers' classroom management event *representations*—that is, how teachers *integrate* bottom-up visual classroom information and top-down classroom management scripts (CMS) into coherent mental models. Yet, such insights could expose the knowledge structures underlying event representations (Lehtinen et al., 2020; Wolff et al., 2021). Furthermore, theoretical models of (teacher) expertise see building and restructuring domain-specific knowledge as crucial for expertise development (Boshuizen et al., 2020; Gegenfurtner, 2024; Wolff et al., 2021). For example, the knowledge-based processing assumption in the cognitive theory of visual expertise (Gegenfurtner, 2024; Gegenfurtner et al., 2023; see Fig. 1) holds that, when expert teachers perceive classroom information, they build connections among image chunks to create a coherent mental model in long-term working memory (*organizing image chunks*). This mental event representation is further enriched with and interpreted through knowledge and CMS (*integrating*). Such a coherent and well-structured mental model of, for example, a problematic classroom management situation is a hallmark of teacher expertise (Seidel et al., 2024; Wolff et al., 2021). Thus, novices need to develop knowledge structures that help them build adequate mental representations of classroom management events.

Think-aloud data, in particular, have the potential to elucidate teachers' representations (Ericsson, 2018a). Yet, to date, research on PV-CM has not fully used this potential. A promising method in this context is epistemic network analysis (ENA) which investigates cognitive networks through the connections among elements in discourse data and visualizes these connections using network models (Shaffer et al., 2016; Shaffer & Ruis, 2017). First studies on teacher professional vision have applied ENA for analysing think-aloud data (Stahnke & Friesen, 2023; van Driel et al., 2023) and written answers (Farrell et al., 2022). Their results hint at new insights ENA might provide that complement standard frequency-based approaches. However, the specific advantage ENA could offer in elucidating novice and expert teachers' professional vision has not been investigated yet.

This study aims to explore the potential of both methods as a means to provide insights into expertise differences with respect to teachers' PV-CM. For this purpose, a subset of an existing dataset of novice and expert teachers' think-aloud transcripts is analysed (Stahnke & Blömeke, 2021b) with both a standard frequency-based approach and ENA (see Csanadi et al., 2018, for a similar method comparison in the field of problem-solving). We ask what type of insights into novice and expert teachers' PV-CM each method can offer.

2. Teacher professional vision of classroom management

Teacher professional vision is a crucial element of teacher expertise that distinguishes novices and experts and influences both instructional quality and student learning (Blömeke et al., 2022; König et al., 2022; Stahnke et al., 2016). Introducing the concept of professional vision, Goodwin (1994) characterized it as “socially organized ways of seeing and understanding events that are answerable to the distinctive interest of a particular social group” (p. 606). Besides the notion of teacher professional vision (Seidel & Stürmer, 2014; Sherin & van Es, 2009), the terms noticing (Jacobs et al., 2010; van Es & Sherin, 2002) or situation-specific skills describe similar teacher skills (Blömeke, 2024). These different conceptualizations are all interested in teachers' perception of events in a classroom scene and their' interpretations of these events. In addition, some conceptualizations consider how teachers generate next courses of action, i.e., their decision-making (Blömeke, 2024; Jacobs et al., 2010). Teacher professional vision is characterized as knowledge-based: Teachers draw on their knowledge in order to make sense of events, to reason about them, and to decide what they should do next (Blömeke, 2024; Gegenfurtner, 2024; Seidel et al., 2024; Seidel & Stürmer, 2014; Sherin & van Es, 2009; van Es & Sherin, 2002). In this study, we will focus on teachers' PV-CM and define it as comprising the three skills of teachers' perception of classroom management events, their interpretation of these events, and their decision-making about next classroom management strategies.

Previous studies have often approached PV-CM from distinct perspectives such as either a cognitive-psychological perspective, an expertise perspective, or a socio-cultural perspective (König et al., 2022; Santagata et al., 2021). For example, studies either focused on the cognitive processes underlying individual teachers' professional vision (cognitive-psychological perspective), on the differences between novice and expert teachers (expertise perspective), or rarely on the socially and culturally embedded nature of professional vision (socio-cultural perspective). Integrating these isolated perspectives could offer a more comprehensive view. For instance, rather than focusing only on the cognitive skills of individual teachers, adopting an integrated perspective that considers the shared, situated cognitive processes within groups of experts or novices could provide a more holistic perspective on the construct of teacher professional vision (Scheiner, 2021; Sherin & van Es, 2009; see also the *practice-based interaction assumption* in the cognitive theory of visual expertise, Gegenfurtner, 2024).

In classrooms, many different events take place quickly which often progress in unexpected directions (Doyle, 2006). In order to deal with these challenges, teachers need to develop a PV-CM since classroom management is a crucial dimension of instructional quality that impacts students' academic, behavioural, and motivational outcomes

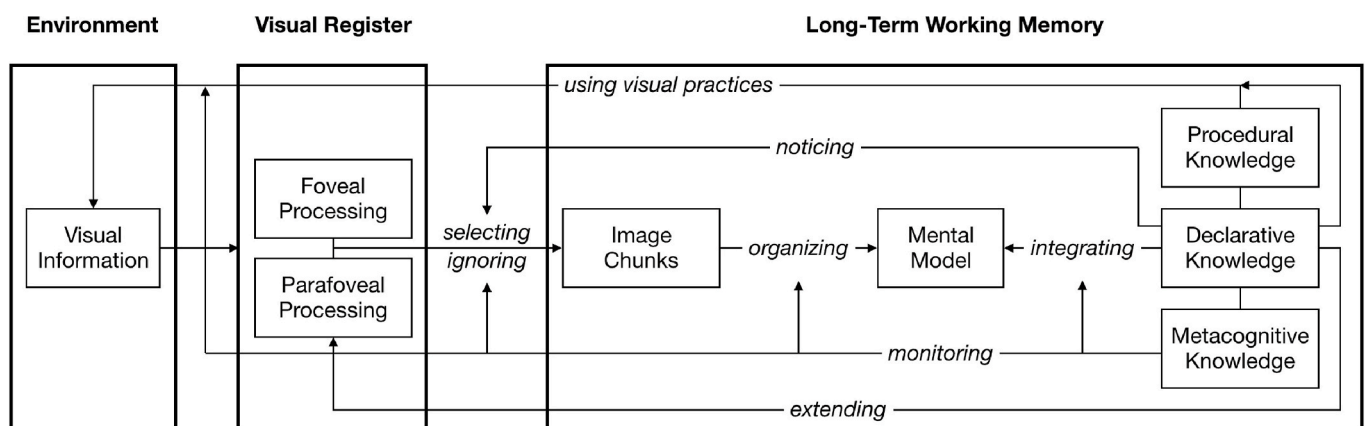


Fig. 1. Cognitive theory of visual expertise.

Table 1
Differences and similarities between novice and expert teachers' professional vision of classroom management.

Elements of teachers' PV-CM	Characteristics of novice teachers	Characteristics of expert teachers	Similarities between groups
Visual attention (measured through eye-tracking data)	- Focus on the teacher in observed video scenes (Gabel et al., 2023; Stahnke & Blömeke, 2021a; van den Bogert et al., 2014; Wolff et al., 2016)	- Focus on and distribution of attention across students (Huang et al., 2021; Keskin et al., 2024; McIntyre & Foulsham, 2018; Stahnke & Blömeke, 2021a; Wolff et al., 2016)	- In teacher-centred settings, visual attention is guided by salient events (Seidel et al., 2021; Stahnke & Blömeke, 2021a)
Noticing of classroom management events (measured through think-aloud data)	- Struggle with more student-centred settings, where they tend to notice only salient events (Stahnke & Blömeke, 2021a)	- Notice relevant classroom management events more often (Shinoda et al., 2021; Stahnke & Blömeke, 2021a)	- Notice similar numbers of events in some studies (Grub et al., 2022; Keller et al., 2021; van Driel et al., 2021)
Representation of classroom management events (measured through think-aloud data)	- Frequently describe their perception of events without interpretations of their meaning (Gegenfurtner et al., 2020; Wolff et al., 2017) - Most concerned with student discipline (Wolff et al., 2015, 2017)	- Frequent utterances indicating deep knowledge-based interpretations (Gegenfurtner et al., 2020; Stahnke & Blömeke, 2021b; Wolff et al., 2015, 2017) - Reason about how the observed classroom management affects student learning (Stahnke & Blömeke, 2021b; Wolff et al., 2015, 2017) - Articulate alternative classroom management strategies and future teacher actions, indicating skilled decision-making (Gegenfurtner et al., 2020; Stahnke & Blömeke, 2021b)	- Comparison of structure and content of beginning, intermediate, and experienced teachers' epistemic networks shows more differences within groups than between groups (van Driel et al., 2023)

(Korpershoek et al., 2016). Classroom management describes “the actions teachers take to create an environment that supports and facilitates (...) learning” (Evertson & Weinstein, 2006, p. 4). In order to create such an environment, teachers need to manage behavioural, instructional, and social-emotional aspects (Doyle, 2006; Kounin, 1970; Piowar et al., 2013; Wubbels et al., 2015): They need to react to and prevent student misbehaviour or disengagement through establishing rules and routines or giving punishment or rewards (behavioural management), manage the flow of the lesson, choose suitable structures and settings, and manage active learning time (instructional management), as well as establish a positive climate and relationships (socio-emotional management). Although these different aspects are analytically distinguished, teachers often need to consider all aspects simultaneously during teaching and with regard to their representation of events. Moreover, teachers need to develop an extensive repertoire of classroom management strategies. Such strategies include reactive strategies that follow disengagement or disruption as well as preventive strategies that prevent such behaviour and support learning (Kounin, 1970; Piowar et al., 2013).

Prior research on teachers' PV-CM revealed several differences but also similarities between novice and expert teachers with respect to their visual attention, their noticing of classroom management events, and their representation of such events. Table 1 provides a summary of these characteristics. Overall, there is first—although not entirely coherent—evidence of expert teachers' remarkable PV-CM. Their professional vision is assumed to be based on more extensive and well-structured knowledge, which guides what they notice and how they reason about it (Boshuizen et al., 2020; Chi, 2006; Gegenfurtner et al., 2023; Haider & Frensch, 1996; Lehtinen et al., 2020; Seidel et al., 2024; Sheridan & Reingold, 2017; Wolff et al., 2021). This knowledge informs where experts guide their attention in the classroom, thus resulting in more top-down instead of bottom-up stimulus-driven processing (Gegenfurtner et al., 2020; Keskin et al., 2024; Seidel et al., 2021; Stahnke & Blömeke, 2021a). Additionally, experts' extensive and well-structured knowledge allows for faster encoding of visual information about classroom events and for a faster retrieval of that classroom management knowledge from memory that could be useful with respect to the event at hand (Ericsson, 2018b; Gegenfurtner et al., 2023). Consequently, experts are able to build a coherent representation of the classroom situation quickly (Gegenfurtner et al., 2023).

The knowledge structures that are particularly important in the context of classroom management are CMS (Boshuizen et al., 2020; Chi, 2006; Wolff et al., 2021): Such classroom management scripts are built

through learning and experience with typical classroom management events and are comprised of conditions enabling the event, consequences of the event, and adaptive strategies. CMS of novices and experts exhibit notable differences with novices relying primarily on their knowledge about behavioural classroom management (strategies), whereas experts also consider instructional and social-emotional aspects (Wolff et al., 2021). Learning more about these knowledge structures could reveal what characterizes expertise with regard to the PV-CM and how this expertise develops.

3. Eliciting teacher professional vision with think-aloud methods

Think-aloud is a method that gives researchers direct access to novices' and experts' thoughts and can provide insights into their processing of information, their mental representations, and differences in their underlying knowledge structures (Ericsson, 2018a; Ericsson & Simon, 1980). In contrast to interviews, think-aloud data are elicited while a person engages in a task that is characteristic for the domain in question and thus uses their knowledge in context (Ericsson, 2018a; van Someren et al., 1994). Concurrent think-aloud methods (i.e., verbalization during the task) are considered to provide more valid indicators of the thought processes taking place during the task than retrospective methods (i.e., verbalization immediately after a short task; Ericsson, 2018a). However, for more complex tasks with time limitations, affordances of concurrent think-aloud can interfere with task-specific cognitive processes, thus resulting in distorted eye-tracking or think-aloud data (Prokop et al., 2020; van Gog et al., 2005). In the context of classroom management, teaching or observing teaching are such complex tasks. Thus, often retrospective think-aloud methods are used.

To support the validity of retrospective think-aloud methods, verbalizations can be gaze-cued, i.e., a person's gaze during the task is replayed in order to cue prior cognitive processes (Hyrskykari et al., 2008; van Gog et al., 2005). Such retrospective, cued think-aloud protocols have been frequently used when investigating teacher professional vision since concurrent verbalizations are either impossible (when measured during teaching) or very complex (when measured while observing video) (e.g., Gabel et al., 2025; Keller et al., 2021; Stahnke & Blömeke, 2021a, 2021b; van den Bogert et al., 2014; van Driel et al., 2021, 2023; Wolff et al., 2015, 2016, 2017). Moreover, observing other teachers' video material in contrast to video of own teaching can enable teachers to access their knowledge and express more analytic

thoughts (McIntyre et al., 2022; Seidel et al., 2024).

In summary, think-aloud during domain-specific tasks is an established method for assessing mental representations and underlying knowledge structures of novices and experts (Ericsson, 2018a; Ericsson & Simon, 1980; van Someren et al., 1994). In the case of teachers' PV-CM, think-aloud data can thus allow similar conclusions about teachers' mental representations of classroom management events and their CMS as the knowledge structures underlying teachers' event representations.

Yet, previous studies on teachers' PV-CM have predominantly analysed think-aloud data in an aggregated way: Transcripts were segmented into units, which were coded for the occurrence of elements of PV-CM, and (relative) frequencies of codes were then counted (a 'coding-and-counting' approach, Csanadi et al., 2018). Such approaches generate important insights into certain aspects of teacher expertise such as the quantity of noticed events or the frequency of thoughts expressing, e.g., a certain knowledge element (Gabel et al., 2023; Gegenfurtner et al., 2020; Grub et al., 2022; Stahnke & Blömeke, 2021b; Wolff et al., 2015). While analyses that emphasise frequencies of singular elements are certainly important, such a frequency-based approach tends to neglect relations and connections between elements of teachers' event representations. Investigating these connections could uncover teachers' CMS. A methodological alternative to 'coding-and-counting'—one that foregrounds structures and interconnections—is ENA.

4. Revealing teacher professional vision with epistemic network analysis

ENA is a method from quantitative ethnography for analysing discourse data (Csanadi et al., 2018; Schaffer et al., 2016; Shaffer & Ruis, 2017; Wang et al., 2021). It is based on epistemic frame theory which states that members of a community of practice share similar knowledge, skills, or values. Becoming a group member means developing the same epistemic frame by acquiring knowledge, skills, or practices and developing similar structures between these elements, i.e., a similar epistemic frame (Shaffer et al., 2016). With ENA, epistemic frames are identified based on the co-occurrence of codes representing such knowledge elements (or skills, values, or practices) in discourse data. More specifically, ENA analyses temporal co-occurrences of codes representing, for example, knowledge elements within stanza which are segments of data referring to separate tasks or conversations. Thereby, ENA identifies, measures, and illustrates connections between such knowledge elements and uncovers shared representation (i.e. epistemic frames and mental models) of CM events within groups. Thus, patterns

within time- or event-intervals (as defined by the stanza) can be revealed and inform us about teachers' epistemic frames. Such patterns would remain invisible when using a frequency-based approach only (for a comparison of frequency-based analysis and ENA for problem-solving, see Csanadi et al., 2018). Table 2 provides a comparison of both methods.

While ENA has been applied in a wide range of educational studies analysing discourse, surveys, log files, or even game play (Elmoazen et al., 2022), only first studies have used this method to investigate teacher professional vision of tutoring sessions (Farrell et al., 2022) or classroom management (Stahnke & Friesen, 2023; van Driel et al., 2023). Yet, epistemic frame theory that underlies ENA closely aligns with Goodwin's understanding of professional vision as "socially organized perceptual frameworks shared within the (...) profession" (1994, p. 616) and the notion of expertise development as building and restructuring knowledge (Boshuizen et al., 2020; Gegenfurtner et al., 2023; Seidel et al., 2024; Wolff et al., 2021). Thus, to analyse teachers' classroom management event representations—and particularly their ways of seeing and understanding these events—ENA might be a promising approach.

A further strength of ENA relates to its event-relatedness. Similar to how physicians' knowledge is structured in a case-based way (Boshuizen et al., 2020), teachers' knowledge about classroom management is assumed to be event-based (Hogan et al., 2003; Wolff et al., 2021; Zacks et al., 2007). Accordingly, teachers' CMS are knowledge structures about typical classroom events and inform the representations teachers build of a newly observed classroom event (Wolff et al., 2021). Consequently, investigating event representations and their underlying scripts calls for a method of data analysis that preserves the event-relatedness of teacher cognition instead of aggregating think-aloud data across multiple classroom management events. By focusing on patterns within sequences of think-aloud related to specific events, ENA could be a promising method in this regard.

First studies used ENA to analyse think-aloud data with respect to teacher professional vision: For instance, ENA revealed differences between biology and mathematics expert teachers' event representations, showing that biology experts view classroom management events more in terms of strategies for planning and providing structure while mathematics experts were more concerned with in-the-moment management of behavioural problems (Stahnke & Friesen, 2023). Comparing beginning, intermediate, and expert teachers' cognitions with ENA, van Driel et al. (2023) revealed small differences between groups indicating that, with increasing expertise, teachers' interpretations of events are connected with more complex cognitions. These results suggest that investigating think-aloud data with ENA might offer new insights into

Table 2
A comparison of a frequency-based analysis and epistemic network analysis for research on PV-CM.

	Frequency-based analysis	Epistemic network analysis
Data base	<ul style="list-style-type: none"> - Aggregated data matrix with frequencies of individual codes per participant representing elements of PV-CM - Level of analysis: individual code level 	<ul style="list-style-type: none"> - Data matrix with occurrence/frequency of at least three codes per idea unit of each participant - Data divided in unit and stanza levels - Level of analysis: event-based units, stanza, code levels
Metric	<ul style="list-style-type: none"> - Absolute or relative frequencies of codes representing elements of PV-CM 	<ul style="list-style-type: none"> - Network demonstrates mean co-occurrences of codes within event- or time-intervals (i.e., stanza)
Results and interpretations	<ul style="list-style-type: none"> - Frequency distribution across codes or participants - Group differences regarding (absolute or relative) frequencies of codes representing elements of PV-CM 	<ul style="list-style-type: none"> - Knowledge elements with a high frequency most prominent in networks, but ENA further provides insights into <ul style="list-style-type: none"> o relationships and patterns of codes representing elements of PV-CM o dimensions of the network - Both quantitative and qualitative group network comparisons regarding network code co-occurrence patterns <ul style="list-style-type: none"> o Quantitative difference between network mean centroid positions on x and y axes, respectively o Qualitative group similarities and differences based on network centroid and code positions within the projection space

teachers' PV-CM that complement those provided by standard frequency-based approaches. The present study adds to this emerging research field and aims to reveal how each method, analysing the same think-aloud data, contributes to a deepened understanding of expert-novice differences in teachers' PV-CM.

5. Aim of the study and research questions

The guiding methodological research question of this study is: What insights into novice and expert teachers' PV-CM can be gained via each method? More specifically, we compare both methods for revealing expertise-related differences in novice and expert teachers' classroom management event representations and CMS as expressed in their think-aloud data. These two methods are (a) a frequency-based approach that codes the occurrence of elements of teachers' PV-CM in think-aloud data and counts these occurrences and (b) ENA that investigates the co-occurrence of elements of teachers' PV-CM within event-related units of think-aloud transcripts (Csanadi et al., 2018; Shaffer et al., 2016; Shaffer & Ruis, 2017). We expect that ENA provides three additional insights in comparison to the standard frequency-based method: Firstly, ENA in comparison to frequency-based approaches visualizes the co-occurrence of knowledge elements in networks and can thereby reveal teachers' event representations which could allow conclusions about novices and expert teachers' integration of visual information and CMS into mental models of classroom management situations, highlighting the particular role of knowledge structures. Secondly, in addition to frequency-based approaches that aggregate data, ENA provides the opportunity to preserve the event-relatedness of teachers' PV-CM. And finally, while both methods allow for group comparison, ENA might be particularly suited to investigate the shared vision within groups of expert or novice teachers and could thus provide a more holistic perspective on teachers' PV-CM.

6. Methodology

The present study used two methods to analyse novice and expert teachers' PV-CM. The data corpus was a subset of think-aloud transcripts collected in a prior study. Results using the whole data set (including eye-tracking and think-aloud data) have been published elsewhere, either focusing on teachers' visual attention and noticing of events (Stahnke & Blömeke, 2021a) or their representation of events across multiple classroom scenes (Stahnke & Blömeke, 2021b). For the purpose of this study, a subset of data was chosen that focuses on one video clip. Based on prior studies, this scene should produce most expertise differences and be thus most feasible for comparing the potential of both methods for uncovering novice and expert teachers' PV-CM. The present study extends the previously reported analyses (Stahnke & Blömeke, 2021a, 2021b) by addressing a methodological research question, comparing two methodological approaches to deepen our understanding of how novice and expert teachers integrate visual information and CMS into mental representations of the observed classroom scene.

6.1. Sample

The sample was comprised of 20 expert and 19 novice secondary teachers from an urban area in Germany. The criteria to be considered an expert teacher were at least five years of experience and additional tasks or responsibilities in teacher education ($M_{age} = 45.1$, $SD = 9.7$; 75 % female). Expert teachers had on average eighteen years of teaching experience ($M_{exp} = 18.30$, $SD = 10.9$; 63 % female) and all reported to have experience in teacher education and the mentoring of pre-service teachers. Novices were pre-service teachers in their master program ($M_{age} = 26.9$, $SD = 3.8$). To minimize the influence of subject-specific effects, only biology and mathematics teachers were invited to participate in the study. Both subjects were represented equally among novices and experts, comprising approximately half of each group. The study

was reviewed and approved by the State Senate Department for Education, Youth and Family with regard to ethics and data protection.

6.2. Material

In the original study, teachers observed four video clips which were selected through a multi-step procedure to ensure quality and authenticity, focusing on observable classroom management events (for details on the selection of video clips based on theoretical considerations and an expert validation, see Stahnke & Blömeke, 2021a, 2021b). This study focusses on one video clip showing a partner work scene for three reasons: (1) A previous study revealed significant differences in novice and experts' distribution of visual attention and their noticing of classroom management events for this setting (Stahnke & Blömeke, 2021a). (2) Open settings like partner work demand more top-down processing which is facilitated by expert teachers' extensive and well-structured knowledge, including their CMS (Seidel et al., 2021; Stahnke & Blömeke, 2021a). (3) Regarding teachers' think-aloud data, a prior frequency-based analysis across multiple video clips indicated expertise effects (Stahnke & Blömeke, 2021b). By focusing on the partner work scene, we anticipate differences between novice and expert teachers' event representations to be particularly prominent since the setting necessitates more knowledge-based top-down processing, which calls for domain-specific knowledge in the form of CMS to create meaningful event representations. Observed differences in event representations would then allow conclusions to be drawn about script differences. Appendix A provides a description of the scene.

6.3. Procedure

A gaze-cued retrospective think-aloud protocol was used in the original study: After obtaining informed consent, a trial run followed to familiarize participants with the think-aloud procedure. Then, teachers viewed each video clip twice. First, their gaze was recorded and they pressed a button whenever they noticed an important classroom management event. Then, the video clip was overlaid with their prior gaze, viewed for a second time and paused at each time-stamp (i.e., whenever teachers had pressed a button to indicate a note-worthy event; van den Bogert et al., 2014). Teachers were instructed to think-aloud about events noticed (see Appendix A for specific instructions and more details on the procedure). A gaze-cued retrospective think-aloud method was used instead of a concurrent method because of the complex nature of the task (Hyrskykari et al., 2008; van Gog et al., 2005). For the purpose of this study, only data concerning one video clip—a partner work setting—were analysed.

6.4. Data analysis

6.4.1. Content analysis coding

Teachers' think-aloud data were transcribed and segmented into idea units by two independent coders, each unit representing one new thought. Disagreements in unitization were resolved through discussion. Then, idea units were coded with MAXQDA 2022; VERBI Software, 2021). The coding scheme for teachers' PV-CM was comprised of thematic codes, i.e., what aspects of classroom management teachers' think about and structural codes representing the three facets of professional vision, i.e., how teachers think about events (for more details on the development of the coding scheme, see Stahnke & Blömeke, 2021b). Thematic codes were comprised of three main codes *student*, *teacher*, and *context* with multiple subcodes and the structural codes were comprised of three main codes *perception*, *interpretation*, and *decision-making* with multiple subcodes. Since this study focuses on one video clip only, some codes were very rare. Such rare codes were merged and negligible codes were dropped from analysis (see Appendix B for the simplified coding scheme used in this study and Appendix C for an example of coded data of one teacher). The data corpus is comprised of all transcripts referring

to the partner work setting ($n = 1146$ idea units). A second, independent coder coded a random subset of 10 % of the transcripts. Inter-coder reliability was substantial (Cohen's $\kappa = .78$).

6.4.2. Frequency-based analysis

The coded think-aloud data were the basis for both methods of analysis. For the frequency-based approach, we compared mean frequencies of all codes for both groups. A participant's frequency of 4 for the code *student learning* indicates that this participant's think-aloud data include 4 idea units that focus on the theme of *student learning*; a mean frequency of $m = 4$ indicates that, on average, participants utter 4 idea units focusing on *student learning*. Due to the small sample size, we used non-parametric Mann-Whitney U tests to compare code frequencies of novices and experts.

6.4.3. Epistemic network analysis

The ENA Web Tool (Marquart et al., 2018) was used. Participants were treated as units and codes as nodes. Since expertise with respect to PV-CM is assumed to be based on CMS of typical events (Wolff et al., 2021), we preserved the event-relatedness in our data by defining all idea units referring to one time-stamp as stanza (using a whole conversation stanza window). Stanza define segments within the data in which the temporal co-occurrence of codes is meaningful, i.e., co-occurrences of codes while describing one or a few related events rather than across all utterances of one participant. The positions of nodes in a network space are determined by optimizing the fit between the projected and measured data. For each unit (i.e., each participant), a network is modelled via association matrices representations (Bowman et al., 2021). These networks have identical node positions which enables comparisons, but the strength of connections between nodes differs (Shaffer & Ruis, 2017). The location of points indicates which aspects of the network structure explain most differences between participants with points in the centre sharing more variance between participants. Each participant's epistemic network reveals how they individually represent events observed in the scene.

Mean epistemic networks for novices and experts were aggregated and represent the group's shared PV-CM (i.e., the professional vision within the community of novices or experts, Goodwin, 1994). Subtraction networks were generated that visualize differences between mean networks of both groups. In such subtraction models, larger nodes with more connections indicate differences in influential codes and thicker lines indicate differences in influential connections. Since two groups are compared, we used mean rotation which maximizes differences across the x-axis. Due to the small sample size, positions of centroids of both groups were compared with non-parametric Mann-Whitney U tests. Additionally, goodness of fit for all models was calculated (Spearman's correlation between centroids and projected points).

7. Results

7.1. Frequency-based analysis

Table 3 shows the descriptive results of thematic and structural code frequencies. The frequency-based analysis of novice and expert teachers' think-aloud observations for the video clip of the partner work setting offers insights into overall similarities and differences between groups.

Regarding group similarities, both groups of teachers often talked about student behaviour, the teacher's management of misbehaviour, and the context of events. Additionally, expert teachers often spoke about the teacher's monitoring of student activity. With respect to structural codes, both groups uttered many perceptions and negative evaluations of the classroom management observed.

Regarding group differences, experts compared to novices made significantly more comments addressing student behaviour ($U = 262.00$, $p = .044$, $r = .33$), student learning ($U = 277.50$, $p = .013$, $r = .41$), and the teacher's management of misbehaviour ($U = 263.50$, $p = .038$, $r =$

Table 3
Novice and expert teachers' code frequencies.

	Novices ($n = 19$)		Experts ($n = 20$)		Differences ^a
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	
Thematic Codes					
Students: Behaviour	4.26	3.68	7.60	4.76	$U = 262.00$, $p = .044$, $r = .33$
Students: Learning	0.84	1.17	3.05	3.33	$U = 277.50$, $p = .013$, $r = .41$
Teacher: Control of lesson flow	1.84	2.71	1.55	1.73	$U = 191.50$, $p = .967$, $r = .00$
Teacher: Management of misbehaviour	6.21	4.63	9.20	3.97	$U = 263.50$, $p = .038$, $r = .33$
Teacher: Monitoring student activity	0.95	1.39	3.80	5.71	$U = 242.50$, $p = .141$, $r = .25$
Context of events	4.05	3.29	5.65	4.20	$U = 229.00$, $p = .283$, $r = .18$
Structural Codes					
Perception of the scene	7.11	3.64	11.25	6.02	$U = 260.50$, $p = .047$, $r = .32$
Interpretation: Inferences/Predictions	1.11	1.22	2.35	2.54	$U = 238.50$, $p = .175$, $r = .23$
Interpretation: Positive Evaluations	1.89	3.13	2.00	2.38	$U = 207.50$, $p = .627$, $r = .08$
Interpretation: Negative Evaluations	4.05	4.09	7.55	6.30	$U = 249.50$, $p = .095$, $r = .27$
Interpretation: Orienting in the Scene	2.53	2.65	2.95	2.89	$U = 208.00$, $p = .627$, $r = .08$
Interpretation: Contextualizing	1.63	1.42	2.10	2.22	$U = 200.00$, $p = .792$, $r = .05$
Decision-Making	1.74	2.62	4.50	3.64	$U = 284.00$, $p = .008$, $r = .43$

^a Results of Mann-Whitney U tests are reported including test statistic U , p value and effect size r .

.33). For structural codes, experts compared to novices talked more about their perception of events ($U = 260.50$, $p = .047$, $r = .32$) and their decision-making ($U = 284.00$, $p = .008$, $r = .43$). Experts also tended to state more negative evaluations of the observed classroom management. However, this expertise effect did not reach the level of significance ($U = 249.50$, $p = .095$, $r = .27$). All effect sizes r were of medium size.

Overall, the frequency-based analysis revealed that novices frequently tried to orient themselves in the scenes while experts more often talked about the students in the scene, reflected on the teachers' behavioural management and often showed decision-making skills by proposing more alternative strategies (i.e., received more decision-making codes).

7.2. Epistemic network analysis

ENA showed a strong fit between the model and the data ($r = .98$ for the x-axis and $r = .98$ for the y-axis). Fig. 2 shows the mean networks of novices and experts representing their shared event representations. Nodes in the centre of the networks reveal common connectivity across teachers and across groups. In our case, nodes representing the codes *negative evaluation*, *orienting* and *context* were most central in the networks. Furthermore, nodes positioned close to each other share common variance. Such code pairs were *orienting/context*, *contextualizing/managing misbehaviour*, *perception/lesson flow* and *monitoring/positive evaluation*. ENA offers insights into overall similarities and differences between the groups of expert and novice teachers.

Regarding group similarities, the strongest connections in both mean group networks were found between *perception*, the teacher *managing misbehaviour*, and *student behaviour*, revealing typical elements of teachers' event representations.

In terms of group differences, ENA revealed that the mean networks of novices and experts differed significantly along the x-axis, i.e. the

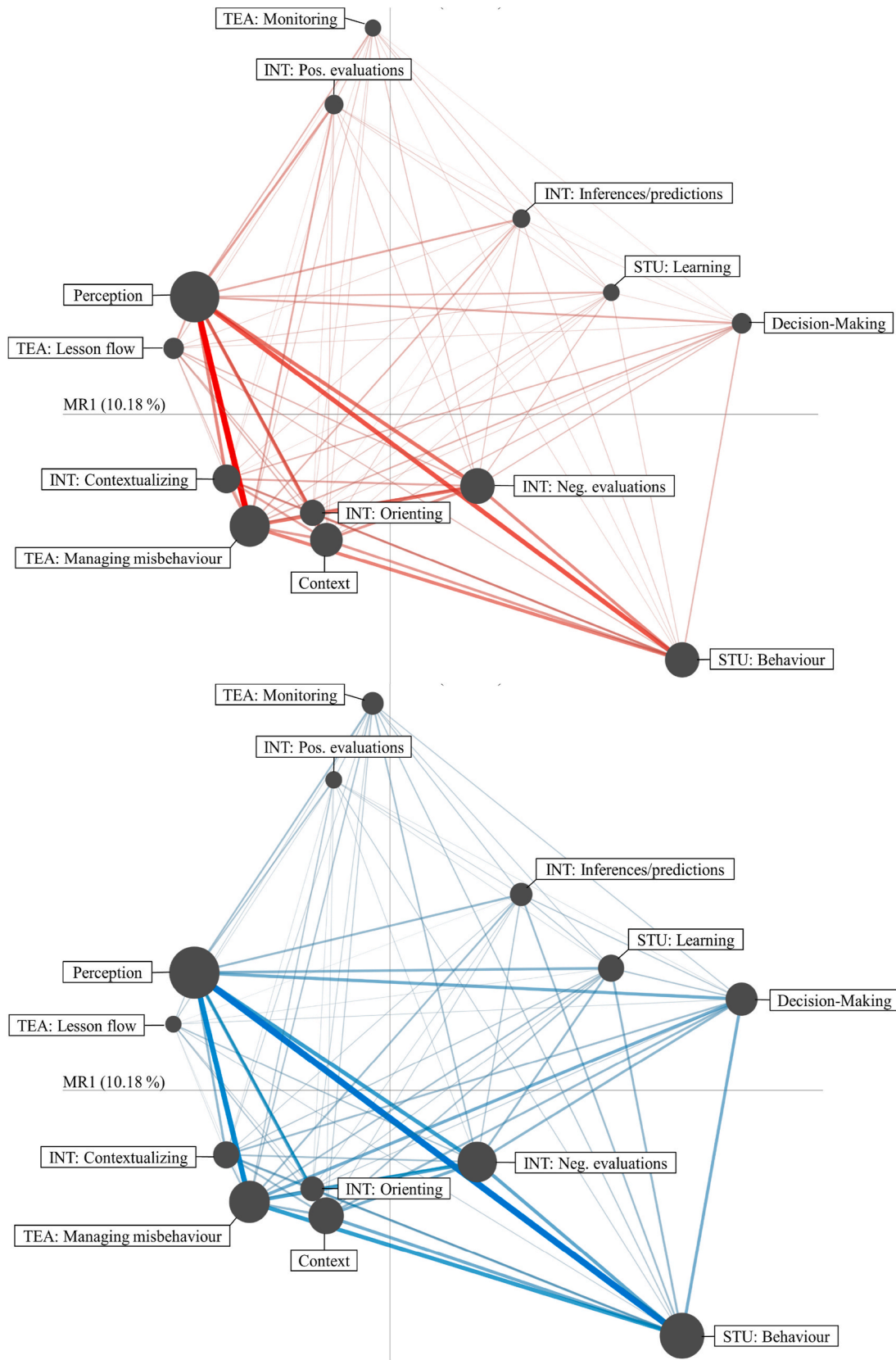


Fig. 2. Epistemic group networks of novice (top) and expert teachers (bottom)
 Note. Black dots indicate nodes, their size indicates the frequency of codes; coloured lines indicate the strength of connections between nodes. INT = interpretation, STU = students, TEA = teacher. For a definition of each code, see coding scheme in [Appendix B](#).

centroids of experts' networks were significantly more on the right side than the centroids of novices' networks (Fig. 3; $U = 319.00, p < .001, r = -.67$). Thus, codes and connections that are on the left or right side of the network were more frequent for either novices or experts. On the left side, nodes that characterize novices' event representations include *perception*, *contextualizing*, *lesson flow*, and *managing misbehaviour*. On the right side, nodes that characterize experts' representations are *decision-making*, *student behaviour*, and *student learning*. Moreover, the subtraction network in Fig. 3 reveals connections between nodes that are stronger for one group, indicating differences in the shared event representations. Expert compared to novice teachers' networks show many stronger interconnections of the nodes *decision-making*, *student learning*, and *student behaviour* suggesting more differentiated and elaborated event representations that pay more attention to students. Particularly strong connections can be found between *student behaviour/perception*, *student behaviour/student learning*, *student behaviour/decision-making*, and *managing misbehaviour/decision-making*. In contrast, novice compared to expert teachers' networks show only few connections that are stronger;

these connections include the node pairs *perception/positive evaluations*, *perception/managing misbehaviour*, *perception/contextualizing*, and *lesson flow/managing misbehaviour*.

Overall, the ENA revealed that experts build more elaborate representations of events that more frequently consider *students* and their *behaviour* and *learning* as well as *decision-making*, i.e. alternative classroom management strategies. In contrast, novices' evaluation of what they observed seems to be more positive. They focus more on the teacher's management of misbehaviour and the lesson flow. However, novice teachers also struggle with making sense of and integrating what they see as indicated by the nodes for *contextualizing* and *orienting* (i.e. they compare events, look for alternative explanations or try to orient themselves in the scene). In summary, experts' representations were more differentiated and had more and stronger connections between nodes compared to novices' representations. These findings suggest that expert teachers were able to form more coherent mental models of the CM events and enriched these models with their classroom scripts stored in long-term working memory more than the novice teachers did.

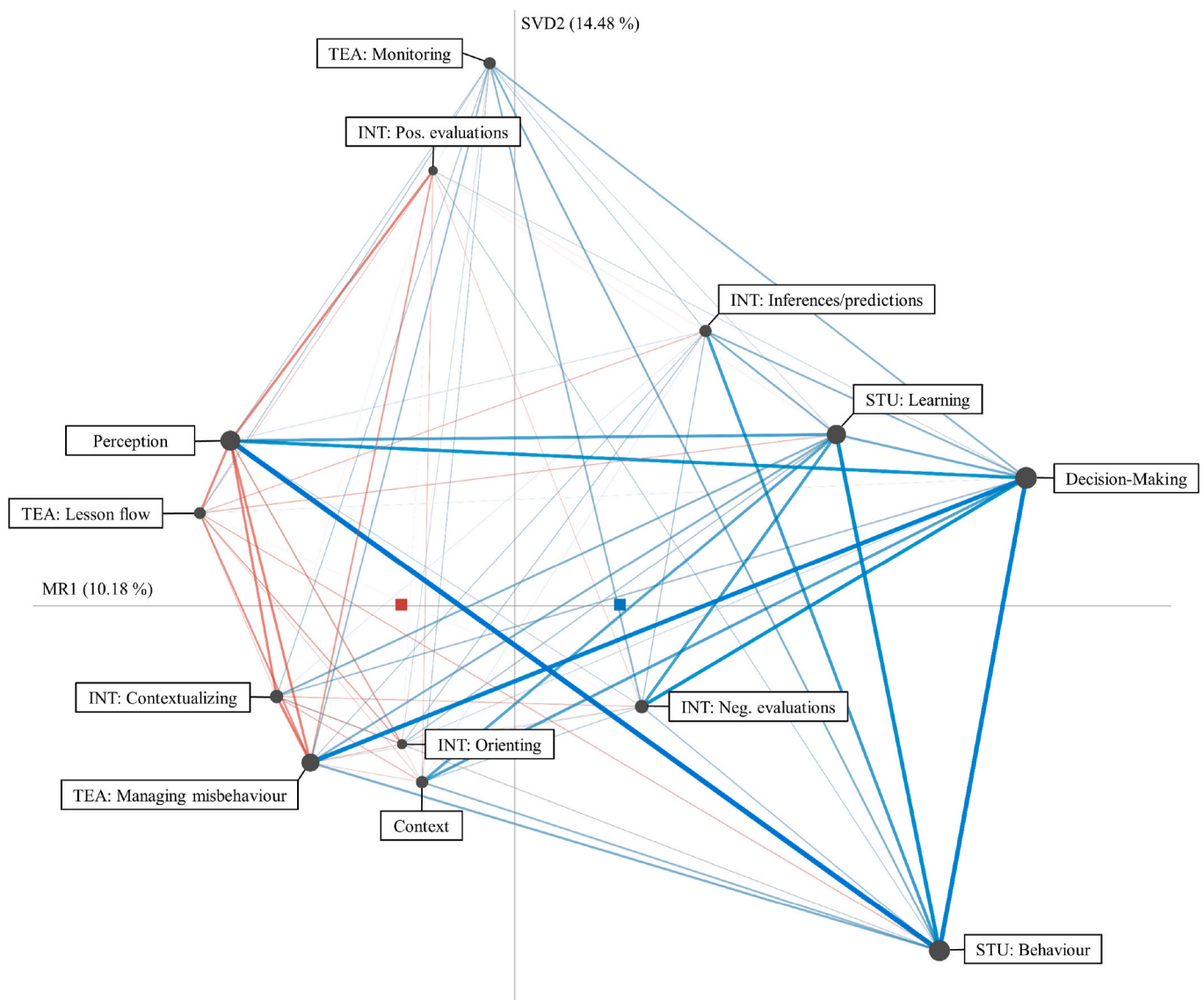


Fig. 3. Epistemic subtraction network of difference between novice (red) and expert teachers (blue)
 Note. Black dots indicate nodes, coloured squares indicate centroids of group networks for novices (red) and experts (blue), coloured lines indicate differences of strength of connections between both groups: red lines show stronger connections for novices, blue lines stronger connections for experts, thicker lines show more frequent connections. INT = interpretation, STU = students, TEA = teacher. For a definition of each code, see coding scheme in Appendix B. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

7.3. Methods comparison

Both analytic approaches—the frequency-based approach and ENA—revealed a number of expert-novice differences that are unique to each method. For example, the frequency-based approach revealed the extent to which expert and novice teachers attended to individual PV-CM components, such as the students or the teacher, student misbehaviour, and teacher behavioural management, and the extent to which alternative decisions to deal with the CM events were articulated. Particularly, experts were on average more focused on student behaviour and student learning and they more frequently considered alternative teacher actions (i.e., decision-making).

In addition to the insights the frequency-based approach revealed, ENA analysis offered a holistic analysis and visualization of the epistemic frame of the group of novices and the group of experts. ENA also helped to (1) reveal the interconnectedness of knowledge structures, (2) preserve the event-relatedness of teacher cognition and (3) account for a socio-cultural understanding of professional vision. ENA revealed new insights into characteristics of expertise with regard to the PV-CM supporting the assumption that experts have more elaborate and well-structured CMS that help them form coherent event representations.

8. Discussion

The study aimed to compare a standard frequency-based approach and ENA as two methods for investigating teacher think-aloud data in order to gain more insights into novice and expert teachers' knowledge structures.

8.1. Insights into novice and expert teachers' knowledge structures

Both methods offer differential insights into novice and expert teachers' mental model integration in terms of their classroom management event representations and their underlying CMS. For example, the standard 'coding-and-counting' approach revealed that experts' think-aloud across all events noticed expressed *quantitatively more* thoughts addressing student learning, student behaviour, and the observed teachers' management of student misbehaviour. Moreover, they uttered *more* perceptions of the scene and showed *more* decision-making in terms of alternative strategies. Since the scene teachers observed was an open partner work setting, more top-down processing was necessary (Seidel et al., 2021; Stahnke & Blömeke, 2021a). Experts were able to use their knowledge about classroom management strategies and the role of such strategies for student learning to interpret the observed events and to propose next adaptive strategies.

In comparison, ENA revealed new insights into novice and expert teachers' representation of events: For both groups, their perceptions of the scene, student behaviour and the observed teacher's management of misbehaviour frequently co-occurred in their event-related think-aloud data. In contrast to van Driel et al. (2023), our ENA showed significant differences between novices and expert teachers' classroom management event representations: Experts' representations were more differentiated and had more and stronger connections between nodes. They showed a strong interconnection of student behaviour, student learning, and the teacher's management of misbehaviour. Furthermore, their representations have stronger links to the context of events (e.g., setting or phase of instruction). Decision-making was a crucial aspect in their representations, thus their analysis of events involved how the situation can be improved. These differences in novices and experts' event representations allow some conclusions about their underlying knowledge structures in the form of CMS: Expert scripts seemed to include knowledge about effects of typical classroom problems on student learning along with adaptive next strategies to improve the situation and to (re-) create an environment that enables learning while novices still seemed to lack this well-structured knowledge. In sum, the results of ENA

suggest elaborate and well-structured mental models underlying experts' PV-CM, which supports the knowledge-based processing assumption in the cognitive theory of visual expertise (Gegenfurtner, 2024; Keskin et al., 2024; Wolff et al., 2021).

In contrast, novices' networks suggested that they struggled with making sense of events and building coherent representations as indicated by the stronger connections to the codes for orienting themselves in the scene and contextualizing their prior thoughts. These results support the assumption that novices lack the knowledge necessary to form meaningful classroom event representations (Miller et al., 2024; Wolff et al., 2021). However, their networks also showed some strengths: Novices' representations are more linked to the teacher's control of the lesson flow as one crucial aspect of instructional classroom management (Gabel et al., 2023, 2025; Korpershoek et al., 2016). Moreover, novices seemed to be more positive in their evaluation of observed events. These aspects of novice teachers' event representations in their mental models have not been revealed in prior, frequency-based analyses.

8.2. Comparison of methodological affordances

The two methods compared in this study come with specific methodological strengths and limitations. A standard 'coding-and-counting' approach allows for different statistical tests and the estimation of effect sizes which allows the testing of hypotheses focusing on specific elements of expert and novice teachers' PV-CM. However, since recording and analysing think-aloud data is laborious work, sample sizes are often small and code frequencies low, limiting the power of statistical tests. The potential of ENA to provide new insights into teachers' PV-CM based on think-aloud data can be attributed to three aspects: (a) the importance of *knowledge structures* as the basis of teacher PV-CM (particularly CMS and mental model integration), (b) the *event-relatedness* of these knowledge structures, and (c) the *socio-cultural understanding of professional vision* as perspectives that are shared within a community of practice.

ENA provides visualizations of cognitive networks indicating teachers' epistemic frames or mental models of their classroom management representations, thereby revealing the structure, integration, and interconnections of knowledge elements in their mental models of classroom situations, which is a hallmark of expertise (Boshuizen et al., 2020; Gegenfurtner et al., 2023; Seidel et al., 2024; Sheridan & Reingold, 2017). Grounded in the cognitive theory of visual expertise (Fig. 1), ENA is thus useful to show empirically how experts build connections among selected image chunks to create a coherent mental model of classroom events (*organizing image chunks*) and how experts further enrich their mental representations with CMS stored in long-term working memory (*integrating*).

Since ENA is a stanza-based method, we defined stanza as think-aloud data referring to one or few related event(s) and thereby modelled that teachers' classroom management knowledge is event-based (Wolff et al., 2021; Zacks et al., 2007). By analysing which codes co-occurred within the event-related think-aloud data, we could observe that contextualizing events and attempting to make sense of them are characteristic features of novice representations of classroom management events. In our frequency-based analysis, however, we did not find such results; across all events, both groups did not differ significantly in the frequency of codes related to contextualization.

Moreover, ENA can elucidate group comparisons and representation or underlying knowledge structures shared within a group or community, for example among novices or experts. By aggregating mean epistemic networks for novices and experts that represent novices' or experts' shared PV-CM (i.e., the professional vision within the community of novices or experts, Goodwin, 1994), we could reveal that within the group of experts', alternative strategies are central to the representation of a classroom management event and strongly linked to its perception and interpretation. Moreover, within both groups, PV-CM

was characterized by different evaluations of the observed events: experts were more negative and novices more positive. In further research, ENA could also be used to explore how dispositions, including teacher attitudes and cultural beliefs, are interconnected with teachers' PV-CM (Blömeke, 2024; McIntyre & Foulsham, 2018) and how these networks differ between novices and experts.

However, ENA is limited with respect to the availability of effect sizes or statistical tests (Elmoazen et al., 2022). To our knowledge, there are not yet any guidelines for effect sizes or for testing the strength of specific connections. Furthermore, interpreting networks with many nodes and drawing conclusions based on visualized networks can be difficult (Elmoazen et al., 2022).

8.3. Limitations

There are some limitations of this study. The sample size was rather small. Further research replicating our results with larger sample sizes is needed. Expert teachers were not selected based on peer nomination or student achievement data (Palmer et al., 2005) since such data is hardly available in the German context. However, all teachers reported to have experience in teacher education which we view as a further indicator of their expertise. Our study used videos of other teachers instead of own teaching. This might have supported teachers in accessing their knowledge but might have reduced immersion and resulted in teachers' expressing less relational thoughts (McIntyre et al., 2022). Moreover, results and conclusions of both a coding-and-counting approach and ENA depend on how data are coded. While our coding scheme was developed based on theory and prior research, other researchers might have emphasized other aspects in their coding schemes and thus generated different results. For instance, we did not analyse the quality of teachers' event representations. Furthermore, coding focused on the participant level; future studies may explore coding on other levels, for example units per video clip or CM event. Finally, we conducted multiple statistical tests which could result in a higher probability of alpha errors. We decided against an alpha correction since the tests conducted in this explorative study did not constitute a test family, making family-wise alpha correction unnecessary (Tutzauer, 2003). In the context of this explorative study, we considered the consequence of an alpha error to be less severe than the effects alpha correction would have had on test power.

8.4. Implications and conclusions

Our comparison of two methods for analysing teacher think-aloud data suggests that ENA can provide new results that complement those of a 'coding-and-counting' approach with limited potential to reveal structures or connections. Of course, results based on frequencies provide important insights, especially when it is crucial that teachers notice many events or provide many different alternative strategies to improve a classroom situation. Yet, ENA can tap into the potential of think-aloud data to reveal complex knowledge structures underlying

Appendix A

Details of the procedure

- (1) The participant was provided with the following instruction before the first observation of the video clip:

"During the first observation, we will record your eye movements. Please push this button every time you notice an event that is relevant for classroom management. By classroom management, we mean creating and maintaining a classroom environment that enables students to learn. During the second observation, we will pause the video at each event. Please tell us what you thought when first seeing this event and why this event is relevant to you."

- (2) The participant observed the partner work scene from a biology lesson which is one min long. Understanding the scene does not require any subject knowledge. Eye movements and time-stamps (i.e., when teachers pressed a button to indicate note-worthy events) were recorded. The

expert and novice teachers' PV-CM by identifying, quantifying, and visualizing connections between knowledge elements (Shaffer & Ruis, 2017). Furthermore, by defining stanza based on events, ENA can account for the event-relatedness of teachers' event representation and their underlying classroom management knowledge (Hogan et al., 2003; Wolff et al., 2021; Zacks et al., 2007). Moreover, the epistemic frame of a group of experts and novices can be compared, reflecting the socio-cultural nature of professional vision (Goodwin, 1994; Lehtinen et al., 2020; van Es & Sherin, 2002). Despite these potential benefits, however, ENA models can be difficult to interpret due to many codes and many connections. Thus, methods for finding the most parsimonious model could help identify reduced models that still have explanatory power (Wang et al., 2021). Moreover, developing methods for testing specific elements of epistemic networks (e.g., group differences in the strengths of co-occurring knowledge elements within whole networks as indicators of the integration quality of mental classroom representations) would allow researchers to use ENA for more focussed rather than explorative research questions (Elmoazen et al., 2022). In conclusion, we see ENA as a useful method to investigate teacher professional vision that can complement a frequency-based approach by revealing event-related structures and connections in teachers' representations. ENA is thus a valuable addition to the method repertoire of researchers interested in examining how teachers integrate classroom information into mental models as indicators of teacher professional vision and expertise.

CRedit authorship contribution statement

Rebekka Stahnke: Writing – review & editing, Writing – original draft, Visualization, Methodology, Investigation, Formal analysis, Conceptualization. **Andreas Gegenfurtner:** Writing – review & editing, Visualization, Methodology.

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Declarations of interest

None.

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video contains many different classroom management events that teachers could notice:

- Student-discipline events: At the beginning of the scene, the whole class is loud and not paying attention. Two students are fooling around and fight with each other behind the teacher’s back. Additionally, one student puts on a hoody, another student put on a hat.
- Student-learning events: A few students seem disengaged and not motivated to work on the task. Other students are engaged and attentive.
- Reactive classroom management events: The teacher is rather lenient with students’ misbehaviour and does not react to misbehaviour, or reacts in ways that are not intrusive by looking at students, talking calmly to them, or shortly pulling at the hat.
- Preventive classroom management events: The teacher goes through the rows and monitors student activity. Instructions and a timer on the smart board provide structure for the task. The teacher’s posture and presence are friendly and he seems to have positive relationships with his students.

(3) The participant was provided with the following instruction before the second observation of the video clip: “We will now see the video clip again and pause every time you noticed an event. Please tell us what you thought when you first saw these events.”

(4) The participants observed the partner work scene again. The video was overlaid with their own prior gaze to stimulate their cognitive processes (Hyrskykari et al., 2008; Prokop et al., 2020; van Gog et al., 2005). The video was paused whenever teachers noticed a classroom management event and participants were instructed: “Please tell us what you thought when you first saw these events.” Whenever participants were quiet for a longer period, they were asked if they wanted to add any thoughts before proceeding to the next event.

Appendix B

Coding Scheme – Professional Vision of Classroom Management

For a more detailed version of the coding scheme, see Stahnke and Blömeke (2021b).

Codes	Definition
Thematic codes	
Student Behaviour ^{1,2}	Statements about student behaviour (positive or negative, e. g., engagement or misbehaviour)
Student Learning ²	Statements about students learning and its outcomes
Teacher: Control of Lesson Flow ³	Statements about the teacher’s control of the flow of the lesson, the clarity of goals, or the smoothness of the lesson flow
Teacher: Management of Misbehaviour ³	Statements about the teacher’s (non)reaction to students’ misbehaviour or disengagement
Teacher: Monitoring Students ³	Statements about the teacher’s monitoring of student activity or the teacher’s noticing of what is going on in the classroom
Context of Event ^{1, 3}	Statements about the classroom and the school environment, classroom rules, and school rules or the phase of the lesson or the setting
Structural codes	
Perception ^{1, 2}	Statement that describes what can be seen or heard in the scene.
Interpretation: Inferences and Predictions ^{1, 2}	Assumptions about cognitive, motivational, or affective states of the students or the teacher or assumptions about how an event will develop in terms of next actions or student learning
Interpretation: Positive Evaluations	Statements that positively evaluate the teacher, their actions, or their intentions
Interpretation: Negative Evaluations	Statements that negatively evaluate the teacher, their actions, or their intentions
Interpretation: Orienting	Statement about the participant orienting themselves in the classroom scene
Interpretation: Contextualizing	Statements that put prior or subsequent statements into perspective with alternative explanations or with comparisons to other events
Decision-Making ^{1, 2}	Statements on how to improve the situation in specific or teaching in general

¹ Code is merged from multiple original subcodes in Stahnke and Blömeke (2021b).

² Codes adapted from Wolff et al. (2017).

³ Codes adapted from Piwovar et al. (2013).

Appendix C

Example of coded data from one expert teacher (translated from German)

Time Stamps	Idea units	Structural code (general code/ subcode)	Thematic code (general code/ subcode)
1	1: First of all, I like that there is a clear task on the smart board with a time limit.	Interpretation: positive evaluations	Teacher: control of the lesson flow
	2: It is very visible what everybody has to do.	Perception	Teacher: control of lesson flow
	3: And it’s good that he is not standing somewhere on the side, but tries to actively monitor the students’ progress.	Interpretation: positive evaluations	Teacher: monitoring
2	1: It seems that the teacher decided not to react to his behaviour yet [student puts on a hat].	Interpretation: inferences and predictions	Teacher: management of misbehaviour
	2: He [the teacher] first observed and waited what he [the student] will do next.	Perception	Teacher: monitoring
	3: This can be a sensible decision if you do not want to escalate the situation.	Interpretation: positive evaluations	Teacher: management of misbehaviour
3	1: This seating arrangement would annoy me - I would change it.	Decision-making	Context
	2: They [the students] are supposed to work together, but the seating arrangement does not work with this setting.	Interpretation: negative evaluations	Context
	3: That’s why they are getting so loud.	Interpretation: negative evaluations	Students behaviour
	4: But maybe he [the teacher] cannot change this [seating arrangement] in this room with these tables.	Interpretation: contextualizing	Context

Data availability

The authors do not have permission to share data.

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