Revisiting 'withitness': Differences in teachers' representations, perceptions, and interpretations of classroom management

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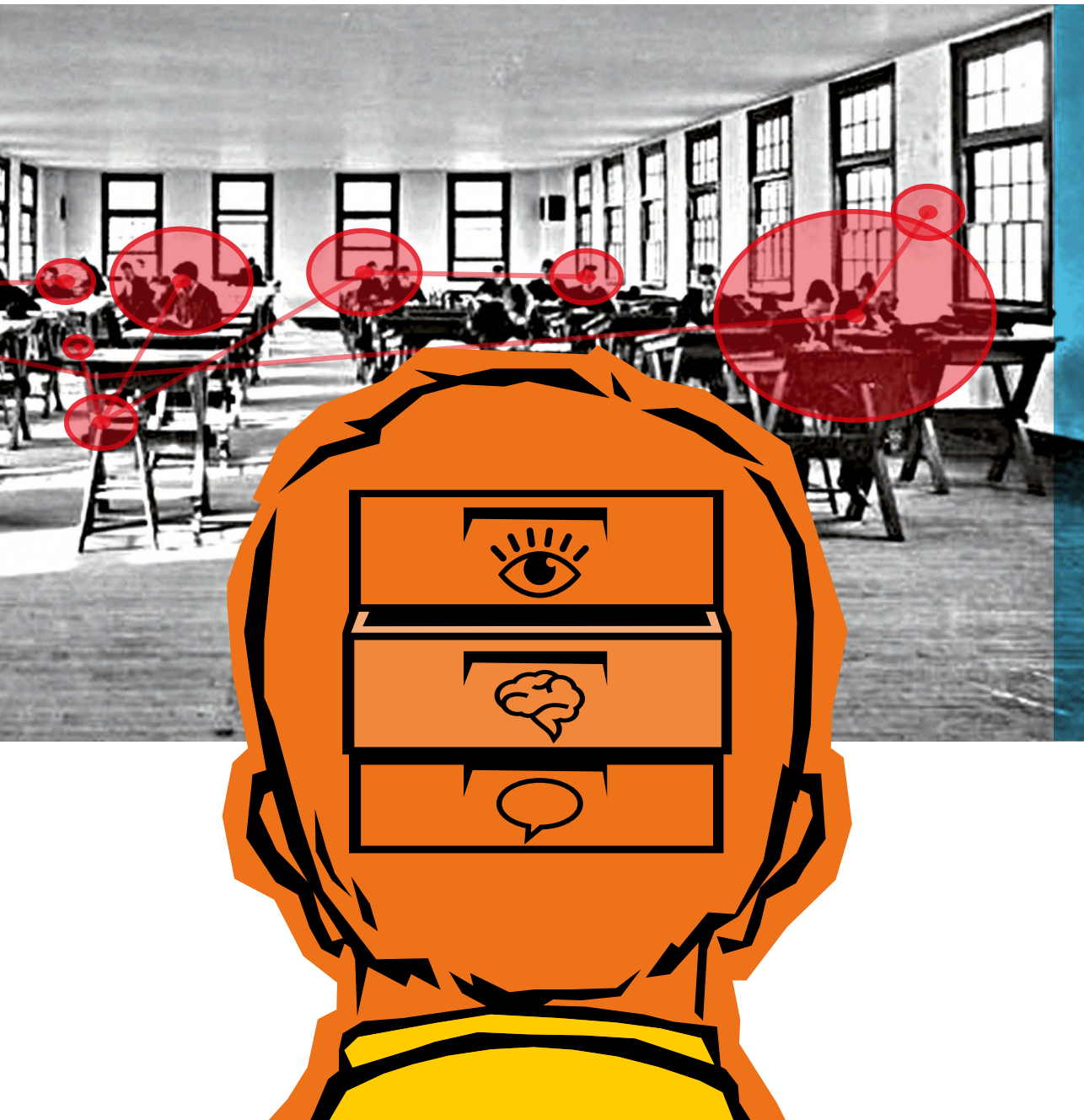

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CHAPTER 1

General introduction: Teacher expertise and classroom management

Have a look at the still shot above and take a moment to consider what is happening in this classroom. What catches your eye? Any number of things may flash through your mind. To some it may capture a distraction, seem to be filled with diverted attention. To others it may appear rather subdued, with nothing too troubling at first glance. Maybe this is what learning looks like, maybe this is what misbehavior looks like. No matter what one may say or think about this moment, no single explanation will exhaust the interpretative possibilities (Bruner, 2003). The idea to keep in mind is that the sense one makes of this particular moment, this classroom event frozen in time, depends largely on which features of the classroom one notices, and even more so depends on how this information is interpreted in one's mind. The interpretation, in turn, depends profoundly on one's knowledge of classrooms and the innumerable events that happen within them.

Classrooms are dynamic spaces, filled with a varied mix of people, activities, and goals, and how learning happens within them is a matter somewhat open to interpretation. Maintaining a well-managed classroom, a classroom in which the learning environment is sustained and active student engagement is achieved, is not a skill to be taken for granted. The events that play out in classrooms are only partially predictable and controllable: good management practice also requires adapting to what emerges within the classroom.

Effective management, which is key to effective teaching, relies heavily on acquiring and developing classroom knowledge directly related to classroom practice (Emmer & Stough, 2001). Specifically, it requires knowledge which is grounded in an understanding of the complexity of classroom events and what they mean for teaching and learning (Doyle, 1990). Experience with classroom teaching is imperative for a teacher to develop keen perceptions and responses to classroom events, but it is not experience

alone which leads to mastery of classroom management and other hallmarks of exemplary teaching (Berliner, 2001). Teachers must build the professional knowledge and expertise for handling the challenges that classroom life presents. Through experience and practice, teachers gradually acquire and integrate diverse pedagogical knowledge that allows them to process and manage the complexities arising from the dynamics of the classroom. In the summarizing words of Shulman (2000),

> "As you begin to experience the difference between what it means to know and understand something yourself and what it takes to help someone else come to know and understand it, and as you begin to recognize the complexity of that process, you have come a very short distance into studying the problem of learning and teaching" (p.130).

CONNECTING TEACHER EXPERTISE TO CLASSROOM MANAGEMENT

Certain features of the classroom environment contribute directly to the challenges of teaching, and coping with these features differs according to a teacher's expertise and the knowledge they apply to classroom management. Here, it is *pedagogical knowledge*, which applies directly to teaching and learning situations regardless of content, and which helps maintain the flow and pattern of classroom interactions in alignment with instructional goals, as opposed to *pedagogical content knowledge* (Bromme, 2001; Hogan, Rabinowitz, & Craven, 2003, see below for definition). Before looking more closely at why the classroom environment is so cognitively complex, it is important to clarify what classroom management entails. As defined by Brophy (2006; 1988), classroom management can be seen as "actions taken to create and maintain a learning environment conducive to successful instruction (arranging the physical environment, establishing rules and procedures, maintaining students' attention to lessons and engagement in activities)" (2006, p.17). He differentiates management from the closely related function of disciplinary intervention, which are the actions teachers take to elicit or compel behavior improvements in situations where students do not meet expectations or misbehave in ways that disrupt the overall management system. On a practical level, this distinction implies that management entails more than creating a learning environment and managing groups of students. It is also about engaging students and understanding the relationship between students, teachers, and the dynamics of classroom interactions and events that lead to learning.

There are several dimensions to the classroom environment outlining the complexity of classrooms and successfully managing the situations and events characteristic of classrooms (Doyle, 1977). First and foremost, they are *multidimensional*, meaning they are filled with many events, tasks, social concerns and instructional objectives. These many events and activities are often occurring at the same time, underlining their *simul-*

taneity, and often occur at rapid pace allowing little time to reflect before responding, underlining their *immediacy*. Furthermore, there is a strong element of *unpredictability*, as events interact and can easily take unexpected turns, in spite of teachers' efforts to plan activities and anticipate their reception and ensuing behavior. These dimensions place heavy cognitive demands on teachers, both in terms of planning instruction and sustaining effective management, and also in terms of monitoring and evaluating the steady flow of events.

A crucial variable for effective management is teachers' *withitness*, the ability to maintain an ongoing awareness of what is happening in the classroom and the events taking place within it (Kounin, 1970). Withitness is crucial not only to the perception of classroom events, but also to how these events are represented in the minds of teachers, how they notice cues and anticipate problems based on the cues and events they perceive. It requires accounting for diverse knowledge not only of events, but also about students, lesson content and curriculum goals, and the processes through which teaching leads to the attainment of learning. This knowledge must also be synthesized in such a way that the awareness remains constant and spot-on. "Like circus performers who keep plates spinning on top of sticks, teachers must not only establish a management system that works but keep it working by monitoring events continually and responding when breakdowns occur." (Brophy, 1988, p. 3). When presented with problems in the classrooms, experts have been shown to devote more of their thinking to defining and understanding problems, while novices think more about short-term solutions to the problems (Swanson, O'Connor, & Cooney, 1990). To manage effectively, teachers need to know how to generate productive and efficient patterns of interaction, and they must also know how to respond to and deal with difficult problems and situations. They need the general pedagogical knowledge that develops through expertise (Bromme, 2001).

In addition to reliance on knowledge, there is an important visual component to withitness in the classroom. Much of the information that the human mind processes and deconstructs relies on our eyes, as vision is the dominant sense through which we perceive and interpret situations the world presents (Medina, 2008). Teachers' *professional vision*, the ways in which teachers see and understand events particular to teaching, helps define teachers' ability to notice and interpret relevant aspects of classroom interactions (Goodwin, 1994). This ability is not innate, it is a competency which develops over time as teachers learn to perceive classroom events and arrive at meaningful interpretations of their perceptions in terms of teaching and learning (Sherin, 2001; Van Es & Sherin, 2002). Much of what teachers notice relates to issues of pedagogy, classroom climate, and classroom management (Colestock & Sherin, 2009).

Research on teachers' visual processing clarifies a number of key differences between expert and novices that are applicable to classroom management. Carter, Cushing, Sabers, Stein, and Berliner (1988) pointed out that expert teachers, "…perhaps by the very nature of acquiring expertise through extensive and varied teaching experienc-

es, have a rich store of classroom knowledge about both students and events, and they use that knowledge to understand and explain classroom phenomena" (p.31). Novices, in contrast, tend to be more hesitant in their depiction of instruction and management in the classroom, offering shallow and sometimes inaccurate descriptions of classroom phenomena, and evidence a lack of well-developed schemas for processing visual information in the classroom. In an experiment designed to recreate the classroom features of multidimensionality, simultaneity, and immediacy of the classroom by presenting a classroom lesson across three video screens, experts and novices differed in their ability to monitor and interpret classroom events (Sabers, Cushing, & Berliner, 1991). Expert teachers spread their attention across the screens, but novices devoted more than half their attention to the center screen. Experts' scanning also showed a better integration of not only visual but also auditory information. Their interpretations showed a better comprehension of events and evaluation of the instructional strategies employed, and deeper analytical reasoning about student behavior. In contrast, novices mainly described what they saw with little evidence of interpretation of instruction or reasoning about student behavior, and were more concerned with behavior that was inappropriate and expressing disapproval. Overall, expert teachers are more efficient at recognizing meaningful patterns, interpreting multiple events, and are more selective in their attention to events (Copeland, Birmingham, DeMeulle, D'Emidio-Caston, & Natal, 1994; Tsui, 2003). In dealing with the complexities of the classroom, an important visual strategy that develops through experience involves being selective and discriminating about attending to events, particularly differentiating between which events are relevant and which are not (Doyle, 1977; Haider & Frensch, 1996).

A BRIEF OVERVIEW OF TEACHER RESEARCH AND THE ROLE OF TEACHER EXPERTISE

The centrality of teachers' knowledge and the cognitive processing it supports in the classroom has not always been the primary focal area of teacher research. Throughout the first half of the 20th century, defining the knowledge base of teaching mainly relied on identifying or isolating desirable teaching behaviors that were directly linked to an educational impact. This impact was often measured as gains in student achievement, but not necessarily as gains in student learning (Bromme, 2001; Verloop, van Driel, & Meijer, 2001). A driving idea behind this research was that if teachers learned effective teaching behaviors, either in the teacher training programs or through targeted professional development, this would lead to desirable educational outcomes in their classrooms.

In terms of classroom management, attention to the knowledge base at the classroom level was focused either on curriculum or subject-specific content areas or on administrative aspects on the school level. Little attention was given to the knowledge

and skill integration supporting classroom management as a topic. Instead, a set of behavioral techniques, often based on common sense, were offered as management advice. Typical factors in classrooms, such as student confusion, disorder, spotty attendance, etc. were acknowledged, but dealing with these factors was limited mainly to establishing clear expectations and explicit instructions from the first day of school forward, indoctrinating students habits and behaviors to conform with educational goals (Brophy, 2006).

By the mid-20th century, there was a growing recognition of shortcomings in the Teacher Traits paradigm. Much of the advice vacillated between being rather trivial (for example, occupying students with class activities is preferable to penalizing and devising punishments for students) or overly complex and lacking in generalizable results, based more on anecdotal experience and observations rather than empirical research. Notably, these teaching theories lacked explanatory power in terms of how particular teaching characteristics affected different classroom situations and particular grade levels. The Process-Product paradigm gained favor, as researchers strove to clearly define the link between teacher skills and student achievement, but skills often remained framed as teacher effects in behavioral terms (Bromme, 2001). Concepts of social learning and consideration of students' capacity for self-regulation and learning dispositions, for example, suggested the combined techniques of teacher modeling and verbal support of student self-instruction (McLaughlin, 1976).

Interventions prescribed on the basis of this research neglected the complexity of teaching and how teachers functioned, fragmenting the multi-layered processing of classroom teaching (Doyle, 1990). Additionally, teachers and researchers alike questioned this behavior-centric emphasis and the production of *knowledge for teaching* that was distanced from the practical *knowledge of teachers* (Fenstermacher, 1994; Shulman, 1987). As Bromme (2001) explains, by the 1970's there was increasing acknowledgement that "the impact of a specific teacher action on student achievement depended just as much on the students' own activities, interpretations, and interactions as on the subject, the timing of the action, and the sequence (not just the aggregated frequency) of prior events" (p. 15460). The gap between teaching theory and teaching practice became more apparent, and a focal shift from research on teacher behavior yielded to research concentrating on teacher cognition and the underlying beliefs influencing behavior, and their impact within the classroom. As a consequence, research on the interaction between the cognitions and beliefs held by teachers became more prominent, and questions about teachers' knowledge and how these impacted both the learning and behavior of students became more present. The role of teachers' cognitions in the classroom, and how they differed based on teachers' knowledge and expertise, became driving questions, ushering in the Teacher Expertise paradigm (Bromme, 2001; Verloop et al., 2001).

The significance of acquiring rich pedagogical knowledge of classrooms, students, content, and understanding how different stages of expertise development mediates

these processes became essential concerns in the field of education (Berliner, 1988). The concept of *pedagogical content knowledge* – the unique blend of knowledge specific to teaching that culminates in an understanding of how teaching topics and problems are organized, and how they are adaptively represented to students as meaningful instruction – helped illustrate how teacher expertise and competency affected impact in the classroom (Shulman, 1987). Cognitive skill research across professional domains exerted an influence on teacher research, illuminating the cognitive complexity of the teaching domain. Distinguishing qualitative differences between expert and novice teachers' knowledge, thought processing, and actions offered new insights in educational research (Carter & Doyle, 1987; Chi, Feltovich, & Glaser, 1981; Emmer & Stough, 2001; Leinhardt & Greeno, 1986; Livingston & Borko, 1989; Tsui, 2003; Westerman, 1991). Teachers' cognitive *representations*, defined as the way teachers mentally construct, symbolize, preserve, and interpret information about objects and events in the world and in the classroom, provided powerful explanations regarding divergences in teachers' abilities to perceive, infer, recognize, and predict situations arising in the classroom (Hogan et al., 2003; McNamara, 1994). Cognitive concepts such as mental *schemas,* the abstract mental structures used to organize and interpret classroom information, and *scripts*, inter-related action sequences typifying commonly experienced events and consequently guide expectations and behavior in familiar situations, offered additional explanatory power in terms of differences between expert and novice teachers (Bromme, 2001; Schank & Abelson, 2008; Schoenfeld, 1999).

By the latter part of the 20th century, several key patterns in expert and novice representations and schemas had been established. Experts, for example, were shown to possess elaborate and well-integrated knowledge, stored as facts, guiding principles, and experience, that they could easily and flexibly draw upon when engaging in both planning and interactive classroom teaching. This pedagogical knowledge shapes teachers' reasoning, deliberating, and decision-making, and also the development of pedagogical content knowledge that is so critical for classroom teaching and comprehension of classroom systems (Berliner, 2001; Doyle, 1990; Livingston & Borko, 1989; Shulman, 1987). Understandably, beginning teachers lack the benefit of these knowledge-based resources and the insights that practical teaching experience affords. In other words, novices are busily acquiring the experience and understanding that evolves into elaborate representations, schemas, and scripts about classrooms, students, and instructional goals associated with successful teaching. Novices concentrate more on short-term goals and highly scripted lesson planning, while experts incorporate both longer and shorter term goals as they plan and execute their lessons. The scope of novices representations are often framed in terms of how well they executed the lessons they have planned and how well students behave, for example, whereas experts can more flexibly adapt their goals based on student cues, adjusting their teaching decisions in accordance with classroom interactions (Westerman, 1991). As teachers representations and schemas develop, concerns about the classroom environment shifts from a focus on

teacher actions and execution of planning to considerations of organization, efficiency, fluidity, and students' understanding of the content being taught (Hogan et al., 2003). In general, experts learn to anticipate problems before they arise, and when problems occur they respond quickly to prevent these problems from escalating (Klein & Hoffman, 1993). Novices concentrate on what is happening right in front of them, often missing the patterns and cues that experts (often preemptively) detect and recognize.

These shifts in teacher research leading to the growing knowledge base concerned with teacher expertise and teacher cognition delineate important developments in teacher research. However, the methodologies employed to build this research base were not without their limitations. To describe teachers' classroom management, for example, many studies relied on direct observation, using extensive field notes and teacher interviews, often collected at the beginning of the school year when management systems were being established (Emmer & Stough, 2001). The qualitative methods and rich descriptive analysis they yield is highly insightful, but studies are sometimes so context and teacher specific that it becomes difficult to generalize the findings or evaluate them statistically due to small sample sizes (Kagan, 1990). Also, technological options that are ubiquitous in the 21st century were more difficult to incorporate into the research conducted. For example, eye tracking, which offers an objective method for measuring teachers' perception, was seldom employed in educational studies, and is absent from seminal work on teachers' visual processing of the classroom (Carter et al., 1988; Reingold & Sheridan, 2011).

GOALS OF THIS DISSERTATION AND OUTLINE OF ITS CONTENT

The research cited above shows a rich and valuable legacy in terms what is known about teachers' knowledge and cognitions. The role of teaching expertise exerts a strong influence on perceiving, representing, and interpreting the classroom, and how well-equipped a teacher is to manage classrooms and handle the various problems that are bound to arise. And yet, classroom management remains a perennial struggle for beginning teachers and a continuing challenge even for teachers with classroom experience (Evertson & Weinstein, 2006; Marzano, Marzano, & Pickering, 2003; van Tartwijk, den Brok, Veldman, & Wubbels, 2009). In reviewing the available literature on classroom management and expertise, many of the promising insights into teachers' cognition and knowledge organization began in the 1970s, and steadily increased through the 1980s and 1990s. By the early 21st century, however, both empirical and theoretical contributions focusing on cognition for classroom management become scarcer. Almost as if there was a lull in the conversation on these topics.

In their review of research on classroom and management, Emmer and Stough (2001) emphasized the importance of including clear and adequate conceptualizations based on knowledge of effective classroom management, and that this knowledge

should be linked to practice, and proceed with methods situated within real-world context and events. They specified a need for:

> "Developing understanding about classroom management thus requires experience in classroom contexts to be pragmatic; that is, to be integrated into the network of scripts, expectations, and routines that the teacher will utilize in the classroom and to result in the effective management of students" (p. 109-110).

Hattie (2012) stresses the central role of teaching expertise and in achieving and enhancing student learning: the combination of teachers' agency in the classroom and the 'theories of practice' they bring with them to the classroom are crucial factors for achieving learning in the classroom. His research supports the importance that the depth of teachers' representations, the quality of the classroom climate they manage, the ability to recognize problems, and the monitoring and interpreting of classroom events has on student learning.

This dissertation is an attempt to confirm and extend research findings related to conceptualizations of classroom management through the voices and vision of teachers. The research investigates various elements of teachers' withitness, analyzing awareness of relevant events for classroom management by accentuating several aspects of teachers' cognition. To accomplish this, the approach to expertise compares teachers on opposite ends of the expertise development spectrum – experts and novices. The methodological approach combines qualitative and quantitative analyses of both verbal and visual data, utilizing stimuli from real-world situations displaying events from Dutch secondary classrooms. The majority of the dissertation presents empirical research intended to confirm and extend our understanding of expert-novice differences on the topic of classroom management, and one chapter combines the findings from these studies to present a theoretical model describing expert-novice knowledge structures and how they influence classroom interpretations.

Chapter 2 presents differences identified in teachers' representations of classroom management events. It describes a mixed method approach for identifying key differences in teachers' description of selected classroom scenes. The verbal data analyzed in Chapter 2 was collected as video-stimulated retrospective interviews: teachers were asked to describe what they had seen in four different fragments of classroom lessons and how it was relevant to classroom management. Using a grounded theory approach, a multi-layered coding scheme was developed and validated, and significant differences were identified through statistical analysis. The differences provided insight into the way teachers describe and interpret classroom management, what they focus on as relevant for classroom management, how events are referenced temporarily, and larger features of their global cognitive processing.

Chapter 3 presents differences in teachers' professional vision when confronted with problematic classroom scenes. This study focused more closely on teacher vision, emphasizing differences in how experts and novices perceive the classroom. The major-

ity of the data presented in this study was derived from eye tracking data to investigate the influence of expertise as teachers processed two different types of problematic classroom scenes. Teachers viewed videos depicting distinct types of problematic events, and each lesson fragment was shown twice in a row: first to familiarize the participants with the classroom situation, and the second time to think aloud about any thoughts concerning classroom management. The core aims were to determine whether or not experts and novices distributed their visual attention differently, and to detect differences in where teachers monitored classroom events and interactions and where they overlooked information available in the classroom. The verbal data presented in this study was collected as video-stimulated think aloud, and an innovative quantitative approach (textometry) compared differences between expert and novice word usage.

Chapter 4 presents differences in both the perceptions and interpretations of problematic classroom events. The same think aloud data appearing in Chapter 3 was analyzed qualitatively to explore differences in verbalized thoughts more extensively. The coding scheme developed earlier in the Chapter 2 study was modified, and qualitative differences were used to test hypotheses about expert and novices interpretations of problematic classroom management events and provide additional insights into the cognitive processing of experts and novices.

Chapter 5 incorporates findings derived from the empirical studies and offers a theoretical model explaining differences in the knowledge structures of expert and novice teachers and the influence these structures have on the interpretation of problems which arise in classrooms. The theoretical model presented in Chapter 5 can be seen as a synthesis of the results drawn from the preceding studies. Thus, findings of both perceptual and interpretive cognitive processing were merged to develop a theoretical framework considering differences: a) in the way expert and novice teachers structure their classroom management knowledge and make use of classroom scripts; and b) the influence of this knowledge on teachers' awareness and interpretations of problematic classroom events.

Finally, in the general discussion presented in Chapter 6, methodological considerations and challenges pertaining to relationship between eye tracking and verbal data are examined. On the one hand, technological advances that were limited or nonexistent in earlier phases of teacher expertise research offer new options for exploring and analyzing teacher cognition. On the other hand, such options come with affordances and constraints for triangulating multiple data sources and making decisions that weigh heavily on the kinds of results achieved. The methodological issues encountered in the course of conducting research into perceptual and deeper cognitive processing are framed in terms of practical and theoretical implications for research on teacher vision and cognition.

CHAPTER 2

Keeping an eye on learning: Differences between expert and novice teachers' representations of classroom management events [1]

[1] Chapter 2 is based upon:
Wolff, C. E., van den Bogert, N., Jarodzka, H., & Boshuizen, H. P. A. (2015). Keeping an eye on learning: Differences between expert and novice teachers' representations of classroom management events. *Journal of Teacher Education*, *66*(1), 68–85. http://doi.org/10.1177/0022487114549810

ABSTRACT

Classroom management represents an important skill and knowledge set for achieving student learning gains, but poses a considerable challenge for beginning teachers. Understanding how teachers' cognition and conceptualizations differ between experts and novices is useful for enhancing beginning teachers' expertise development. We created a coding scheme using grounded theory to analyze expert and novice teachers' verbalizations describing classroom events and their relevance for classroom management. Four categories of codes emerged. These referred to perceptions/interpretations, thematic focus, temporality, and cognitive processing expressed. Mixed-method analysis of teachers' verbalizations yielded a number of significant effects related to participants' expertise levels. Notably, teachers' cognitive processing diverged significantly based on expertise level. Differences in focus included themes such as student learning, student discipline, and teacher interaction and influence. Experts focused on learning in the classroom and the teacher's ability to influence learning, whereas novices were more concerned with maintaining discipline and behavioral norms.

Although it may seem natural to assume that every teacher places learning at the center of their practice, such an assumption could be sounder in theory than it is in practice. Shared characteristics of expert teachers, including their awareness of and impact on student learning, are well-known (Berliner, 2001; Hattie, 2003). While these characteristics are useful as points of comparison between expert teachers and those still actively developing their teaching skills, they do not provide a clear picture of what teachers' development looks like along the long road leading to expertise. We are left to wonder: how do teachers acquire their expertise, and what are the differences between experienced and inexperienced teachers?

Berliner has explained that "Learning to teach is not simply learning how to survive the first week of school. It is primarily about learning to codify knowledge in order to draw on it again. And it is probably about complexifying and not simplifying the world" (Berliner, 2001, p.477). Identifying how teachers at different stages of development think, how they perform while teaching, how they represent their teaching knowledge, and how they acquire the qualities, skills, and knowledge necessary for expertise are all ways in which we can further research on teacher expertise (Hogan, Rabinowitz, & Craven III, 2003; Palmer, Stough, Burdenski, & Gonzales, 2005; Schempp, Tan, Manross, & Fincher, 1998). While research published during the 80's and 90's has built a solid theoretical foundation concerning teacher expertise and its development, there is a lack of concrete, practical understanding of how teachers differ as they develop and gain expertise. Such an undertaking should be centered around teachers and what they do in practice, rather than theories about what teachers do (Verloop et al., 2001). These older theories also run the risk of being out of touch with the reality of 21st century classrooms. With this renewing, teacher-centered approach in mind, this study aims to update and enhance our understanding of the complexity of teaching, and, in turn, the complexity of *expertise differences* in teaching.

Applying a cognitive perspective to teachers expertise can enhance insights into *knowledge of and for teaching* (Fenstermacher, 1994; Livingston & Borko, 1989). It also highlights the contribution that *experience* has on the expertise development process and the knowledge integration that takes place over the long-term (Copeland et al., 1994; Sabers et al., 1991). Rather than broadly tackling the research gap in terms of relative differences between expert and novice teachers, we have confined our study to the indispensable skill of classroom management. As a complex skill that novice teachers consistently struggle to refine (van Tartwijk, Veldman, & Verloop, 2011), we take the view that classroom management must be performed effectively before deliberate attention can be given to skills in other areas of teaching (Berliner, 1988). Enriching our understanding of differences between experienced and inexperienced teachers' skills and performances – particularly how their sense-making of classroom events differs – helps clarify transformations in understanding that evolve as teachers acquire expertise (Copeland et al., 1994). Insight into teacher expertise differences helps to illuminate how and where and in which ways novices diverge from experts. This research into skill

and knowledge differences can be incorporated into teacher training programs so that teachers in the early stages of their career can establish realistic professional development goals based on the skills, strategies, and knowledge of experienced teachers.

1.1 Teacher expertise and expert-novice differences

Complexity of teacher expertise. In spite of inconsistencies associated with defining teacher expertise, researchers have produced a diverse collection of studies outlining differences between experienced, expert teachers and their less proficient counterparts. The fact that teaching requires a remarkably robust combination of skills and knowledge to achieve the end goal of generating meaningful learning outcomes only adds to the challenge (Brophy, 1988; Spalding, Klecka, Lin, Wang, & Odell, 2011). To overcome these challenges, there is a need to re-conceptualize teacher expertise by examining teaching expertise in 'real-world' settings (Sternberg & Horvath, 1995). Studying teachers' descriptive interpretations of actual classroom lesson videos helps fulfill this need for an authentic, real-world context. Likewise, it necessitates treating teaching as a complex cognitive skill in line with research on cognitive skills in other domains (Berliner, 2001; Doyle & Carter, 1996; Leinhardt & Greeno, 1986; Livingston & Borko, 1989). In a detailed summary of expert teachers and their attributes, Berliner created parallels between teacher expertise studies and more prominently researched expertise domains (Ericsson, 2006b), affirming that "there is no basis to believe there are differences in the sophistication of the cognitive processes used by teachers and experts in other fields" (Berliner, 2001, p.471). Although the primary goal of this study is to learn more about differences in the skills and knowledge of teachers when processing real-word classroom scenes, a secondary intention is to substantiate the complexity of teaching expertise and its ensuing development.

Teachers' cognition and representations. A common and fundamental characteristic of experts is their highly developed knowledge, including crucial differences in how information is processed, how knowledge is organized, and how such knowledge and information interacts (Glaser, 1987). Clearly, we can expect notable differences in the cognitive functioning of experts and non-experts. Experts are aware of and know things that others do not due to the richness and sophistication of their knowledge, which also allows for more efficient recall and application of this knowledge (Schempp et al., 1998). The cognitive dexterity of experts includes their *mental representations* – the way one mentally constructs, symbolizes, preserves, and interprets information about objects and events in the world (Hogan et al., 2003).

Perceiving the classroom. The principal 'workplace' of the teacher is situated in the classroom, which is a space characterized by instant/reflex and rapid/intuitive modes of cognition (Eraut, 2004). Experts tend to use multi-layered, 'deep' structural features to represent and resolve problems, rather than relying on surface features and causal relations to analyze and understand problems as novices often do (Hogan et al., 2003).

Furthermore, experts are able to detect and recognize relevant information more quickly and with a more efficient processing of visual information than novices. This allows them to perceive and process important details that novices often fail to see (Reingold & Sheridan, 2011; Chi, 2006). Considering the role visual expertise plays in perceiving, interpreting, and managing classroom interactions, the visual agility of expert teachers, combined with the knowledge gained through experience, augments their cognitive advantage when compared to novices.

Dimensions of teacher expertise. Upon conducting an extensive literature review to establish dimensions distinguishing expert teachers from experienced, highly-competent teachers, Hattie (2003) and his colleagues synthesized data from more than 500,000 teaching studies. They identified the foremost dimensions of teaching expertise, specifying that expert teachers: identify essential representations of their subjects; guide learning through classroom interactions; monitor learning and provide feedback; and positively influence student outcomes (Hattie, 2003). Expert teachers maintain more elaborate understanding than non-experts, and these structures are supported by the quality and quantity of knowledge gained through their teaching experience (Clark & Peterson, 1984; Copeland et al., 1994). There are other distinctive qualities of expert teachers that novices need time to develop. These include: the ability to integrate a range of knowledge linked to the act of teaching; the manner in which teachers relate to their conceptualizations of teaching within a given context; and the ability to consciously reflect and deliberate about their teaching (Tsui, 2009). These findings resonate with Hattie's teaching expertise dimensions, adding the dimension of expert teachers' ability to be contemplative and reflective about their teaching practice to the list.

Expert teachers' classroom performance. Still, one may wonder: how does teachers' knowledge support their classroom representations and facilitate meaningful classroom interactions? In a case study tracing differences between novice teachers and the (expert) mentor teachers they were working with, Livingston and Borko (1989) found that knowledge acquired by experts "provides a framework for determining what information is relevant to their planning and interactive decisions and what information can be ignored" (p. 39). This allows experts to teach in a manner these authors likened to improvisational acting. Extensive behind-the-scenes preparation blends knowledge of content and curriculum, knowledge about students, and knowledge about how to teach with the dynamism of the classroom to achieve an adept, interactive, and fluid performance. Expert teachers 'perform' teaching in a way that is heavily based on classroom interactions, and that is highly responsive to the counter performance of the students in the class and the events arising amidst the interactions.

Impact of expertise on students. In terms of monitoring and attending to attributes of students, a study by Carter, Cushing, Sabers, Stein, and Berliner (1988) investigating the visual processing of teachers showed that experts tended to focus more on student work arrangements and often distinguished between typical and atypical events and situations in their assessment of the classroom, while novices and postulants did not.

Striking differences were expert teachers' ability to relate what they observed to their own classroom and teaching practice, and how they used their knowledge of classrooms to make sense of what was happening. The powerful combination of experiential knowledge and teaching knowledge used to monitor and assess classroom scenes and interactions is one of several factors distinguishing expert teachers from otherwise 'good' teachers. Fenstermacher and Richardson (2005) draw a line between *good* versus *successful* teaching, specifying that the learning achievements of students are the main determinant of successful teaching. Berliner (2001) furthered this discussion of the learning-outcomes issue, pointing out that the development of deep representations of subject content, offering a challenging curriculum, and demonstrating proficiency in monitoring and providing feedback to students are strong determinants for discriminating between experts and non-experts. His work reinforces Hattie's (2003) dimension of influencing student learning outcomes, offering evidence that students of expert teachers show greater learning motivation and self-efficacy, hold deeper understandings of subject content, and exhibit higher levels of achievement. Thus, expert teacher knowledge relies on representations of subject content, and includes knowledge about students as well as effective strategies for stimulating spontaneous classroom interactions, and providing meaningful content-specific and student-specific feedback. Overlooking teachers' impact on student learning outcomes misses the big picture. Moreover, it downplays the quality and added value that experienced, expert teachers bring to the educational experience of students (Woolfolk-Hoy & Weinstein, 2006).

1.2 Classroom Management as a Core Component of Teaching Expertise

Successful teaching requires synthesizing various forms of knowledge and developing the practical knowledge and skills needed to effectively manage the classroom. *Practical knowledge* is the knowledge that teachers themselves develop as they gain experience, and as they reflect upon their teaching experiences (Fenstermacher, 1994). In this sense, classroom management can be considered fundamental practical knowledge of teaching. Classroom management is a complex enterprise that is consistently cited as a characteristic stumbling block for beginning teachers (Doyle, 1990; Van Tartwijk et al., 2011; Zuckerman, 2007). It can mean different things to different teachers, somewhat irrespective of their level of expertise. There are differing perspectives on the function it serves, the strategies involved, and its association with other elements of effective teaching (Emmer & Stough, 2001; Martin, 2004; Wolfgang, 2005). In training and in practice, teachers show wide variation in their preconceptions, knowledge, and beliefs about classroom management. A further complicating factor is the contrast between teachers' conceptions of 'good' classroom management versus students' conceptions and expectations of their teachers. Teachers tend to prioritize compliance, classroom order, and academic concerns over interpersonal relationships with students, while

students cooperation in the classroom often hinges on their perception of their relationship with their teachers, namely how supportive and caring they consider the teacher (Woolfolk-Hoy & Weinstein, 2006).

Although it certainly includes components linked to compliance and discipline, classroom management is arguably more extensive than these two basic dimensions. While deeply rooted in the classroom, it goes far beyond the rules and procedures employed for maintaining an orderly classroom. Doyle (1990) has described teaching as "…a cognitive activity based on a knowledge of the probable trajectory of events in classrooms and the way specific actions affect situations" (p.355). Accordingly, classroom management involves knowledge about, processing of, and representation of the full spectrum of classroom events. Likewise, it requires responding to and interacting effectively within this spectrum of events.

We conceptualize *classroom management* as a multi-faceted skill set encompassing the structure and atmosphere of the classroom space, the instructional choices of the teacher, the pedagogical and practical knowledge driving these decisions, and the stream of interaction and exchange occurring inside (and outside) the classroom. In short, classroom management is explicitly bound to the enduring learning emerging from the classroom. It denotes one of the "major teaching functions", in league with instruction and socialization (Brophy, 1988).

Like Brophy, our concept of classroom management imposes a space between the concepts of management and discipline. He defined *classroom management* as "…actions taken to create and maintain a learning environment conducive to attainment of the goals of instruction (arranging the physical environment of the classroom, establishing rules and procedures, maintaining attention to lessons and engagement in academic activities)". In contrast, measures associated with *classroom discipline* refer to "… actions taken to elicit or compel changes in the behavior of students who fail to conform to expectations, especially behavior that is salient or sustained enough to disrupt the classroom management system" (Brophy, 1988, p. 2).

Although a relationship clearly exists between these management and disciplinary actions, there is considerable merit in making a distinction between them. From our perspective, disciplinary measures are not taken strictly to correct 'bad' or coerce 'good' behavior in the classroom. Instead, the measures teachers take to deal with disruptions derailing the goals of the management system are viewed as actions taken to ensure that learning takes place within the space of the classroom. Thus, classroom management is reinforced by disciplinary measures, but teachers have other means of effectively managing the classroom available to them. Various elements of teaching function in tandem to achieve the primary purpose of educational institutions; namely, to educate. Considering the challenge that disruptions and non-compliant behavior creates for teachers, especially those with limited classroom experience and those teaching in multi-cultural classrooms, our study concentrates on this problematic element of classroom management (Oliver & Reschly, 2007; van Tartwijk et al., 2009).

Teachers perform an extremely complex and cognitively demanding task, and skillful classroom management – particularly as problems arise, are recognized, and interpreted (or misinterpreted) – plays an essential role in this performance.

As noted earlier, the knowledge and experience that allows management skills to develop into a successful performance does not exist independent of other essential knowledge for teaching. It is closely intertwined with dimensions of teaching that facilitate and achieve student learning. Shulman (1987) has argued that content knowledge, pedagogical knowledge, and pedagogical content knowledge are essential for effective teaching. Content knowledge requires an understanding of the concepts embedded within a particular subject or teaching domain, while pedagogical content knowledge allows a teacher to convey content through various instructional strategies and models of teaching. Classroom management is nested within pedagogical knowledge, which consists of diverse skills and techniques for guiding learning (Hogan et al., 2003). It is the pedagogical knowledge related to classroom management that constitutes an essential aspect of the practical knowledge possessed by experts, whereas novices are less sure about their classroom management knowledge and the actions they can take to improve it. Novices lack the specificity and depth of expert teachers' knowledge repertoire (Emmer & Stough, 2001). To improve other essential teaching skills and knowledge, beginning teachers must first advance their management skills to gain competency in their field. Empirical research identifying how expert teachers represent their classroom management knowledge, and how their representations differ from non-experts, can support novices in making these advances.

As a core skill and knowledge set for effective teaching, one which correlates with other components of effective teaching, we assert that developing and ultimately mastering classroom management constitutes a core component of teachers' expertise. As such, classroom management plays a leading role in the teaching performance, as well as in teachers' expertise development.

1.3 Research Questions

As stated earlier, the main objective of the research presented in this paper is to learn more about differences in the skills and knowledge of teachers when processing and representing real-word classroom scenes. Identifying these differences helps lay a foundation for distinguishing the skills and knowledge of experienced teachers (experts), and understanding how they are distinct from the skills and knowledge applied by inexperienced student teachers (novices).

The research questions addressing this objective are:

1. How do expert and novice teachers' classroom representations differ when describing classroom scenes?

2. Which aspects of teaching or learning do teachers focus on, and how do experts and novices differ in this respect?
3. Can we identify differences in the cognitive processing used by experts and novices when representing classroom management events?

2 METHODS

2.1 Participants

There were 39 participants: 20 experienced teachers and teacher-trainers (experts) and 19 student teachers (novices) from the Dutch educational system took part in this study. Teaching backgrounds included a range of subject domains: Languages (Dutch, English, German); Science (Math, Physics, Engineering); History; Geography (Geology, Earth Sciences); Economics; and Business Administration. Participation in the study was voluntary and uncompensated.

Recruitment of participants. Distinguishing between highly competent and expert professionals can be challenging, particularly with professions like teaching where it is difficult to identify experts (Ericsson, 2006a). In accordance with recommended guidelines for identifying expert teachers, experts participating in this study met the basic screening requirements (Palmer et al., 2005). We selected experts for their proficiency in creating a positive learning environment and their solid grasp on what was happening in their classrooms. All experts (age range: 31-50) were nominated as expert classroom managers by colleagues and school supervisors, had relevant certification in their subject domains, and a minimum of 10 years of teaching experience in secondary education. The 10 teacher-trainers included in the expert group were either concurrently teaching in the secondary classroom or had been out of the classroom for less than five years. Novices (age range: 17-20) were student teachers in their first or second year of pre-service teacher training. Their teaching experience was limited to 10 or 40 hours of classroom teaching experience for first or second year student teachers, respectively. Novices were selected on the basis of their inexperience in the classroom and were not distinguished on the basis of their classroom management skills.

2.2 Materials and Procedure

Video fragments. Stimuli were taken from two authentic secondary level language lessons taught by beginner teachers and recorded from the perspective of the teacher (i.e., the camera was directed at the pupils) used earlier by van Tartwijk, Wubbels, den Brok, and de Jong (2003). We chose these lessons for: high audio/video quality, the presence of numerous classroom management related events, and the absence of sub-

ject-specific content, making them easy for teachers to follow regardless of subject domain. We reduced each full lesson into four representative fragments depicting different points in the lesson: one showing the beginning of the lesson, two showing the lesson-in-progress, and one showing the end of the lesson. A total of eight fragments ranging in length from one minute 47 seconds to three minutes 23 seconds were shown. Participants were not very familiar with teachers or students appearing in the videos. They could ask task-clarification questions, but questions about the classroom or lesson content were answered only after data collection ended.

Video Viewing. Participants viewed these video fragments and clicked a device each time they saw a classroom event that they considered relevant to classroom management concerns. A *classroom event* refers to actions of at least one or more people – i.e., the students and/or the teacher – that disrupts or complicates the lesson flow or learning atmosphere in the classroom. *Classroom management concern* refers to moments in the lesson where the participant saw what they considered either a problem or a potential problem in the lesson. To impose a time constraint on decision making similar to the real-world teaching context, participants were not allowed to pause or otherwise manipulate the video while viewing and clicking.

Retrospective Interviews. Immediately after viewing the video fragments, participants provided descriptions of all the events they had seen when they clicked, referred to as *scenes*. Participants were asked, "Can you describe what you saw there and how you find it relevant to classroom management?" Teachers established for themselves what was or was not important in the scenes and when they had concluded their scene descriptions. For purposes of this study, only scenes that were identified as problematic by approximately the same number of both experts and novices were coded; five in total (see Figure 1). Scenes identified predominately by experts were not included and scenes identified predominantly by novices did not occur. For more details on scene selection and classroom events depicted in the scenes, please refer to van den Bogert, van Bruggen, Kostons, & Jochems (2014).

Descriptions were provided in Dutch. The authors transcribed and coded descriptions in the original language. Quotes from the descriptions, used in this article for purposes of illustration, were translated into English by the native English speaking author proficient in Dutch; translations were verified by native Dutch speaking authors proficient in English.

Scene Name	Identified by Number of	
	Experts	Novices
Scene 14	14	13
Scene 52	9	7
Scene 62	13	15
Scene 67	11	13
Scene 75	10	11

Figure 1. Scenes selected for analysis and the number of experts and novices who described each scene.

2.3 Development of Coding Scheme

In line with the goal of better understanding knowledge differences between expert and novice teachers when processing real-word classroom scenes, we sought a method of analysis centered on the voices of teachers. Our aim was to capture participants' practical knowledge and professional understanding by placing their descriptions at the center of analysis. Rather than applying theories from existing literature, we chose to employ the words teachers themselves used to guide our emerging understanding.

Teachers' descriptions were thus the foundation for understanding and conceptualizing how teachers' knowledge and skill development differed based on experience and expertise. Qualitative differences in participants' transcribed verbalizations were identified via a coding scheme developed according to the grounded theory method. This method generates theory in the absence of preconceived hypotheses, instead allowing concepts and theories to emerge from the data, treating participants statements and concerns as the central point of discovery (Charmaz, 2006; Glaser & Strauss, 1967; Walker & Myrick, 2006).

Multiple rounds of open and subsequent coding helped to refine the code labels and gradually divide the codes into different categories, with each category addressing discrete aspects of the participants' utterances. Each round of coding contributed to the further conceptualization of the coding labels. At the axial coding stage, categories and sub-categories of codes were elaborated and their characteristics were defined to ensure that the emerging coding scheme remained both appropriate and coherent. The codes were then reviewed and discussed extensively with experienced researchers to evaluate the consistency and legitimacy of the individual codes, their definitions, and the coding scheme as a whole. After this joint review, the codes were re-applied to several more rounds of coding, and additional adjustments and refinements to the coding scheme were administered before reaching conceptual and categorical consensus (Boeije, 2010; Moghaddam, 2006).

Ultimately, four categories of codes emerged from the data. The first three categories concerned *idea units* – which were sentence-like segments containing a clear core idea – and the fourth to participants' *whole utterances*. Using this configuration, idea

units received multiple codes (one code each from the first three coding categories); whole utterances received additional codes (four different codes from the fourth category). The four categories were (1) perceptions and interpretation of events; (2) the main theme or focus expressed in the statement; (3) expressions of temporality (contemporaneous, prospective, or retrospective); and (4) the cumulative cognitive processing expressed. The term *cumulative cognitive processing* refers to the accumulation of knowledge, thoughts, viewpoints, interrelatedness, temporality, and certitude conveyed by participants, which, taken together, allowed coders to make inferences about the implicit cognitive processing of the participant. See Figures 2-5 for more details.

Once the coding units and their descriptions had been worked out in adherence to the principles cited above, the coding scheme was formalized and incorporated into a set of coding instructions. These instructions were reviewed and discussed while training one of the co-authors to fulfill the role of second coder. The code categories, code labels, and code definitions were examined and debated by the two coders. Anomalies and inconsistencies were discussed to reach consensus about the codes, their definitions, and how to conduct the coding process. A similar process of examination and debate about how to segment the verbal data (i.e. establishing idea units for participant utterances) was also conducted. The scene containing the highest word count and number of idea units, representing 31% of the verbal data, was assessed repeatedly by the code developer before being coded independently by two coders.

Krippendorf's alpha co-efficient was used to calculate the inter-rater reliability between the two coders. The alphas ranged between 0.88 and 0.98, and the mean inter-rater reliability score was 0.93, demonstrating a high level of reliability.

1: Perceptions & Interpretations	Code Labels	Code Definitions	Example Sentence
Perceptions	*Visual description*	Statements simply describing what is seen in the video	*You saw, actually, that the boy still left his bag on top of the desk.*
	Audio description	Statements simply describing what is heard in the video	*Here, that's what you heard through the microphone.*
	Missing information	Statements mentioning something that cannot be seen or heard, such as people or activities that are not captured by the camera	*But I cannot see if he leans forward or backwards in his chair, it's one of the two.*
	Incomprehensible statement	Statements that are incomplete, do not convey a clear meaning, or that cannot be matched with a code	And yes that is of course not the um, yeah, so that they naturally find um, yeah, but uh…

1: Perceptions & Interpretations	Code Labels	Code Definitions	Example Sentence
Interpretations	*Inferences about the student(s)*	Suppositions about students' cognitive and/or affective states (ex. what students are thinking or feeling or what their intentions are)	*The teacher is busy with reading the story and the students are following or doing simply nothing.*
	Inferences about the teacher	Suppositions about teachers' cognitive and/or affective states (ex. what the teacher is thinking, feeling, or presumed to be able to hear or see)	*The teacher has the impression that he's not really paying attention.*
	Prediction for student learning	Speculation about the level of learning or uptake in the lesson. May refer to an individual student or a group of students, including discussion of consequences for learning	*I think that when you ask her [the student], "What did I just tell?", then it'll be hard for her to paraphrase [what the teacher said].*
	Prediction for classroom management	Speculation about potential outcomes in the lesson with a particular focus on consequences framed in terms of managing the classroom	*So he'll draw everyone into it, and then you'll get what becomes a really noisy class with everyone reacting to each other.*
	Prediction of anticipated behavior	Speculation about an action that a student or the teacher will soon take	*Thereafter, maybe he's going to start drawing.*
	Explanation or Reasoning	Statements extending participants' thoughts or thought processing, justifying their inferences and/or predictions, or providing a premise for the actions or intentions being described. Sometimes these statements come across as evaluative.	*She could come up with the most horrible story, but that still doesn't help (here).*

Figure 2. Category One codes (referring to perception and interpretation of the classroom scene) and their corresponding definitions with examples taken from participants' verbalizations.

2: Themes & Focus	Code Labels	Code Definitions	Example Sentence
Learning & Discipline	*Student attention: Off-Task*	Attention of student(s) is/are not engaged in teacher instruction or lesson activity	*At a given moment, he sits there moving and looking at that girl in the corner.*
	Student attention: On-task	Student(s) is/are engaged in lesson activity and listening or interacting with the teacher	*This seems to be a positive contribution; he and the others are following along.*

2: Themes & Focus	Code Labels	Code Definitions	Example Sentence
	Student learning	Thoughts focused on outcomes that place the emphasis on individual or collective student learning. [note: goes beyond simply stating whether or not students are paying attention; collective may refer to a group of students or the whole class]	*Here again they're not listening to the teacher, and according to me they have still not learned anything whatsoever.*
	Student discipline	Thoughts focused on outcomes that place the emphasis disciplinary concerns, particularly disorderly or distracting behavior and non-compliance with rules	*He's really disrupting the lesson, that's what stands out.*
Norms & Types	*Student behavior: abnormal*	Student behavior (including posture) explicitly or implicitly described as strange, unusual, or as defying expectations	*That is just not the normal (sitting) position.*
	Type of student	Reference to a familiar type or kind of student	*I think that with these kinds of students you need to pull a little more out of your bag of tricks.*
	Type of situation	Reference to a familiar type or kind of classroom event or situation	*So here is the sort of situation that, yeah, from the outside it may look …, but in terms of student activities, their mental activities you may have your doubts about that.*
Lesson Modifications	*Contextualized suggestion/comment*	Thoughts on or about how to improve a specific situation occurring in the video lesson	*So here you just should have chosen another work format for this class, that's where the problem already starts.*
	Generalized suggestion/comment	Thoughts on or about how to improve teaching practices that apply in a general manner, not to the particular event referenced in the video	*In such situations you don't need to be too severe, but just say something like "Hey!".*
	Self-as-teacher	Commentary or suggestions specifying what the participant would do as a teacher	*Then I would say, "I'm glad that you can get out of bed in the morning, but that doesn't mean you need to catch up on lost time here.*
	Teacher influence	Statements describing the role and influence the teacher has on classroom events and situations	*Now the teacher has the class 10x better under control than before, when she was busy reading aloud.*

2: Themes & Focus	Code Labels	Code Definitions	Example Sentence
	Teacher does nothing	Statements noting that the teacher is not aware of (i.e. does not see) nor does s/he address a problematic classroom event (and presumably should)	*He can just do whatever he wants and the teacher doesn't say or do anything.*

Figure 3. Category Two codes (referring to the theme and focus of the descriptions) and their corresponding definitions with example sentences taken from participants' verbalizations.

3: Temporality	Code Labels	Code Definitions	Example Sentence
Past	*Retrospection*	Referencing actor/actors who appeared previously in the video or a preceding event from the lesson video that re-occurs in the scene being described	*And here, once again, he's trying to communicate with other students.*
Present	*Contemporaneous*	Referencing actor/actors who appear currently in the scene being described or a current event from the scene being described	*I just clicked here because there could be something because not every student is sitting full of expectation.*
Future	*Prospection*	Referencing actor/actors who will reappear in the lesson video or an event that takes place at a later point in the lesson video	*That won't become too serious, because after a few seconds she looks away again.*

Figure 4. Category Three codes (referring to temporality expressed) and their corresponding definitions with example sentences taken from participants' verbalizations.

4: Cumulative Cognitive Processing	Code Label	Code Definition
Viewpoint	*Single*	Only one point of view is represented, for example, only that of the student(s) or that of the teacher
	Multiple	More than one point of view is expressed, for example, that of the student *and* the teacher
Perspective	*Integrated*	Reports on what is seen, heard, or understood to be happening that express an interrelated perception of events, includes accounting for multiple items of relevance to classroom management, relates teacher and student actions, and conveys an awareness of how various classroom factors interrelate with one another
	Isolated	Reports on what is seen, heard, or understood to be happening that focus on a single aspect relevant to classroom management [Note: even if multiple events or students are referred to, they are isolated if no connections are described and the protocol overlooks the complexity of interactions]
Continuity	*Continuity*	Referencing a preceding event in the video and describing its relevance and relation to the current situation
	Discontinuity	No reference to preceding or subsequent events in the video

4: Cumulative Cognitive Processing	Code Label	Code Definition
Certitude	*Open-ended*	The interpretive processing expressed in the description of the event suggests that further interpretation may be possible, for example, if the video quality were better or if additional information were available a more conclusive interpretation could follow
	Dead-ended	The interpretive processing expressed in the description of the event is inconclusive, conveys uncertainty, and lacks wording suggesting that the interpretation could be extended

Figure 5. Category four codes (referring to cognitive processing expressed) and their corresponding definitions. This was the only category applied to whole utterances instead of idea units. Refer to Figure 7 to see examples of whole utterances and their corresponding codes.

2.4 ANALYSIS

This study incorporated a mixed-method approach for analyzing the verbal data (Chi, 1997; Johnson, Onwuegbuzie, & Turner, 2007). The developing of the coding scheme and the coding process itself involved a thorough qualitative approach, which allowed differences between expert and novice teachers to emerge. Statistical analyses were included to determine the reliability of the coding scheme, establish significant differences between the expertise groups, and to further interpret coding results. Qualitative analysis yielded statistically significant expertise differences, and conclusions were construed from these quantitative results. Thus, qualitative coding results were supported and enhanced by the quantitative analyses, which were in turn made meaningful by further qualitative interpretation of the statistical effects and the differences found.

Item of Statistical Significance		Values of significance
Category 1 - *perceptions and interpretations*:		
• Main effect for expertise		$F(10, 28) = 2.45$, $p = .03$, $\eta^2 = .47$
• prediction for classroom management	E>N	$F(1, 37) = 10.27$, $p = <.01$, $\eta^2 = .22$
Category 2 - *theme and focus of statements*:		
• Main effect for expertise		$F(13,25) = 3.13$, $p = .01$, $\eta^2 = .62$
• contextualized suggestion/comment	E>N	$F(1, 37) = 9.68$, $p = <.01$, $\eta^2 = .21$
• student learning	E>N	$F(1, 37) = 5.48$, $p = .03$, $\eta^2 = .13$
• teacher influence	E>N	$F(1, 37) = 16.87$, $p = <.01$
• type of situation	E>N	$F(1, 37) = 5.78$, $p = .02$, $\eta^2 = .14$
• student discipline	N>E	$F(1,37) = 12.87$, $p = < .01$, $\eta^2 = .26$
Category 3 - *temporality expressed in statements*:		
• Main effect for expertise		$F(3, 35) = 4.98$, $p = .01$, $\eta^2 = .30$
• retrospection	E>N	$F(1, 37) = 7.12$, $p = .01$, $\eta^2 = .16$

Item of Statistical Significance		Values of significance
Category 4 - *cumulative cognitive processing*:		
• Main effect for expertise		F (9, 29) = 23.35, p = <.01, η^2= .88
• multiple viewpoints	E>N	F(1, 37)=39.02, p = <.01, η^2= .51
• integrated perspective	E>N	F(1, 37)=91.48, p = <.01
• continuity	E>N	F(1, 37)=133.05, p = <.01, η^2= .49
• open-ended	E>N	F(1, 37)=11.24, p = <.01, η^2= .36
• single viewpoint	N>E	F(1, 37)=65.59, p = <.01
• isolated perspective	N>E	F(1, 37)=156.74, p = <.01, η^2= .81
• discontinuity	N>E	F(1, 37)=128.22, p = <.01, η^2= .53
• dead-ended	N>E	F(1, 37)=10.66, p = <.01, η^2= .22

Figure 6. Summary of the significant effects derived from quantitative analysis.
Note: E= expert group and N = novice group.

Analysis was grounded in the teachers' verbal descriptions of classroom events and how they represented the concept of classroom management. Each description was segmented into individual idea units, and each idea unit received a code from three categories: (1) the kind of perception or representation of events; (2) the main theme and focus of the statement; and (3) the temporal references in the statement. Once all participant statements had been separated into idea units and coded as such, the participants' statements were re-evaluated as whole, undivided utterances so that codes from a fourth category, (4) cumulative cognitive processing, could be assigned. This evaluation relied mainly on the entire collection of idea units uttered by a participant, but also took events and features of the particular scene into account. Thus, categories 1, 2, and 3 were concerned with the participants' interpretation of the classroom scene, the primary focus of their descriptions, and how the actors and events were referenced temporally. Category 4 codes helped differentiate the cognitive processing expressed by participants. See Figures 2-5 for detailed descriptions of the codes allocated to idea units and whole utterances.

To integrate qualitative and quantitative analysis, verbal protocols were treated first as *idea units* (Figures 2-4), and the last group of variables was evaluated as *utterances* (Figure 5). Each of these were coded according to the coding system developed and described above. Subsequently, per person utterance scores were calculated as what can be characterized as: (1) the degree to which a person took a single point of view (their own) or incorporated multiple points of view (their own plus that of students or the teacher); (2) the degree to which actions, events, and various classroom factors were connected and related to one another; (3) the degree to which the expressed timescale of events showed continuity; and (4) the degree to which a person expressed certainty about what they were saying. Thus, the resulting measures can be interpreted at the interval level. These scores were then analyzed with MANOVA in order to connect and clarify the relationship between the dependent variables (i.e. the individual

codes). In sum, the quantitative analyses served as confirmation of the qualitative analyses, and vice versa (Chi, 1997). For a similar procedure see Humphrey and Symes (2011) and Marinellie and Chan (2006).

3 RESULTS

3.1 Quantitative Statistical Differences

When calculating the parametric statistical testing, we adhered to the assumptions as reported by Field (2009, p. 359). The Kolmogorov-Smirnov test was applied to confirm that the normality of distribution assumption was met, and in cases where this was not met we conducted additional non-parametric testing via the Mann-Whitney tests to confirm the validity of significant effects. The equality of group size assumption was met since the group sizes were almost identical: an expert group of 20 was compared to a novice group of 19 participants. For each statistical model, we calculated the homogeneity of variances by means of the Levene's test. In instances where this assumption was not met, we report the corrected values instead.

First, the frequency of code occurrence was quantified so it could be statistically analyzed in SPSS. Next, mixed-design MANOVA analyses were conducted separately for all four code categories, with expertise level as the between-subject variable and specific codes per type as within-subject variables. All categories showed significant main effects for expertise. Second, post-hoc ANOVA analysis examining effects of within-subject variables (i.e., the codes themselves) for each category was conducted to determine which specific codes occurred more frequently amongst experts or novices. Lastly, these statistical analyzes were used to support a deeper understanding of the qualitative differences identified during coding.

Category one codes showed a main effect for expertise, $F(10, 28) = 2.45$, $p = .03$, $\eta^2 = .47$. Specifically, experts provided significantly more 'predictions for classroom management' statements than novices, $F(1, 37) = 10.27$, $p = <.01$, $\eta^2 = .22$. Most individual category 1 codes showed no effects for expertise.

Table 1 Mean Frequencies of the Perceptions and Interpretations Category Summarized across All Scenes (with Standard Deviation)

	Expertise		
	Novices	Experts	Total
N	19	20	39
Audial description	0.05 (0.14)	0.19 (0.32)	0.12 (0.25)
Incomprehensible statement	0.08 (0.24)	0.01 (0.05)	0.04 (0.18)
Missing information	0.03 (0.11)	0.20 (0.47)	0.11 (0.35)
Visual description	1.48 (0.80)	1.11 (0.75)	1.30 (0.79)
Explanation or reasoning	2.03 (1.59)	2.96 (1.53	2.48 (1.61)
Inference about student	0.95 (0.92)	1.02 (0.62)	0.99 (0.78)
Inference about teacher	0.14 (0.32)	0.32 (0.43)	0.23 (0.39)
Prediction of anticipated behavior	0.03 (0.11)	0.03 (0.08)	0.03 (0.10)
Prediction for classroom management	0.08 (0.16)	0.36 (0.36)	0.22 (0.31)
Prediction for student learning	0.03 (0.09)	0.09 (0.18)	0.06 (0.14)

An example of an expert statement coded as a prediction for classroom management is "*The risk is that if the teacher just let's this go on*, *is that they are going to communicate about things that don't have anything to do with the lesson*, a*nd that can also cause anxiety*."

Category two codes showed a main effect for expertise, $F(13,25) = 3.13$, $p = .01$, $\eta^2 = .62$. Experts provided significantly more contextualized commentary, mentioned the role or influence of the teacher on the situation more often, referenced student learning, and recognized typical events and situations more frequently than novices, whereas novices referred to rules, behavior, and discipline significantly more often than experts and had more statements that could not be coded. Thus, there was a significant main effect for the following individual codes: 'contextualized suggestion/comment', $F(1, 37) = 9.68$, $p = <.01$, $\eta^2 = .21$; 'no code applicable', $F(1, 37) = 6.18$, $p = .02$, $\eta^2 = .14$; 'student discipline', $F(1,37) = 12.87$, $p < .01$, $\eta^2 = .26$; 'student learning' , $F(1, 37)=5.48$, $p = .03$, $\eta^2 = .13$; 'teacher influence', $F(1, 37)=16.87$, $p = <.01$, $\eta^2 = .31$; 'type of situation', $F(1, 37)=5.78$, $p = .02$, $\eta^2 = .14$. The remaining category 2 codes showed no main effects for expertise.

Table 2 Mean Frequencies of the Themes and Focus Category Summarized across All Scenes (with Standard Deviation)

	Expertise		
	Novices	Experts	Total
N	19	20	39
Contextualized suggestion/comment	0.16 (0.32)	0.92 (1.04)	0.53 (0.84)
Generalized suggestion/comment	0.05 (0.13)	0.01 (0.05)	0.03 (0.10)
Self-as-teacher suggestion/comment	0.34 (0.54)	0.25 (0.34)	0.30 (0.45)
Student attention: off-task	2.28 (1.52)	2.90 (1.46)	2.58 (1.50)
Student behavior: abnormal	0.54 (0.70)	0.68 (0.63)	0.61 (0.67)
Student discipline	0.75 (0.80)	0.06 (0.23)	0.42 (0.69)
Student learning	0.05 (0.11)	0.22 (0.31)	0.13 (0.25)
Student attention: on-task	0.10 (0.26)	0.25 (0.42)	0.17 (0.35)
Teacher does nothing	0.10 (0.34)	0.23 (0.44)	0.16 (0.39)
Teacher actions	0.00 (0.00)	0.55 (0.60)	0.27 (0.50)
Type of situation	0.00 (0.00)	0.10 (0.19)	0.04 (0.14)
Type of student	0.08 (0.26)	0.08 (0.17)	0.08 (0.33
No code applicable	0.45 (0.70)	0.04 (0.11)	0.25 (0.54)

Examples are as follows: A contextualized comment/suggestion from an expert is, *"So you'd better choose a different working method for this class; that is already the initial problem."* An expert statement focused on student learning is *"I suspect, but you'd have to measure it afterwards, that they aren't taking anything away from (the lesson)."* An expert statement focused on the teacher's influence is "*A recurring theme: it's deadly for your lesson if you, as a teacher, continuously talk and the students just have to listen."* A type of situation identified by an expert is "*So this is a kind of situation where on the outside you have activity in terms of students, but for the mental activity out there, you have your doubts."* A novice statement concerning student discipline is *"The teacher asks a question, and people just answer without putting their hands up, while they know that's the rule."* A novice statement that received 'no code applicable' for category 2 is *"And yes that is of course not the um, yeah, so that they naturally find um, yeah, but uh…"*

Category three codes showed a main effect for expertise, $F(3, 35) = 4.98$, $p = .01$, $\eta^2 = .30$. Experts provided significantly more 'retrospective event' codes, $F(1, 37) = 7.12$, $p = .01$, $\eta^2 = .16$. An example of an expert's retrospective statement is "*Once again, those girls in the back row, and the teacher still has not said anything about it."*

Table 3 Mean Frequencies of the Temporality Category Summarized across All Scenes (with Standard Deviation)

	Expertise		
	Novices	Experts	Total
N	19	20	39
Contemporaneous	4.36 (2.61)	4.86 (2.11)	4.60 (2.36)
Retrospection	0.25 (0.31)	0.98 (1.18)	0.61 (0.92)
Prospection	0.13 (0.25)	0.36 (0.45)	0.24 (0.38)

Category four codes showed a main effect for expertise, F (9, 29) = 23.35, p <.01, η^2= .88. Experts provided significantly more integrated perspectives with open-ended descriptions, expressed multiple points of view, and referenced the continuity of classroom events more often than novices. Conversely, novices provided non-integrated accounts, more frequently provided only one point of view, gave more dead-end descriptions, and referred mainly to events without maintaining temporal continuity. All codes (with the exception of 'category 2: non-applicable') concerning participants' cognitive processing showed a significant difference between experts and novices: 'discontinuity' , $F($ 1, 37)=128.22, p < .01, η^2= .53; 'continuity ', $F($1, 37) = 133.05, p < .01, η^2= .49; 'dead-ended description', $F($ 1, 37) = 10.66, p < .01, η^2= .22; 'open-ended description' , $F($ 1, 37) = 11.24, p < .01, η^2= .36; 'non-integrated perspective ', $F($ 1, 37) = 156.74, p < .01, η^2= .81; 'integrated perspective', $F($ 1, 37) = 91.48, p < .01, η^2= .71; 'multiple viewpoints' , $F($ 1, 37) = 39.02, p < .01, η^2= .51; 'single viewpoint ', $F($ 1, 37) = 65.59, p < .01, η^2= .64. For experts, these codes helped capture the depth and breadth of their descriptions by noting their capacity to perceive classroom events as interrelated, adopt the point of view of the teacher and students in the video as well as their own, keep track of events happening before, during, and after a particular moment, and to express their interpretations with surety. For novices, these codes captured the somewhat superficial nature of their descriptions, which generally focused on isolated events from their own point of view, omitted events occurring before and after the moment being described, and were delivered in a tentative, uncertain manner. See Figure 7 below for exemplary utterances from an expert and a novice.

Table 4 Mean Frequencies of the Cumulative Cognitive Processing Category Summarized across All Scenes (with Standard Deviation)

	Expertise		
	Novices	Experts	Total
N	19	20	39
Single viewpoint	0.84 (0.22)	0.22 (0.25)	0.54 (0.39)
Multiple viewpoints	0.14 (0.23)	0.74 (0.36)	0.43 (0.42)
Integrated perspective	0.09 (0.15)	0.83 (0.31)	0.45 (0.44)
Isolated perspective	0.89 (0.17)	0.14 (0.21)	0.52 (0.42)
Open-ended description	0.05 (0.15)	0.32 (0.32)	0.18 (0.28)
Dead-end description	0.19 (0.26)	0.00 (0.00)	0.10 (0.21)
Certitude: not applicable	0.75 (0.31)	0.65 (0.34)	0.70 (0.33)
Discontinuity	0.74 (0.26)	0.20 (0.25)	0.47 (0.37)
Continuity	0.24 (0.23)	0.77 (0.31)	0.50 (0.38)
Type IV Codes: not applicable	0.02 (0.07)	0.04 (0.13)	0.03 (0.11)

3.2 Qualitative Differences

Below are two illustrative whole utterances, one from an expert and one from a novice, describing the same moment from Scene 62 quite differently. The novice verbalization had more words and was segmented into more idea units (155 words in original Dutch, 123 in English; 11 idea units), while the slightly shorter expert protocol (150 words in original Dutch, 164 in English; 8 idea units) conveys a much richer description of what is happening in the classroom and how it is relevant to classroom management.

Expert Whole Utterance from Scene 62	Codes from Category 1, 2, and 3
[1] *Here he is moving his arm under the table.* [2] *You still see more and more of that, in the beginning he sat with his arms above the table.* [3] *At one point, he does that with his arms under the table, then he starts to move.* [4] *And even a little further in the video he starts to move with his body, because he just cannot get rid of that energy.* [5] *That has, of course, more to do with the fact that a high level of concentration is missing.* [6] *Because it's not easy to understand that Dutch sentence that the teacher says out loud from beginning to end.* [7] *I suspect, but you would have to be able to measure it afterwards, that they do not take much away from the lesson.* [8] *I ask myself if that teaching method is suitable or not for this type of student.* [9] *It will be difficult, with this type of child, if you ask questions later.*	[1] Visual description; student attention off-task; contemporaneous [2] Visual description, student attention off-task, retrospection [3] Visual description; student attention off-task; contemporaneous [4] Inference about student; student attention off-task; prospection [5] Explanation or reasoning; student learning; contemporaneous [6] Explanation or reasoning; teacher role or influence; contemporaneous [7] Prediction for student learning; student learning; contemporaneous [8] Explanation or reasoning; type of student; contemporaneous

Expert Whole Utterance from Scene 62	Codes from Category 1, 2, and 3
	[9] Prediction for student learning; student learning; contemporaneous
	Codes from Category 4
	Integrated perspective; multiple viewpoints; continuity; open-ended
Novice Whole Utterance from Scene 62	**Codes from Category 1, 2, and 3**
[1]*Yes, here I wondered about where that strange head comes from, you know.* [2] *It looks very strange, as if a loose head is on a table.* [3] *It becomes clear that there really is a body attached to it, but if you just look it at so, between the girl with the scarf you see a very strange head.* [4] *If you look carefully between the table then ... I have no idea what is sitting there.* [5] *But in any case the head, in any case it's not paying attention.* [6] *It sits here looking out to the other side and there's bound to be something to it.* [7] *And it is clearly not paying attention.* [8] *It's completely slumped over.* [9] *It is no longer visible at all.* [10] *She's watching what they are doing there on the right, and it seems that they're daydreaming or something.* [11] *He is clearly not paying attention.*	[1]Explanation or reasoning; student behavior abnormal; contemporaneous [2]Explanation or reasoning; student behavior abnormal; contemporaneous [3] Explanation or reasoning; student behavior abnormal; contemporaneous [4] Explanation or reasoning; student attention off-task; contemporaneous [5] Inference about student; student attention off-task; contemporaneous [6] Explanation or reasoning; student attention off-task; contemporaneous [7] Inference about student; student attention off-task; contemporaneous [8] Visual description; student behavior abnormal; contemporaneous [9] Visual description; student behavior abnormal; contemporaneous [10] Inference about student; student attention off-task ;contemporaneous [11] Inference about student; student attention off-task; contemporaneous
	Codes from Category 4
	Isolated perspective; single viewpoint; non-continuity; dead-ended

Figure 7. Examples of an expert's and novice's complete descriptions of the same classroom event from Scene 62. Numbers in superscript reference the number of the idea units the utterance was segmented into during analysis. Codes applied to each idea unit (Categories 1, 2, and 3) and the whole utterance (Category 4) are listed to the left of the descriptions.

The expert protocol begins with several visual descriptions of what a particular student is doing in the classroom (idea units 1-3), gradually resulting in an inference about the student and his behavior (idea unit 4). This is followed by reasoning about what is happening in the class as a whole, offered as an explanation of why this particular student is interacting in a certain way and is unable to concentrate or actively engage in learning (idea unit 5). Next he explains the teacher's role in what is happening in the class (idea unit 6). The class is depicted as a whole comprised of many students, while spotlighting

an individual student (idea units 5-8). This representation evolves into a prediction about the level of learning achieved by the student (idea unit 7), which is supported by additional reasoning identifying the student as a specific, and presumably familiar, type of student (idea unit 8). The description culminates in a reiteration of his predictions of student learning but this time referring not to the particular student, but the particular type of student (idea unit 9). In the expert's utterance, student learning comes across as a prominent theme. He views and evaluates the classroom based on interactions between the class and the teacher, while simultaneously considering the specific lesson context and the specific student behavior exhibited. This representation of classroom events then transforms into a macro-concept of recognizable types of students that teachers encounter, all while recognizing the teachers' influence on the situation and linking teacher behavior to student behavior.

The novice approaches the classroom scene in another way. There is preoccupation with describing an oddity noticed in the video, namely the presence and position of an out of place head (idea units 1 -4), before inferring that a head engaged in such antics is one that is certainly not paying attention (idea unit 5). The participant justifies this claim by repeating inferences about the student's level of attention (idea units 6-7), and describing the movements of the student's head (idea units 8-9). The description culminates in an extended inference, speculating about who sees what, and repeating the conclusion about the student's lack of attention on the lesson. In the novice utterance, there is mainly talk about student behavior, including explanations of why the behavior strikes the participant as strange and what such behavior means in terms of student attention, which comes across as the main theme of the description.

Though both participants identified the same moment within the lesson as relevant for classroom management and the descriptions were nearly the same length, the sum of knowledge and cognitive processing expressed were noticeably different. The novice gets hung up on student behavior and attention, whereas the expert touches upon these same issues, but elaborates concerns and predictions themed around the level of learning taking place, the teachers' influence on a disengaged student, and why it is difficult for such a student to pay attention to what is being taught.

4 DISCUSSION

In the detailed discussion that follows, the results of the mixed analysis (qualitative and quantitative) are framed in relation to the research questions that they help address.

4.1 Differences in Representations

Several categories of codes help to address the first research question: *How do expert and novice teachers' classroom representations differ when describing classroom*

scenes? Codes from category 1, which detailed participants' perceptions and interpretations of the scenes, indicated that expert teachers provided significantly more classroom management predictions. Category 2 codes, referencing the focus of participants' statements, and category 3 codes, expressing temporality, also shed light on other ways in which experts differed from novices.

Experts' ability to make predictions about classroom management events confirms their richer store of knowledge and deeper understanding of the myriad possible outcomes and consequences associated with events observed in the videos. Carter et al. (1988) presented similar findings in their study investigating expert-novice differences in perceiving and processing visual information in the classroom (using photographic slides instead of videos). They explained how experts were able to use their memory of classroom events to make sense of events seen by aligning these observations with common classroom situations experienced many times over by experienced teachers. They suggested that experts' efficient access to event-based knowledge is what allows them to "…predict the likely configuration of events, and develop solution strategies to deal with the complexity of their environment" (Carter et al., 1988, p.29). Our coding analysis supports the idea that expert teachers rely on experiential knowledge in their interpretations of classroom events. Experts process new information differently from novices because they are able to assimilate new information in relation to prior experiences of similar events. Their richly developed awareness of what is happening is an awareness gained through experience. Experts have developed a sophisticated ability to make observations, recollect and link these to past experience, and phrase interpretations of their observations as predictions about what may arise. Novices rarely make predictive statements, probably because they do not have enough prior experience to recognize the spatial and temporal patterns that support formulating observations as predictions about the consequences of events. Certain category 2 codes, which coded the thematic focus of participants' statements, further support our claim about experts' event- and experience-based knowledge. Experts recognized and referenced typical events and situations significantly more than novices. Moreover, they provided more contextualized commentary regarding possible modifications and/or strategic interventions specific to the events of the recorded classroom situations.

The category 3 codes referencing temporality also address the first research question. These codes were created to compare teachers' ability to keep track of events along a time continuum. Due to the nature of the experimental task, 'contemporaneous' was the most common time code. Participants mainly referred to classroom events in the video in the present tense. Sometimes, however, participants referenced the recurrence of actors and events appearing earlier or later in the video, coded as 'retrospection' and 'prospection', respectively. Experts retrospectively referenced actors and events significantly more than novices. We associate this with a general feature of expertise, namely experts' ability to detect, register, and incorporate information faster than non-experts (Reingold & Sheridan, 2011). Even outside of the context of

their own classroom, experts displayed more temporal complexity in their depiction of the classroom videos. Thus, a feature of experts' classroom management skill includes their ability to recognize previously unknown students and events (from the videos) and then assimilate the recurrence of actors and events into their representation of classroom management events.

4.2 Differences in Themes and Focus

Category 2 codes, which referred to the thematic focus of participants' statements, align with the second research question: *Which aspects of teaching or learning do teachers focus on, and how do experts and novices differ in this respect?* These codes accounted for the distinct themes emerging from teachers' verbal protocol, and help to clarify central differences between experts and novices.

Experts provided significantly more statements themed around lesson modifications. This was expressed as more contextualized commentary and more statements focused on the role of the teacher and his or her influence on classroom situations perceived as problematic. Experts also consistently focused and referred to the level of student learning taking place in the classroom, whereas novices' predominant focus was on describing off-task student behavior. Novices also showed a preoccupation with behavior framed in terms of rules and discipline, and were often unable to recognize or describe typical events and situations occurring in the classroom.

The novice teachers' commentary shows a preoccupation with describing whether or not students' behavior is congruent with their expectations of appropriate classroom behavior, and whether or not students' are attentive and compliant in the class. In contrast to experts, novice statements were disconnected from concerns with whether or not the students were learning.

Although experts also frequently referred to student attention and engagement, they were significantly more focused on the learning, or lack thereof, evident in the classroom. Experts' focus suggests that the goal of ensuring learning is closely connected to their conceptualization of classroom management. Novices expressed goals linked to discipline, or a lack thereof, in the classroom, and the extent to which students were distracting other students, straying off-task, or disregarding classroom rules and behavioral norms.

Novice teachers were satisfied when students behaved attentively and followed generally accepted behavioral norms in the classroom, but showed little concern with whether or not the students took anything away from the lesson. Experts, instead, kept a close eye on learning when depicting expectations of classroom management.

Such an interpretation of experts' conceptualization endorses our definition of *classroom management* as involving actions related to creating and maintaining a learning environment that serves instructional goals (Brophy, 1988). Novices, on the other hand, express an understanding more in line with *disciplinary interventions*, which carry the

goal of having student behavior conform to teachers' expectations. Our analysis of the focus of teachers' statements indicates that experts and novices have not only dissimilar conceptualizations of what classroom management is, they also have correspondingly incongruent representations of the meaning of events in the videos. Strikingly, the focus of their management concerns shows a divergence between learning-centered and behavior-centered goals associated with classroom management.

This divergence helps explain why expert statements focused more on 'typical' events, often included contextualized references, and focused heavily on the crucial role the teacher plays in maintaining classroom structures. This includes describing how actions that a teacher takes or does not take contribute to what happens in the classroom. As mentioned in the discussion of research question one, experts' ability to provide more of these statements relates to their ability to understand and interpret classroom events in greater depth than novices (Sabers et al., 1991). Furthermore, as Tsui (2009) noted, expert teachers understand, reflect upon, and deliberate about what is happening in the classroom quite differently from novices. She specified three differences: (1) the capability for integrating diverse aspects of classroom knowledge to the act of teaching; (2) the manner in which teachers' relate to their particular work context and how this informs their understanding of what teaching constitutes; and (3) the capability for reflecting on and consciously deliberating about teaching practice (Tsui, 2009, p.424). Our analysis extends these conclusions, showing that novices and experts relate to the work of managing the classroom in stark contrast to one another. For experts, learning is central, and the role of the teacher is deeply integrated into whether or not students are actively engaged so that learning can happen. For novices, it is the other way around: the disruptions and misbehavior of students is a problem arising from the students, disconnected from the teacher, and the teachers' role is simply to intervene and deal with problems, not to ensure lesson engagement and enhance learning opportunities.

4.3. Differences in Knowledge and Processing

Results from Category 4 codes, which referred to the cumulative cognitive processing expressed, are the most informative for tackling the third research question: *Can we identify differences in the cognitive processing used by experts and novices when representing classroom management events?* Our analysis revealed that the cognitive processing of the expert teachers differed significantly and consistently from that of novices for all Category 4 codes. Thus, representations of experts repeatedly expressed multiple points of views, conveyed integrated perspectives that maintained the continuity of events in the classroom videos, and provided more self-certain, open-ended statements. Contrastively, typical novice verbalizations expressed only a single point of view, rarely maintained a sense of temporal continuity, provided uncertain, dead-end descriptions, and gave accounts that expressed events as disparate and disconnected from

other events. Novices rarely described a relationship between what the teacher and what students were doing in the classroom.

In their examination of the practical thinking styles of teachers, Sato and colleagues reported that experts "…utilized multiple perspectives, namely their own perspective, the teachers' perspective and the learners perspective to search for a problem of a lesson and to discover possible approaches for better teaching" (Sato, Akita, & Naoki, 1990, p. 10). This resonates with our analysis concerned with representations of classroom management events. Regarding the prevalence of integrated perspectives amongst experienced teachers, Carter et al. (1988) described how experts made assumptions about what they saw in the images, appeared to actively seek out the meaning of events taking place, inferred relationships between actions and events, and zoomed in on anomalies in the images to support this sense-making of the visual scene. Accordingly, we associate experts' integration of events with their mature knowledge and representations, and their adeptness at noticing events that correspond to classroom management concerns. Experts better understand and thus read more into the events unfolding in the classroom videos. Novices' lack of experiential, event-driven, practical classroom knowledge prevents them from seeing the inter-relatedness between actors and events within the classroom.

As mentioned earlier in the discussion, experts' ability to weave elements of temporal continuity into descriptions of actors and events mirrors experts' ability to detect and process relevant information more quickly than novices. Since they can see more in less time, they are better able to monitor this information over the course of time (in this case the length of the video fragments), can more easily assimilate events occurring in the lesson, and can account for which actors and interactions are responsible for the events unfolding in the classroom. Understandably, the novice teachers struggled to make sense of the complexity of the classroom, and found it harder to keep track of all that was happening, and between whom it was happening. Novices mainly reported on what was happening in the moment being described, and often left out references relating current events to those occurring earlier or later in the video, and events that might have developed.

Regarding the differences found pertaining to open-end and dead-end descriptions, we attribute this to a lack of self-assurance on the novices' part when it comes to assessing and articulating the classroom events in the video, especially when assessing the teaching quality of other teachers. Novices lack the extensive practical knowledge that develops alongside classroom experience. Their inexperience constrains their ability to make sense of events. The vast experience of experts, on the other hand, provides extensive, contextualized, personal knowledge of the ins and outs of the classroom. In turn, experts represent classroom interactions and the interrelatedness of classroom events, and their bearing on classroom management in the videos, with greater certainty. As Berliner has pointed out, "They are very confident in their domain of expertise. This confidence probably is the reason that they are more evaluative of other teachers

than are novices" (Berliner, 2001, p.477). Thus, expert teachers can assess classroom scenes with a surety that develops through extensive practice in the classroom. This experiential knowledge enhances their descriptions and representation of events, allowing them to verbalize more assuredly and even specify the kinds of information they would need in order to develop their evaluations even further.

5 CONCLUSION

This study investigated expertise-based differences amongst teachers as they observed and described problems in other teachers' classroom lessons. Following in-depth, qualitative coding of the words and representations of expert and novice teachers, we produced practice-based, empirical insights centered on the voices of teachers. Our findings exposed expertise-based differences in the representation and corresponding processing of classroom events, which both confirms and updates existing theories of teacher expertise. The grounded theory approach substantiates and adds specificity to findings from earlier research, and the statistical analysis employed adds rigor to the conclusions that we and other researchers have drawn, pointing out a substantial blind spot in novices' conceptualization of classroom management. For beginning teachers, the concept remains closely linked to discipline and student behavior rather than the pedagogical choices teachers make to create and sustain learning in the classroom. Individual codes showing significant differences clearly identify features distinguishing expert and novice teachers' event-based processing. These findings add detail to our knowledge of the specific ways in which experts' construct richer, more meaningful representations of classroom events while underscoring a gap in novices' representations: their inattention to student learning.

The coding scheme we developed to analyze teachers' verbalizations provides a validated, reliable basis for revealing relative differences between expert and novice teachers in terms of conceptualizations and cognitive processing associated with classroom management skills. This scheme can be applied and modified by other researchers, contributing to a more detailed, coherent picture of teachers' skills and cognitive processing, especially when it relates to the influence of classroom experience on representations of classroom events.

Comparing experts with novices, as we have done, is a good starting point, but further steps include looking into the representations of competent, experienced teachers who are still developing into experts. This step relates to a limitation in our identification of experts: we accepted administrative and peer recommendations of experts at face value. Using student performance levels as an indication of expertise – ensuring that 'expert' teachers have a documented history of positive impact on student learning – can strengthen the identification of experts. This would also help distinguish the pro-

ficiency levels of experienced teachers, since the number of years in teaching does not necessarily equate with expert teaching performance (Palmer et al., 2005).

While this study focused on descriptions of *other* teachers' classroom management, it may also provide a useful heuristic for analysis of teachers' representations of events in the familiarity of their *own* classrooms. Closer examination of differences amongst teachers can be transformed into potent implications for teacher training by offering a realistic, up-to-date, teacher-centered description of classroom management concepts to inexperienced teachers. Experts' classroom management representations can be developed, for example, into points of deliberate practice for novices (Ericsson, 2006b). They can aid novices in learning how to notice and predict classroom problems before they escalate into full-blown class disruptions. They can also guide novices in re-conceptualizing the sources of classroom management events by de-emphasizing the behavior of students and re-emphasizing the role of the teacher in preventing and responding to classroom events (Hogan et al., 2003). Moreover, including real-world lessons that show successful, learning-oriented classroom management (rather than problematic scenes as shown in this study) may help less-experienced teachers recognize the fundamental link between effective management and effective learning.

The differences we identified spotlighted significant discrepancies in the processing and foci of novice teachers when compared to experts. While this attests to the complexity of expert teachers' knowledge, it has not demystified the complexity of learning to teach. Nor has it illuminated the practices and skills novices must acquire and adapt as they learn to teach like experts (Spalding et al., 2011). While insights into expertise-based differences in teachers' understanding remain informative, investigations into how teachers transform existing knowledge and acquire the knowledge that helps them make sense of the classroom in a proactive, expert manner can contribute even more to teacher education programs (Copeland et al., 1994). Future research should examine both teachers' and students' perspectives on the classroom management concerns being raised, since the way these events are experienced and understood from each perspective do not always converge (Woolfolk-Hoy & Weinstein, 2006).

Experts' representation of teacher-student interactions emphasized the influence of the teacher in managing the classroom to support student learning. In contrast, novices' descriptions failed to recognize the valuable role the teacher plays in striking a balance between the goals of instruction, degrees of student engagement, and the consequent behavior of the students. Most surprising was novices disregard for the quality and sum of learning taking place in the classroom, meaning missed opportunities for students' learning success. Research exposing teacher expertise differences, when combined with new insights into processes of teachers' skill and knowledge integration as they acquire expertise, offers a means of supporting all teachers, especially beginners, in keeping an eye on student learning.

CHAPTER 3

Teacher vision: Comparing expert and novice teachers' perceptions of problematic classroom management scenes[2]

[2] Chapter 3 is based on:
Wolff, C. E., Jarodzka, H., van den Bogert, N., & Boshuizen, H. P. A. (in press). Teacher vision: Expert and novice teachers' perception of problematic classroom management scenes. *Instructional Science.*

ABSTRACT

Visual expertise has been explored in numerous professions, but research on teachers' vision remains limited. Teachers' visual expertise is an important professional skill, particularly the ability to simultaneously perceive and interpret classroom situations for effective classroom management. This skill is complex and relies on an awareness of classroom events. Using eye tracking measurements and verbal think aloud, we investigated differences in how expert and novice teachers perceive problematic classroom scenes. Sixty-seven teachers participated, 35 experienced secondary school teachers (experts) and 32 teachers-in-training (novices). Participants viewed videos of authentic lessons and their eye movements were recorded as they verbalized thoughts about what they had seen in the lesson and how it was relevant to classroom management. Two different types of videos were viewed: lesson fragments showing (1) multiple events depicting disengaged students with no overt disruptions and (2) multiple events that included a prominent disruptive event affecting the class. Analysis of eye movements showed that novices' viewing was more dispersed whereas experts' was more focused. Irrespective of the video type, expert teachers focused their attention on areas where relevant information was available, while novice teachers' attention was more scattered across the classroom. Experts' perception appears to be more knowledge-driven whereas novices' appears more image-driven. Experts monitored more areas than novices, while novices skipped more areas than experts. Word usage also differed, showing that expertise was associated with a higher frequency of words referencing cognition, perception, and events than novices.

Classrooms are full of complicated situations. At any given moment, there is a staggering amount of visually complex information teachers need to process to understand what is happening. Making sense of the classroom involves observing students behavior, monitoring interactions between students, keeping up the pace of instruction, making snap decisions about how to intervene in classroom disruptions, and other pedagogical concerns. Managing the diversity of classroom interactions and attending to the cues and events which are most relevant for understanding them hinges on sophisticated cognitive processing (Berliner, 2001; Copeland et al., 1994; Van Es & Sherin, 2002).

An immense quantity of varied, fast-paced, co-occurring classroom events characterize the complexity of perceiving and processing a classroom: namely, the visual demands of simultaneity, multidimensionality, and immediacy in classrooms (Sabers, Cushing, & Berliner, 1991). Kounin (1970) described the ability to remain aware of what is going on in the classroom as *withitness* and suggested that teachers direct attention to relevant information in the classroom and continually monitor the progression of events to manage all that goes on in the classroom. Part of this understanding is reliant on the detection of *visual cues*, which can be defined as the signals or hints that a teacher perceives, either consciously or unconsciously, and uses to make sense of what they see happening in a classroom. Withitness is underpinned by the cues that a teacher notices. Being 'withit' also relies on cognitive competencies that develop through practice, alongside the knowledge gained while teaching in classrooms (Berliner, 2001). It requires continually monitoring classroom scenes to interpret and understand cues and events, guided by a cohesive integration of classroom knowledge and pedagogical knowledge. This integrated cognitive processing is informed by teachers' visual and perceptual abilities.

TEACHER EXPERTISE

Although consensus on generic distinctions between expert and novice teachers is lacking, it is widely accepted that teacher expertise influences cognition and representation, depth of content knowledge, and goal-focused thinking (Hogan et al., 2003). In terms of attention distribution, pre-service (novice) teachers have been shown to devote more than half of their viewing-time to only one student, whereas experienced teachers distribute attention more evenly across groups of students (van den Bogert et al., 2014). Expert teachers have shown efficient information-reduction abilities when interpreting classroom complexity, even in classroom scenes that were previously unknown to them. This has been attributed to a difference in the event-structured knowledge of experts (Carter et al., 1988).

Teachers use pedagogical knowledge gained through experience to organize information into meaningful units. Expert teachers attend to different facts and interpret information differently than novices (Rink, French, Lee, Solmon, & Lynn, 1994). Multiple

studies have revealed that experts often integrate concerns of teaching and learning when analyzing classroom events, while novices tend to consider surface-level concerns, such as teacher and student characteristics or behavior and disciplinary issues (Tsui, 2003). In their study investigating the strategies teachers use when viewing classroom videos, Colestock and Sherin (2009) determined that the majority of events noticed and commented upon by teachers concerned issues of pedagogy, classroom climate, and classroom management. This suggests that maintaining an effective classroom climate and managing the classroom is closely connected to the events perceived by teachers, and the visual processing therein. A teacher's perception and representation of classroom events often diverges as a result of teaching experience (Wolff, van den Bogert, Jarodzka, & Boshuizen, 2015).

Visual Expertise

While teaching has not been as extensively researched as other professional domains, it is clear that professional expertise and experience are influential factors in visual processing across professions (Reingold & Sheridan, 2011). Experts are adept at seeing meaningful patterns within their domain (Boshuizen, 2009; Lesgold et al., 1988). They make faster decisions and show greater accuracy on domain related tasks. This superior perception is domain-specific, meaning the perceptual skill is confined to a particular professional domain (Reingold & Sheridan, 2011).

Professional perceptions and conceptions are shaped by an individual's particular experiences; mental schemas for events, which are reconstructed and updated through experience, are preconditions for understanding (Zacks & Tversky, 2001). Experts possess schemas that enable them to efficiently distinguish relevant from irrelevant information and focus on what is important in the situation at hand (Haider & Frensch, 1996; van Meeuwen et al., 2014). Expert teachers have sophisticated, contextualized schemas, are better able to adaptively integrate their pedagogical knowledge of types of events and students, and are more perceptive to the multidimensional complexity of classroom situations (Berliner, 2001; Carter et al., 1988; Hattie, 2003). Novices must consider the potential impact of all available information, and actively search for it, because they have not yet developed the knowledge and schemas which allow for efficient and effective cognitive processing (Boshuizen & Schmidt, 2008; Haider & Frensch, 1996). Thus, the abundant practical classroom experience and schemas of experts is likely to influence their ability to search for relevant cues in a focused, efficient manner, whereas less-experienced teachers are likely to engage in a time-consuming, rather indiscriminate search for information.

MANAGING AND MONITORING THE CLASSROOM

Classroom management has been succinctly defined as "the actions teachers take to create an environment that supports and facilitates both academic and social-emotional learning" (Evertson & Weinstein, 2006, p. 4). Teachers are under pressure not only to plan educational activities, but also to monitor their effectiveness within the classroom – an environment typified by multidimensionality (many events and actors), simultaneity (many things happening at the same time), and immediacy (the fast pace of these events) (Doyle, 2006). Seeing and understanding the meaning of events amidst these conditions is crucial to classroom management, and it depends upon teachers' keen observational and perceptual abilities (Carter et al., 1988). To manage the classroom, teachers must observe the relevant cues and events, make sense of them, and ultimately make effective pedagogical decisions based upon this information. The 'professional vision' of teachers – their skillfulness at observing, searching for, and making sense of classroom scenes – develops over time as they learn the visual practices particular to their profession (Goodwin, 1994; Sherin, 2001). It is what allows experienced teachers *to seek and monitor* meaningful information.

A recent study contrasted experienced and pre-service teachers' perception and detection of classroom events (van den Bogert et al., 2014). Not only did expertise groups differ in the number of detected (potential) events, they also differed in their interpretation and viewing strategies. In those scenes where both groups identified considerable numbers of (potential) classroom management events, experienced teachers had shorter fixations and more frequent student check-ups than pre-service teachers (i.e., they monitored more of the classroom). The researchers confirmed that experienced teachers have faster processing times than pre-service teachers, and theorized that when inexperienced teachers fail to notice an event, they continue scanning the classroom. Yet, the research did not identify which areas are monitored, which kinds of interactional cues are relevant, and which areas are skipped. Nor did they address how this viewing activity differs between expertise groups.

PROCESSING CLASSROOM SCENES

Classrooms can be characterized as complex scenes. What a teacher notices and where a teacher fixates attention in the classroom is guided not only by the events occurring in the classroom, but also by the collection of experiences in classrooms, and the knowledge developing through these experiences. "The sense that a teacher makes of a particular scene is a product of ordered prior knowledge of classroom scenes, awareness of particular features of a present scene, and cognitive processes that connect knowledge with current awareness" (Carter & Doyle, 1987, p. 149).

While capturing the gist of a scene requires only a single glance, searching for details that guide scene interpretation requires moving and steadying one's eyes. A viewer's schema organizes what is seen within a particular kind of scene, shaping the kinds of goals, elements and events perceived, and helps construct a plausible interpretation from the available information (Zacks & Tversky, 2001). The attention of the viewer is central to how a scene is visually processed, and eye movements offer insight into attention allocation in scenes. Where a person looks directly relates to what they are processing cognitively (Just & Carpenter, 1976)

Salient features of the image itself – *bottom-up, image-driven processing* – such as luminosity, color, orientation and non-uniformity, can influence eye movements (Itti & Koch, 2000). At the same time, cognition – *top-down, knowledge-driven processing* – also exerts a powerful influence (Yarbus, 1967). Eyes are automatically drawn to informative areas of a scene, and what is considered informative depends on a viewer's knowledge. Knowledge arising through experience shapes how one perceives and conceives of events, such that "Effects of familiarity and expertise development show that experience exerts pervasive influence on event conception (Zacks & Tversky, 2001, p.18). A person's event-structured knowledge about a particular kind of scene, such as a classroom, governs where the eyes move, even controlling the very first movement as one begins to perceive a scene (Henderson, 2011; Rayner, 2009).

In a recent study investigating teachers' awareness of student behavior using eye tracking measures, teachers with varying years of experience were compared to determine whether or not they noticed two students who did not follow the teacher's instruction to close their textbook (Yamamoto & Imai-Matsumura, 2013). No relationship between awareness of target students and years of teaching experience was found. It was shown, however, that teachers who were aware of the targeted misbehavior had significantly more fixations on the target students than those who were unaware, and that their fixations were longer. Contrary to existing expertise and teaching research, the authors suggested that the noticing, or encoding, of student cues is unrelated to teaching experience, and attributed the interpretation of cues to teachers' information processing while teaching. The research presented in this study challenges this conclusion by asserting 1) that teaching experience does, indeed, influence noticing, processing, and interpreting classroom scenes and 2) that awareness of whether or not students' closed their textbook conveys a limited conceptualization of classroom management (Brophy, 1999; Woolfolk-Hoy & Weinstein, 2006).

While research consistently shows that expert teachers have valuable classroom knowledge about students and events that allows them to effectively detect and interpret events to manage classroom complexity, we know little about where teachers perceive relevant events and how they make use of their classroom perceptions (Carter et al., 1988). Existing classroom research has not isolated basic features of teachers visual processing, such as where teachers' find relevant cues and information, how teachers monitor students, where they look most frequently when processing class-

room problems, and where they tend to skip or ignore information. Understanding the particularities of expert-novice differences when recognizing classroom cues is likewise limited (Behets, 1996; van den Bogert et al., 2014).

RESEARCH QUESTIONS

Teaching experience directly influences how classroom information is processed, including how teachers integrate and respond to the student interactions they observe (Behets, 1996; Carter et al., 1988; Hattie, 2003, 2012; Livingston & Borko, 1989; Sabers et al., 1991). We assume that experience in classroom teaching can account for differences in the visual processing of teachers. Experts' knowledge of classroom situations allows for focused perception, directing attention to relevant, informative areas, including student interactions, to interpret classroom events (Berliner, 2001). Novices' limited classroom experience and event knowledge restricts their ability to selectively focus attention, making them likely to look all over the classroom to detect any cues that might be useful for building a plausible interpretation of events (Haider & Frensch, 1996). In brief, we assert that the classroom search of expert teachers' is knowledge-driven, whereas novices' search is likely to be more image-driven.

Our study investigates how differences in teaching experience affect the way expert and novice teachers view classroom scenes and visually process classroom management events within these scenes. Eye tracking measures offer a useful means of exposing the visual processing and perceptual cues that teachers use to interpret classroom scenes and were used to identify expertise-based differences in the visual processing of the classroom. Verbal data were used to identify basic differences in teachers' word usage when thinking aloud about classroom management and to inform interpretation of eye tracking data.

The motivation driving our exploratory analysis was to understand the extent to which experience in the classroom influences teachers' visual perception and subsequent viewing strategies. The overarching question we investigated was: *How does experience influence teachers' visual processing of the classroom?*

1. Do experts and novices differ in their distribution of fixations when viewing classroom scenes?
2. Do experts and novices differ in terms of (a) areas they monitor, and (b) areas where they do not look?
3. Do expert' and novices differ in terms of word usage expressing mental/perceptual and action/event processing?

The first two research questions will be addressed by means of tracking participants' eye movements, and the third will be addressed by participants' verbalizations of their thoughts (for details see below).

METHODS

Participants

Sixty-seven teachers (26 females; 41 males) from diverse subject domains (Language, History, Geography, Math, Biology, Economy, and Information Technology) participated in this study: 35 experienced teachers from six secondary schools in the Netherlands (i.e., experts: M_{age}= 49.2, *SD* = 10.3), and 32 pre-service teachers from a Dutch teacher training program (i.e., novices: M_{age}= 20.6, *SD* = 2.3). Due to data quality concerns and issues of missing data, eye movement data from five experts and two expert think aloud verbalizations were excluded from analysis.

While years of experience alone does not necessarily equate to being an expert teacher, research shows that competency generally develops within the first few years of teaching, and that five to seven years of experience is a reasonable estimate of the time it takes to develop a high level skill and knowledge as a teacher (Berliner, 2004). Experts in this study had at least 7 years of teaching experience, were recognized by fellow teachers as competent or above-average classroom managers, and were recommended by their school leaders as experts in the teaching profession (Palmer et al., 2005). Novices were in either the first or second year of teacher training and had completed between 10 to 40 hours of classroom teaching experience in the context of their training program. Participation was voluntary; experts were recruited in coordination with school directors motivated to engage in teaching research and novices were recruited through a local teacher training program.

Materials and Apparatus

Stimuli were presented using Experiment Center 3.0. Eye movements were recorded with a remote SMI eye tracking system with a temporal resolution of 250Hz (SMI RED250) using iView X 3.0 software. Videos were shown on a 22-inch screen with a resolution 1680x1050 pixels; video stimulated verbalizations were recorded using a standard microphone attached to the laptop. An initial 13-point calibration of the eye tracker was performed at the start of the experiment, and 5-point validations were conducted prior to presenting subsequent video stimuli.

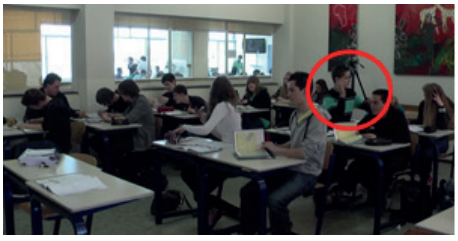
Videos. Video scenes are useful for conveying the multidimensionality, simultaneity, and richness of events within classrooms (Colestock & Sherin, 2009). Two different types of video fragments (2-4 minutes), which were clips from actual lessons, were used

as stimuli. Each fragment was intended to display multiple events connected to classroom management concerns, and showed situations that would not require a teaching background in the subject being taught. All video was filmed from the perspective of the teacher in a static position (no panning or zooming was involved) and showed Dutch secondary school pupils in typical classrooms. They were selected by independent teacher trainers based on criteria defining two types of classroom scenarios in two different classes.

Two Type 1 videos, shown first, displayed multiple but seemingly unrelated classroom events and interactions. These were followed by two Type 2 videos displaying a prominent and pronounced classroom problem alongside multiple, interrelated events and interactions. The first type showed classroom scenarios where students appeared distracted and disengaged from the lesson at hand, but without an overt problem. The second type also showed students detached from the lesson, but, in contrast to Type 1, included students who were blatantly ignoring the instruction of the teacher and leading other students astray in the lesson by throwing wadded paper or sustaining contact and waving to friends in the hallway.

↑ Type 1 video showing off-task students

↑ Type 1 video showing distracted students



↑ Type 2 video showing student throwing spitball

↑ Type 2 video showing students clowning around and baiting other student's attention

Figure 1. Still shots from the two different lessons and video types used in the experiment. Type 1 videos showed disengaged students but lacked overtly disruptive events while Type 2 videos showed disengaged students and featured a conspicuous problematic event.

Procedure

The full experiment took approximately 50 minutes. Prior to beginning the experiment, demographic data pertaining to age, teaching experience, subject-matters taught or being studied, and contact information were collected and consent and release forms were signed. The Miles test, which determines one's dominant eye, was performed and participants were familiarized with the eye tracking equipment (Holmqvist et al., 2011) as well as the think aloud method (Ericsson & Simon, 1980). Participants were informed that they would be viewing different classroom situations. They were asked to imagine themselves as teachers in these lessons and to think aloud about any issues in the classroom that they found relevant to classroom management.

Participants viewed each video twice. The first viewing familiarized them with the video content – they were unfamiliar with the classroom, lesson content, teacher, and students appearing in the video – making it easier to verbalize during the second viewing. The second viewing occurred immediately after the first viewing. They received the prompt "We will play the video a second time. While the video is playing, please think aloud and express what you were thinking when you saw the video for the first time." When there were prolonged silences during the verbalizations, participants were prompted to continue speaking with questions such as "Do you have anything more you'd like to say?" or "Is there anything you'd like to add?" They were free to talk as long as they wanted, even after the video fragment had ended. To replicate the time constraints of real-world classroom monitoring, each video was played at normal speed and participants were not allowed to stop or slow down the video during the experiment. Participants' eye movements were recorded each time they viewed the videos. This study reports only on eye movements made as they engaged in retrospective think aloud about the classroom scenes, when visual processing was linked directly to the verbal interpretations.

Data Analysis

Eye tracking data were analyzed with BeGaze software (version 3.0), which detects eye movement events such as fixations; the velocity algorithm for fixation detection had a minimum setting of 50 milliseconds. A *fixation* is a relatively still, steady gaze when the eye takes-in and processes information (Holmqvist et al., 2011). Fixations tend to concentrate on subjectively informative areas (Yarbus, 1967) and they allow viewers to identify objects, perceive visual features, and cognitively process scenes in a coherent way (Henderson, 2011). They are particularly useful for identifying where teachers focus attention, where they repeatedly monitor information, and what they find informative and what they ignore.

Research Question 1. To investigate the extent to which teachers' fixations were distributed (or not) as they perceived the classroom, participants' *fixation dispersion*

average was calculated. This measure refers to what extent participants' eye movements are spread out while viewing a scene, providing a measure for gaze distribution (Holmqvist et al., 2011).

AOI Grid Analysis

For the next research questions eye-movement data had to be linked to the video stimuli. Given the scarcity of studies applying eye tracking methodology to teaching expertise, we had no a priori hypotheses about where teachers would fixate and what groups of teachers would find informative. We therefore conducted an exploratory analysis to identify such features. Analysis software imposed 8x8 grids onto each video, spatially segmenting the stimuli screen into 64 equally-sized *Areas of Interest* (AOIs). AOIs are regions of the video in which various eye movement data are summarized and were used to identify locations on the screen where fixations were registered. The size of the AOI grids were large enough to spatially distinguish features of the classroom, such as rows of desks, areas with or without classroom activity, and different groups of students.

Research Question 2. *Number of revisits*, calculated as the number of return fixations to an AOI with at least one previous glance, references how often participants' return to an AOI they have already viewed. Repeat-viewings of particular regions help both gather and update information for scene processing. This measure was used to identify where experts and novices monitored classroom information.

Number of Skips, in contrast to revisits, reports AOIs which were *not viewed* during the experiment, and is calculated as an AOI that did not register any fixations from a participant for the entirety of the video. To strengthen the identification of group differences in terms of skipped AOIs, we report only those areas where half or more of the expertise group did not fixate on the AOI.

Research Question 3: *Verbal Data*

Word usage of participants was analyzed using specific lexical features of participants' verbalizations. Think aloud protocols were transcribed verbatim and analyzed using the open-source textometry program TXM (version 0.7.5; http://textometrie.ens-lyon.fr/?lang=en). Textometry makes it possible to compare structural and semantic elements of word usage between individuals or groups by quantifying frequencies of linguistic features, such as lemmas[3]. We quantified and compared lemma frequencies of mental/experiential and action/event/movement words to identify categorical differences between the two expertise groups.

[3] A lemma is a lexical unit representing the set of all word forms sharing the same core meaning, e.g. the lemma *go* represents *go, goes, going, went, gone* (Knowles & Don, 2004).

As our analysis was exploratory, we sought basic yet meaningful differences in the way experts and novices expressed words related to cognitive and event processing. Recent research in the medical domain has shown that comparing frequencies of specific word categories is helpful for combining visual and cognitive perspectives and identifying expertise differences therein (Jaarsma et al, 2015). The theory of *semantic primes* describes a small set of words conveying meaning within languages, and which cannot be reduced to simpler terms or definitions (Drobnak, 2009; Goddard, 2002; Wierzbicka, 1996). Semantic primes provided the basis for our word categories. To detect difference in words related to cognition and perception, we compared semantic primes frequencies related to mental/perceptual words: think, know, want, see, hear, feel. To detect differences in attention to classroom events, we compared semantic prime frequencies related to action, event, and movement: do, happen, move.

RESULTS

We applied a two-step analysis to eye movement measures. First, mixed-design repeated measures ANOVA repeated over type of video with expertise as the between-subjects factor were conducted on group means for three eye movement measures: fixation dispersion averages, total number of AOI revisits, total number of AOI skips. Then, to explore and identify between group differences per AOI, we calculated confidence intervals showing significant between-group differences for AOI revisits and skips for all 64 AOIs in the grid. Confidence intervals provide a range of values for the population mean of a given statistical sample by defining how probable it is that hypotheses derived from the distribution of the measured data are true (Field, 2009).

Research Question 1: Focused viewing

Fixation dispersion: Statistical analysis with a mixed-design ANOVA showed a main effect for expertise with 'fixation dispersion average', $F(1, 60)= 6.04$, $p = 0.02$, $\eta^2 = 0.10$. Novices' fixations were significantly more dispersed than experts, meaning that experts' fixations were more focused while viewing the videos. There was no significant effect for the type of video, $F(1, 60) = 2.323$, $p = 0.13$, $\eta^2 = 0.04$, and there was no interaction effect for video and expertise, $F(1, 60) = 1.376$, $p = 0.25$, $\eta^2 = 0.02$.

Research Question 2a: Monitored areas

Step 1, mixed-design repeated measures ANOVA: Between subject-effects showed no significance expertise differences for the total amount of AOI revisits, $F(1, 60) = 3.187$, $p = 0.079$, $\eta^2 = 0.05$. Experts tended to have more revisits than novices. There was a significant effect for the type of video shown, $F(1, 60) =15.143$, $p <0.01$, $\eta^2 = 0.20$, with

Type 2 videos (Video3; Video4) receiving more revisits than Type 1 videos(Video1; Video2), but there was no interaction effect for video type and expertise, $F < 1$.

See Table 1 for means and standard deviations per video.

Table 1 Means and Standard Deviations for Eye Movement Measures (per video)

Measure	Expertise		
	Experts	Novices	Total
N	30	32	62
Fixation Dispersion Average			
Video 1: Type 1, Class 1	68.69 (17.32)	93.10 (70.84)	81.29 (53.33)
Video 2: Type 1, Class 2	67.02 (18.28)	80.21 (25.80)	73.83 (23.27)
Video 3: Type 2, Class 1	68.34 (17.43)	99.38 (60.14)	84.36 (47.19)
Video 4: Type 2, Class 2	68.69 (22.32)	83.98 (28.76)	76.58 (26.77)
AOI Revisits			
Video 1: Type 1, Class 1	562.10 (181.07)	496.41 (209.76)	528.19 (197.59)
Video 2: Type 1, Class 2	406.50 (128.36)	343.88 (127.37)	374.18 (130.67)
Video 3: Type 2, Class 1	413.17 (129.99)	342.53 (133.28)	376.71 (135.38)
Video 4: Type 2, Class 2	673.32 (273.65)	575.84 (267.07)	623.01 (272.51)
AOI Skips			
Video 1: Type 1, Class 1	33.30 (4.44)	34.25 (4.27)	33.79 (4.34)
Video 2: Type 1, Class 2	36.97 (3.25)	38.84 (4.15)	37.93 (3.83)
Video 3: Type 2, Class 1	39.43 (3.79)	39.50 (3.51)	39.47 (3.62)
Video 4: Type 2, Class 2	35.87 (4.13)	38.09 (5.77)	37.02 (5.12)

Step 2, confidence intervals: To reduce the instance of Type II errors, we only report confidence intervals of 99% or higher. For more means and standard deviations and upper and lower limits for confidence intervals showing significant differences for AOI Revisits, see Table 3 and Table 4 in the Appendix; for more details on the confidence intervals showing significant differences for AOI Skips, see Table 5 and Table 6 in the Appendix.

Experts revisited, or monitored, more areas than novices in all four videos. In both video types, novices revisited AOIs showing limited or no classroom activity (i.e. walls, paintings, a bright window showing hallway activity). Experts appear to be searching for information between students and following posture and body movements, while novices returned more often to areas showing little or no student activity. For example, novices monitored an area showing the leg of a fidgety student wearing fluorescent green shoelaces that appear to be an image-driven attractor for the novice group. Contrastively, experts returned more often to areas showing students and classroom activity. These areas displayed students' shoulders, chests, arms, elbows, hands, their desktops, and occasionally their legs. When experts revisited AOIs showing faces, these AOIs

generally show multiple students in the AOI, including interactive regions between different rows of students. In sum, experts revisited more areas showing physical and verbal interactions of or between students, while novices revisited regions lacking classroom interactions. See Figure 2 for details on the number of AOIs showing significantly more revisits per expertise group.

Figure 2. Stills comparing revisits: areas in the classroom repeatedly monitored by experts and novices.
Note. Blue grids denote significantly more revisits from experts, orange grids from novices. To locate specific AOIs, columns are identified by letters and rows are identified by numbers.

Research Question 2b: Skipped areas

Step 1, mixed-design repeated measures ANOVA: No expertise effects were found in the number of AOI skips per expertise group, $F(1, 60) = 2.709$, $p = 0.10$, $\eta^2 = 0.04$. There was a significant effect for the type of video shown, $F(1, 60) = 25.212$, $p < 0.01$, $\eta^2 = 0.30$, with Type 1 videos (Video1; Video2) showing more skips than Type 2 videos (Video3; Video4). There was no interaction effect for video type and expertise, $F< 1$.

Step 2, confidence intervals: In all four videos, novices skipped more AOIs than experts, meaning half or more of the novices viewing the videos never looked at these areas. In the one instance where the majority of experts skipped an AOI (Video4) the area mainly shows an empty space between two rows of students. Novices, on the

other hand, skipped areas showing students, interactions between groups of students, desk surfaces, and empty spaces between rows of students. In general, it appears that novices are consistently missing areas that experts are viewing. See Figure 3 for details on the number of AOIs showing significantly more skips per expertise group.

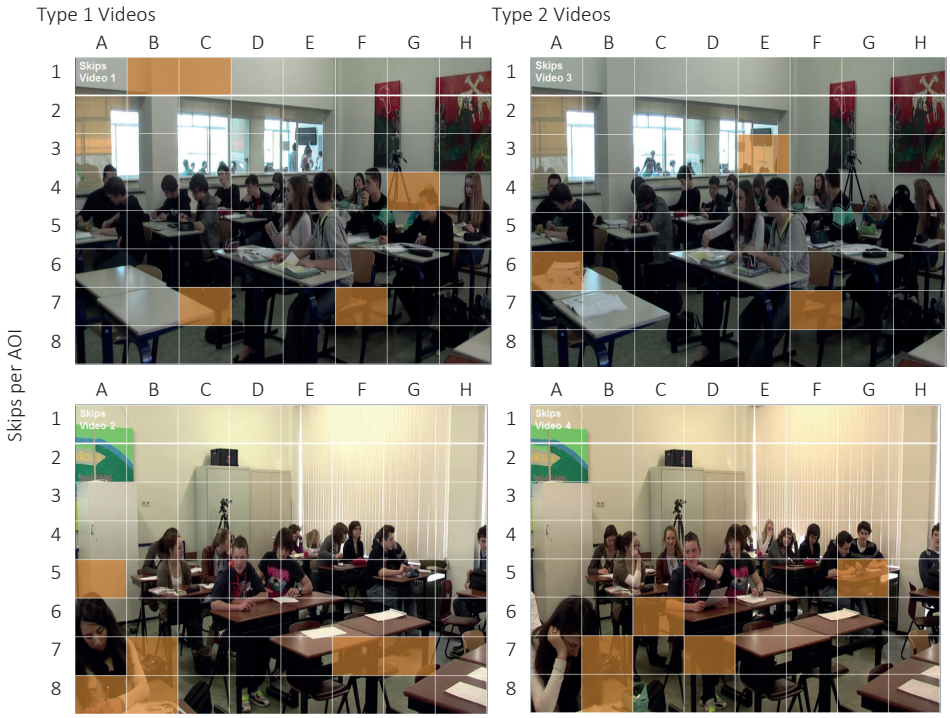


Figure 3. Stills comparing areas experts and novices teachers skipped while viewing classroom videos.
Note. Orange grids show areas skipped significantly more by novices; the expert group did not have significantly more skips. To locate specific AOIs, columns are identified by letters and rows are identified by numbers.

Research Question 3: Word usage

Chi-square tests are used to measure associations and compare frequencies observed in different data categories (Field, 2009). We compared the occurrence of specific semantic primes per level of teaching expertise. There was a significant association between experience and word usage, χ^2 (8, n=937) =30.45, p < .001. Teaching experience was associated with higher frequency of both mental/perceptual and action/event word categories.

Expert teachers used the action/event word 'happen' significantly more, (n = 58, versus 43.8 expected, z = 2.1, p< .001), whereas novices used it less (n = 16, versus 30.2 expected, z = -2.6, p< .001). That is, experts expressed more words related to action/event processing. See Table 2 for the percentages of word frequencies.

Table 2 Percentage of Semantic Primes per Word Categories and Expertise Group

Semantic Prime	Type 1 Videos			Type 2 Videos		
	Total	Experts	Novices	Total	Experts	Novices
Mental/perceptual processing words						
think	117	52%	48%	123	63%	37%
know	150	48%	52%	108	48%	52%
want	49	69%	31%	63	75%	25%
see	212	58%	42%	220	54%	46%
hear	31	65%	35%	29	52%	48%
feel	9	100%	0	10	90%	10%
Actions/event/movement processing words						
do	287	60%	40%	298	51%	49%
happen	74	78%	22%	83	70%	30%
move	8	63%	37%	10	90%	10%

DISCUSSION

This study investigated the question of how experts and novice teachers differ in their visual processing of the classroom. We considered multiple ways in which teachers' perceptual processing allows teachers to interpret cues, events, and interactions occurring in problematic classroom scenes. We compared elements of expert and novice teachers' visual processing to determine 1) how distributed a particular expertise group's fixations were; and 2) which areas and features were repeatedly monitored and which were skipped in the search for classroom information. We also compared teachers' think aloud verbalizations to determine 3) how experts and novices differed in terms of word usage linked to cognition, perception, actions, and events.

Research Question 1. Consistent with research conducted in other professional domains, we found that teaching experience directly related to significant main effects of fixation dispersion across all videos, irrespective of the types of classroom problems depicted. As a group, experts fixations were less spread out (i.e. more focused) than novices, suggesting efficient perceptual encoding of the available visual information and supporting the idea that experts chunk the visual information into meaningful units which serve to guide and focus their search (Reingold & Sheridan, 2011). Novices' fixations were more dispersed, and their viewing, overall, appeared to be less selective and discriminating than that of experts.

Van den Bogert el al. (2014) concluded that pre-service teachers' event-noticing draws their fixation towards a single event at the expense of noticing other events in the classroom. They did not, however, consider the extent to which teachers fixations were focused or dispersed. Our finding suggests that novices do actually distribute their

fixations across the expanse of the classroom, but they are not exposed to the same range of meaningful cues and events as experts due to the scattered, disorganized spread of their fixations.

Research Question 2. Experts consistently had more revisits to specific, concentrated areas than novices did in all videos. Revisit results offer a configuration which is rather stable for both expertise groups. Novices exclusively revisited more AOIs void of discernible student activity, whereas experts were inclined to monitor AOIs showing students' body parts, such as trunks, shoulders, arms, elbows, and hands, and occasionally faces (where human attention is typically drawn). In these AOIs, many interactions and movements between students are also present.

Particularly in Video3 and Video4, these activities escalate into the most disruptive students unmistakably distracting adjacent students by throwing spitballs across the room, by waving their arms repeatedly at a student outside the classroom and taking away the papers that neighboring students are working with. Experts' monitoring in these blatantly disruptive scenes do not fixate most frequently on the students creating such distractions, but rather on the surrounding students. They appear to be viewing the effects of disruptions on groups of students situated elsewhere in the classroom. These patterns suggest that experts' monitoring is guided by knowledge of how problematic situations influence students on the periphery of problematic behavior. Novices' monitoring, on the other hand, suggests an image-driven pattern with a narrower field of vision (for example, revisiting an AOI showing sneakers with fluorescent shoelaces). We link their constrained ability to detect and monitor informative, interactive areas to a lack of experience and event-based professional knowledge that helps overcome the tendency to return to visually salient yet uninformative areas of the class.

Experts' revisits cover an extended field of vision, alluding to a professional skill of selectively focusing on areas containing informative cues for continually monitoring classroom events. Our claim is that experts have learned through experience to pass over disingenuous cues, and instead seek subtle but consequential cues conveyed via students' posture, physical movements, and discreetly suggestive behavior. They monitor such areas attentively because they have learned over time to be more discriminating, and have developed a perceptive professional sensitivity to less conspicuous physical and interactional cues (Sherin, 2001).

Concerning skipped areas, the novice group skipped more AOIs than experts in every video, and in some cases they skipped the same areas that experts frequently revisited. Experts only skipped one AOI in Video4, and this overlooked area mainly showed a space between two rows of desks, and no direct student interactions. The findings aligns with general features of professional expertise, namely that experts detect and focus on features that novices miss (Chi, 2006). It also suggests that experts are capable of passing over irrelevant information in classroom scenes because they have learned to systematically reduce the kinds of information that should be sought after. They can

devote more time to informative areas, whereas novices lack the experience and knowledge to do so (Haider & Frensch, 1996).

Research Question 3. In both types of classroom management scenes, experts more frequently used mental/perceptual words associated with complex thinking styles and also employed words denoting actions and events more frequently (Pennebaker, 2011; Wierzbicka, 1996). We take this to mean that their thoughts are organized closely to their sensorial perception ('see'; 'hear') and their experiential knowledge and expectations of classrooms ('think'; 'want') in relation to the actions and events taking place in the video ('do'; 'happen'; 'move').

Results from our analysis of basic differences in the words used by experts and novices offers supplemental support to the hypothesis that experts' knowledge drives their visual processing. It aligns with research showing that experts' have richer stores of knowledge about classrooms and students than novices, allowing them to verbalize visual processing in a more complex manner (Carter et al., 1988). Novices' emerging knowledge of classroom events hinders their ability to recognize relevant information as they process classroom scenes, as their management focus is often framed around issues of behavior and discipline. Experts' knowledge allows them to: focus on actions and events themed around student learning, consider management concerns from multiple points of view, predict problems before they intensify, and keep track of the continuity of classroom events and interactions (Wolff et al., 2015).

Limitations

While our exploratory analysis of teachers' eye movements confirms that experience plays an important role in teachers reading of classroom cues, it only does so in a general way. We found significant differences between expertise groups as a whole. Exploring within-group differences may provide further insights into how teachers' visual processing develops and differs amongst beginner and experienced teachers. Similarly, contrasting results from differently-sized AOI grids, particularly smaller grids, could yield interesting result both between and within expertise groups.

Although we contrasted different types of problematic classroom situations, our study sheds no light upon expert-novices differences in non-problematic situations. The inclusion of smoothly executed, dynamic classroom management scenes in future research could offer insights for distinguishing effective from ineffective management. Also, our concentration on visual processing furthered understanding of teachers' perception, but it would be interesting to further explore the link between perceptual and interpretative cognitive processing. Identifying the cues, actors, events, and conceptualizations of classroom management teachers consider most meaningful may help improve models of teacher cognition and explain both convergences and divergences in teachers' thinking (Colestock & Sherin, 2009).

CONCLUSIONS

Expertise differences in fixation dispersion as well as the grid analysis can be read as an indication that experts and novices recognize different visual cues as being important to classroom management. Experts' experience-based, event-structured knowledge allows them to derive meaning from these cues differently than novices. This knowledge drives focused observational strategies that selectively seek and revisit specific visual cues that inform the interpretations of events. In the case of experts, it allows them to interpret and predict potentially relevant management events before they occur (Haider & Frensch, 1996; Wolff et al., 2015) and directs their repeated monitoring of the classroom.

The key issue of interpreting problematic situations may not be a strict question of whether or not a teacher sees an event and has access to the requisite relevant information, but more a matter of how they recognize what they are observing and what it means for teaching practice. Van Es and Sherin (2002) define three central elements of teachers' noticing: 1) identifying what is important about the teaching situation; 2) relating the specific classroom interactions to the larger principles of teaching and learning what they represent; and 3) using knowledge about context to reason about the classroom interactions that are noticed. Copeland et al. (1994) suggest that an ability to articulate a clear sense of educational purpose may also guide attention as teachers notice, interpret, and process classrooms. Perhaps novices lack more than just integrated, organized knowledge structures – supported by practical classroom experience – to generate pedagogically-sound hypotheses. They also lack contextualized, purposeful, practice-oriented event knowledge to guide their attention and distinguish which kind of cues and classroom events are meaningful enough to notice. This makes it difficult for novices to locate and concentrate on relevant cues, and may explain why novices instead continue indiscriminately searching all over the classroom for any information that could be construed as potentially relevant (Berliner, 2001; Boshuizen & Schmidt, 2008; Carter et al., 1988).

Our findings challenge the few existing studies investigating the role of teaching experience via eye tracking measures that found no expertise effects. While we have shown that experience guides teachers' withitness as they process the complex array of problematic events that arise in classrooms, many aspects of teachers' processing remain unclear. The contours of teachers' visual processing are emerging, but research clarifying the developmental link between teachers' vision and classroom schemas, and how teaching experience helps develop this knowledge, remains to be seen.

APPENDIX

Table 3 Confidence Intervals Showing Significant Differences for AOI Revisits in Type 1 Videos

	Video 1			Video 2	
AOI	M (SD)	99% CI	AOI	M (SD)	99% CI
Experts			Experts		
A2	69.3 (19.3)	[31.4, 107.2]	A7	95.7 (23.7)	[49.3, 142.1]
A3	84.3 (17.2)	[50.6, 118.0]	A8	1.8 (1.9)	[-1.9, 5.6]
A5	229.8 (44.6)	[142.4, 317.2]	B4	131.4 (29.6)	[73.3, 189.5]
B3	55.2 (17.3)	[21.4, 89.0]	B5	122.7 (23.1)	[77.5, 167.9]
B5	462.3 (65.5)	[333.9, 590.7]	C4	448.2 (52.5)	[345.3, 551.2]
B7	22.5 (8.9)	[5.0, 40.0]	C5	506.4 (78.1)	[353.3, 659.5]
D7	2.7 (2.9)	[-2.9, 8.4]	D6	219.3 (42.7)	[135.7, 302.9]
E6	163.2 (29.1)	[106.2, 220.2]	E6	123.9 (31.5)	[62.1, 185.7]
G5	499.8 (62.7)	[376.9, 622.7]	G5	174.0 (333.9)	[227.4, 440.4]
G6	39.3 (13.1)	[13.6, 65.0]	Novices		
H5	76.8 (26.3)	[0.00, 76.8]	D7		[2.3, 46.3]
Novices			D8		[-2.78, 34.6]
E3	170.7 (46.6)	[79.3, 262.1]	E3		[-5.4, 138.6]

Note. CI = confidence interval.

Table 4 Confidence Intervals Showing Significant Differences for AOI Revisits in Type 2 Videos

	Video 3			Video 4	
AOI	M (SD)	99% CI	AOI	M (SD)	99% CI
Experts			Experts		
A3	23.4 (8.8)	[6.2, 40.6]	A7	52.5 (15.1)	[22.9, 82.1]
A6	5.7 (4.3)	[-2.7, 14.1]	B5	254.1 (50.5)	[192.4, 499.4]
B5	249.3 (44.0)	[163.1, 335.5]	B6	141.6 (21.4)	[99.6, 183.6]
C5	195.9 (37.4)	[122.7, 269.1]	B8	10.2 (6.1)	[-1.8, 22.2]
D6	64.8 (16.6)	[32.3, 97.3]	C6	51.6 (16.9)	[18.5, 84.7]
E3	37.5 (15.1)	[8.0, 67.0]	C7	2.7 (2.9)	[-2.9, 8.4]
E4	1128.9 (102.2)	[928.7, 1329.1]	D6	289.8 (52.2)	[187.5, 392.1]
F4	1793.4 (162.0)	[1475.9, 2111.0]	D7	5.7 (4.1)	[-2.2, 13.6]
G5	387.3 (51.4)	[286.5, 488.1]	E5	1231.8 (179.7)	[879.7, 1583.9]
Novices			E6	185.7 (36.9)	[113.4, 258.1]
H3	24.3 (11.4)	[1.9, 46.7]	E7	2.7 (2.9)	[-3.00, 8.4]
			F5	565.2 (117.3)	[335.4, 795.0]
			F6	52.5 (13.4)	[26.3, 78.7]

	Video 3			Video 4	
AOI	M (SD)	99% CI	AOI	M (SD)	99% CI
			G5	479.1 (110.4)	[262.7, 695.5]
			H5	147.3 (38.6)	71.6, 223.0]
			H6	30.0 (16.5)	[-2.3, 62.3]
			Novices		
			B3	19.8 (12.7)	[-4.9, 49.6]
			D8	11.4 (7.5)	[-3.2, 26.0]
			G3	70.2 (30.5)	[10.5, 129. 9]
			H3	54.3 (19.9)	[15.3, 93.3]

Note. CI = confidence interval.

Table 5 Confidence Intervals Showing Significant Differences for AOI Skips in Type 1 Videos

	Video 1			Video 2	
AOI	M (SD)	99% CI	AOI	M (SD)	99% CI
Novices			Novices		
B1	28.2 (1.4)	[25.5, 30.9]	A5	26.4 (1.9)	[22.8, 30.1]
C1	29.1 (0.9)	[27.2, 31.0]	A8	24.3 (2.2)	[20.0, 28.6]
C7	29.1 (0.9)	[27.2, 31.0]	B7	18.9 (2.7)	[13.6, 24.2]
F7	28.2 (1.4)	[25.5, 30.9]	B8	16.8 (2.7)	[11.4, 22.2]
H4	18.9 (2.7)	[13.6, 24.2]	F7	27.3 (1.6)	[24.1, 30.5]
			G7	28.2 (1.4)	[25.5, 30.9]

Note. CI = confidence interval.

Table 6 Confidence Intervals Showing Significant Differences for AOI Skips in Type 2 Videos

	Video 3			Video 4	
AOI	M (SD)	99% CI	AOI	M (SD)	99% CI
Novices			Novices		
A6	24.3 (2.2)	[20.0, 28.6]	B7	16.8 (2.7)	[11.4, 22.2]
E3	26.4 (1.9)	[22.8, 19.6]	B8	19.8 (2.6)	[14.7, 25.0]
F7	28.2 (30.1)	[25.5, 30.9]	C6	13.2 (2.7)	[7.8, 18.6]
			D7	25.2 (2.0)	[21.2, 29.2]
			G5	14.1 (2.8)	[8.6, 19.6]

Note. CI = confidence interval.

CHAPTER 4

See and tell: Expert-novice differences in teachers' perceptions and interpretations of problematic classroom management events[4]

[4] Chapter 4 is based upon:

Wolff, C. E., Jarodzka, H., & Boshuizen, H. P. A. (2015). *See and tell: Expert-novice differences in teachers' perceptions and interpretations of problematic classroom management events.* Manuscript submitted for publication.

ABSTRACT

Teachers' knowledge and experience in the classroom influences how they represent, conceptualize, and interpret events occurring in the classroom. However, the extent to which this knowledge and experience impacts their processing of problematic events has not been explored in-depth. This study specifies significant differences in how expert and novice teachers cognitively process different types of problematic classroom events. A detailed coding scheme was used to test predicted differences in expert-novice teacher representations pertaining to the processing and interpretation of two different types of problematic classroom event videos. One video type displayed multiple, unrelated problems such as disengaged, off-task students (Fuzzy Events) and the other multiple, interrelated problems connected to a blatant classroom disruption affecting many students or the whole class (Striking Events). Expert and novice interpretations were coded line-by-line and as whole utterances to identify between-group differences and confirm or reject expected differences. All coding categories showed significant main effects for expertise, and most showed interaction effects for the type of problematic event. Group differences for specific codes were also identified. Novices offered more visual descriptions and focused more on issues of behavior and discipline. Experts expressed more interpretive processing, were more focused on student learning, stressed the influential role of the teacher on the problematic events in the classroom, and mentioned more relations between actors in the video. The overall cognitive processing of experts was more elaborate and integrated than that of novices, although novices did offer semi-integrated perspectives when problematic events were striking.

Classroom experience influences how teachers grasp the meaning of classroom events. Expertise differences between expert and novice teachers' noticing (perception) and sense-making (interpretation) of the classroom have been shown to differ in several key ways. Experts possess a wealth of knowledge about classrooms – the kinds of situations and social interactions that arise in the course of teaching – and have developed elaborate practical knowledge for making sense of the complexity of events unfolding in classrooms. Novices, in contrast, have limited, less elaborate knowledge, and attend to classroom events with less interconnectedness and coherency. The goal of this study was to identify significant differences in how expert and novice teachers processed different types of problematic classroom events.

1.1 Developing classroom management skills

Learning to manage a classroom and teach effectively is complicated, and the majority of the knowledge and skill development required for effective teaching takes place within the classroom itself (Doyle, 1977). Amongst the many competencies teachers need to develop, classroom management is widely recognized as a daunting challenge and concern for teachers, particularly beginning teachers (Emmer & Stough, 2001; Smith & Ingersoll, 2004; van Tartwijk et al., 2011, 2003). *Classroom management* refers to the multi-faceted actions a teacher takes to create, support, and facilitate the goals of instruction and learning in the classroom. It is a system of activities for maintaining an effective learning environment that includes, but is not defined by, *discipline*, which comprises actions taken to prompt behavioral changes in students who do not comply with expectations, especially behavior that disrupts the classroom management system and the learning environment (Brophy, 1988; Doyle, 1990; Woolfolk-Hoy & Weinstein, 2006). The primary purpose of classroom management is maximizing learning, and a secondary purpose is minimizing misconduct that is disruptive to learning.

Classroom management can be considered fundamental to successful teaching and learning: it is intrinsically linked to both the content being taught and the pedagogical processes through which content is delivered. These components are intertwined (Brophy, 1999; Doyle, 1990). A *classroom event* refers to a moment in time that is situated in the space of the classroom and – in the mind of the teacher – is tied to the ongoing activity in the classroom. Classroom events are generally directed towards a goal (for example, managing a class of high school students) and involve both animate and inanimate objects (for example, pupils and worksheets, respectively). The temporal and spatial boundaries of events are notoriously fuzzy, and when they begin and end depends on who is observing them (Zacks, Speer, Swallow, Braver, & Reynolds, 2007). What constitutes a classroom event depends upon on a teacher's perception and interpretation of a given classroom situation.

Depending on their level of experience, teachers conceptualize and represent classroom management differently. Less experienced teachers assess management in terms

of rules and discipline in the classroom: how attentive pupils are, whether or not they are on-task and exhibiting acceptable classroom behavior. For more experienced teachers, matters related to student thinking are of greater concern: they focus on the quality of the student attention they observe, how engaged students are in learning processes, and how learning may be improved in particular contexts (Copeland et al., 1994; Wolff et al., 2015).

In the context of teaching, a tension exists between the immediate needs of classroom practice, and the long-term, on-going process of developing professional skills to effectively manage classrooms. Expert teachers' knowledge of classrooms is richer and more accessible than that of beginner teachers, allowing them to quickly process complex information, represent problems flexibly, and recognize meaningful patterns amidst the complexity and problems. Novices need time to develop and automatize their management routines so they can move beyond simply dealing with classroom problems and devote cognitive resources to understanding why and how classroom problems arise (Berliner, 2001). On the one hand, teachers face immediate, fast-paced, on-the-spot classroom complexities, which cause difficulties for novices. On the other hand, experts have the benefit of experience and knowledge accrued over time in order to face such complexities insightfully and effectively (Doyle, 2006).

1.2 Perceiving and interpreting classroom events

Teachers' ability to recognize and interpret classroom events gradually develops through classroom experience, relying on knowledge situated in the context of classrooms (Bromme, 2001; W. Doyle, 1990). Classrooms are perplexing, multidimensional environments that are not always predictable: there are numerous co-occurring events, a variety of purposes and objectives to be accomplished, and many different people to account for. The continual, co-occurrence of multiple events, i.e. their multidimensionality and simultaneity, demands that teachers perceive, process, and decide what to do about these events almost instantaneously, emphasizing the immediacy of the classroom (W. Doyle, 2006; Sabers et al., 1991). Concepts of classroom management are tightly connected with how a teacher perceives, thinks about, and makes sense of classroom events.

Teachers must first notice and recognize events before they can render them meaningful. The events a teacher notices, as well as the meaning attributed to them, is determined by their perception of classroom information (the people, objects, interactions, and spatial dimensions of the classroom itself) and the way these merge with ongoing knowledge-based processing, which transforms this information into an interpretation. In this study, *perception* refers to the sensory information the teacher notices in the classroom, i.e. relevant cues and events. *Interpretation* refers to the teachers' ability to make sense and derive meaning from the classroom events and interactions they perceive. Interpreting a particular situation draws upon prior knowledge of class-

rooms situations, awareness of the current events arising in the classroom, and an integrated fusion between what one knows about classrooms and what one is perceptually aware of in real-time (Carter & Doyle, 1987).

There are several interconnected elements for any form of professional practice (such as interpreting the classroom): assessing situations, deciding whether or not actions need to be taken, pursuing a course of action, and monitoring one's thoughts, activities, and reflections (Eraut, 2007). The timescales of interpretive processing are not fixed: sometimes processing is automatic and rapid, other times deliberative and prolonged. They depend upon the situation, the context in which it occurs, and the knowledge one has about such situations. As a teacher acquires expertise, they accumulate vital case knowledge that influences and transforms their representations of situations. Greater expertise generally leads to quicker access to information for interpreting (and acting within) various situations. The time it takes to recognize, assess, and make decisions about situations reduces as expertise increases (Eraut, 2007). Consequently, expertise transforms the way a teacher represents their professional knowledge and understands problems within their profession (cf. Boshuizen & Schmidt, 2008).

When learning to teach, much emphasis is put into learning how to act in the classroom, rather than learning how to interpret what happens in the classroom (Putnam & Borko, 2000; Van Es & Sherin, 2002). Yet, this ability to interpret events and interactions plays a powerful role in making-sense of and making decisions amidst the complexity of the classroom. In other words, teachers' interpretations determine their actions. Van Es and Sherin (2002) have identified basic elements of teachers' noticing and interpreting, such as honing in on what is important about particular situations, and using contextual knowledge to reason and make sense of these interactions. The nature of classrooms makes interpreting the abundant array of events an arduous endeavor:

> "The individual elements involved in good teaching may not be especially difficult to learn, but during implementation under classroom conditions, they are numerous and shifting from moment to moment, so that it becomes very difficult to orchestrate them into an optimal combination that is ideally suited to the needs of any particular moment, let alone to adjust continuously so as to be able to sustain an optimal situation..." (Brophy, 1988, p.3)

1.3 Classroom event processing

Experts have been shown to have a richer store of classroom knowledge about events and students than novices to fuel their interpretations. Novices often lack explanations for what they see and fail to develop meaningful interpretations of what they are processing. Carter et al. (1988) found notable differences in the way experts and novices perceived classroom events, interpreted non-verbal behavior of students, and how they made sense of student interactions. Experts were shown to engage in deeper,

knowledge-based interpretations about the visual evidence they perceived. Experts more consistently noted the same events and agreed about their relevance to instruction or management. Novices agreed only a fraction of the time and gave inconsistent interpretations as a group, occasionally contradicting themselves or providing interpretations opposing those offered by experts. In their study, however, classroom complexity was reduced to sequential slides missing the dynamism of actual teaching.

As explained above, expert and novice teachers focus their attention towards classroom events differently, and experts are better able to integrate their perceptions to monitor and make sense of the steady flow of events and interactions, maintaining a global perspective on classroom situations (Berliner, 2001; Sabers et al., 1991). Recent research has pointed out that preservice (novice) teachers often fail to perceive relevant events, and that even when they perceive relevant events, they tend to devote their attention to one event and ignore the rest of the classroom, whereas experts continue scanning the classroom (van den Bogert et al., 2014). Expert teachers monitor the classroom continually, even when engaging with a particular student (Cortina, Miller, McKenzie, & Epstein, 2015).

When making interactive teaching decisions, experts rely on their experiential knowledge of classrooms to determine what information is relevant to the situation at hand and what can be ignored. Novices are still in the process of developing the knowledge that help distinguish relevant and irrelevant information, and have been shown to be less selective in determining which informational cues are important (Livingston & Borko, 1989). Experts, on the other hand, actively engage with and compare direct informational input with their existing knowledge, and more easily discern relevant from non-essential information (Haider & Frensch, 1996).

When analyzing classroom videos, experts consider classroom situations in terms of the teaching principles and concepts they represent, relating current awareness to larger issues of teaching and learning, whereas novices often simply provide a 'flat', literal, visual description of the events they observe (Carter et al., 1988; Van Es & Sherin, 2002; Wolff et al., 2015). Experienced teachers tend to cite student involvement, interactions among students and between the teacher and students, and engagement with learning materials as relevant, and seek meaning by framing their thinking in terms of lesson goals linked to actions of the teacher (Copeland et al., 1994). Successful management has been explained "as a process of guiding a moving system through time and space", whereas unsuccessful management is marked by misconceptions of classroom management and the importance of the flow and timing of classroom actions and interactions (Carter, 1994, p.250). In terms of how they frame problems encountered while teaching, novices have difficulty integrating concepts of teaching into the context of a situation. Experts', on the other hand, have developed the ability to keep track of multiple events over time in the dynamic space of the classroom by relying on contextualized, impromptu thinking that flexibly constructs and reconstructs interpretations in relation to the classroom situation (Livingston & Borko, 1989; Sato et al., 1990).

1.4 Research questions and aim of study

Expert-novice comparisons provide a useful framework for examining teacher knowledge differences, particularly the prominent themes and features that emerge when knowledge and thinking are made explicit. Existing research shows differences in terms of what teachers perceive as relevant to a situation, as well as to how this relates to the continual processing and monitoring of the classroom (Hogan, Rabinowitz, & Craven, 2003). Our study investigates how knowledge-based differences influence expert and novice teachers' perceptions and interpretations of classroom events by considering the thought processing applied to making sense of challenging situations—those considered as problematic. To achieve this, we used a broad question to guide our analysis, asking *How do expert and novice teachers process different types of problematic classroom events*? We considered multiple categories capturing diverse aspects of expert and novices' mental processing, comparing: perceptions and interpretations, core focal themes, temporal referencing, global cognitive processing, and relations drawn between students and teacher interactions in two different types of problematic classroom situations.

Based on an earlier study identifying expert-novice differences in representations of events in relation to classroom management (Wolff et al., 2015), we hypothesized the following:

1) Concerning whether or not expert and novices differed in verbalizations conveying what was perceived versus interpretations of the perceived information:
    a. Novices are expected to offer more statements about what they perceived (visual and audial) than experts.
    b. Experts are predicted to offer more interpretations than novices.
2) Concerning the themes that experts and novices focus on when expressing their thoughts:
    a. Experts are predicted to focus more statements on the theme of student learning when thinking about problematic events.
    b. Novices are predicted to focus more statements on the theme of student discipline when thinking about problematic events.
3) Concerning the timescales expressed by expert and novice teachers:
    a. Experts are predicted to express thoughts describing events in terms of their temporal connectedness and continuity.
    b. Novices are predicted to express more thoughts describing events in terms of contemporaneous temporality.

4) Concerning cognitive processing differences between experts and novices:

   a. Experts are predicted to use multiple points of view, provide highly integrated perspectives of classroom events, and express more certainty about their thoughts than novices.

   b. Novices are predicted to offer a single point of view, provide less integrated perspectives of classroom events, and to be less certain about their thoughts than experts.

Based on recent research identifying how experts and novices visually perceive problematic classroom videos (Wolff, Jarodzka, van den Bogert, & Boshuizen, in press), we expected experts and novices to differ in their thinking as follows:

5) Concerning their ability to interpret interactions relevant to classroom events:

   Experts are predicted to explicitly describe more relations between actors than novices.

2. METHODS

2.1 Participants

Sixty-seven teachers (M_{age}= 35.5, *SD* = 16.3; 26 females; 41 males) from diverse subject domains (Language, History, Geography, Math, Biology, Economy, and Information Technology) voluntarily participated in this study.

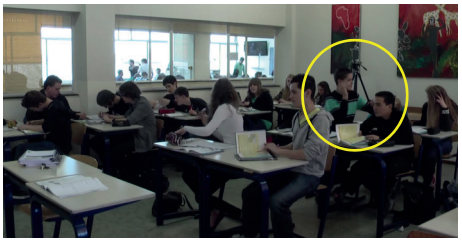
Experts comprised 35 experienced teachers from six secondary schools in the Netherlands (M_{age}= 49.2, *SD* = 10.3). They had a minimum of seven years of teaching experience, were recognized as successful classroom managers by teachers in their school, and were recommended by their school director as experts in the teaching profession (Palmer et al., 2005). Novices comprised 32 pre-service teachers from a Dutch teacher training program (M_{age}= 20.6, *SD* = 2.3), and were in either the first or second year of teacher training, and had between 10 to 40 hours of classroom teaching experience, respectively. Due to issues of data quality and missing data, the data of two experts were excluded from analysis, thus a total of 65 verbalizations were analyzed in this study.

2.2 Materials

Lesson fragment videos from actual classroom lessons (lasting 2-4 minutes) were selected by independent teacher trainers using criteria defining two different types of classroom scenarios. One type of video can be characterized as *Fuzzy Event* videos,

which displayed multiple, unrelated classroom events which were relatively independent of one another (i.e. subtle, unrelated problems co-occurring across the classroom). Another type of video can be characterized as *Striking Event* videos, which displayed a blatant classroom disturbance together with multiple classroom events related to the disturbance (i.e. interconnected, escalating problems). Fuzzy Event videos depicted disengaged, inattentive pupils but, unlike Striking Event videos, lacked an overt problematic disturbance. Two Fuzzy Event videos were shown first, each presenting a different class taught by a different teacher. These were followed by two Striking Event videos, each showing a lesson fragment from the same two classes at a later point in time. While all videos displayed pupils that were daydreaming, ignoring the teachers' instruction, or engaging in alternate conversations and activities, only the Striking Event videos included highly perturbed events. For example, pupils throwing bits of paper across the classroom, persistently waving and signing to friends in the hallway, and actively distracting fellow pupils during the lesson. See Figure 1 for a visual overview of the differences between Fuzzy and Striking Event videos.

↑ Fuzzy Event videos depicting off-task students in two different classes ↑



↑ Striking Event video depicting a student throwing wads of paper across the classroom

↑ Striking Event video depicting two centrally located students disrupting the surrounding students

Figure 1. Four still shots from two different types of problematic classroom events: Fuzzy Events and Striking Events. Fuzzy Event videos showed disengaged students but lacked overt disturbances. Striking Event videos show disengaged and distracted students and included a highly noticeable, blatant disruption effecting the class.

2.3 Procedure

The experiment took about 50 minutes. After completing demographic questionnaires and signing consent and release forms, participants were familiarized with the think aloud method (Ericsson & Simon, 1980). Participants were then told that they would be viewing different classroom situations and should imagine themselves as teachers in these situations. They were asked to provide post hoc think aloud verbalizations about any relevant thoughts they had about the classroom management. Participants' eye movements were tracked as they simultaneously expressed their thoughts about the problematic classroom situations they were viewing.

Participants viewed each video twice. The first presentation of the classroom videos familiarized participants with the content, as they were unfamiliar with the classroom, lesson, teacher, and students appearing in the video. Immediately after, the lesson fragment was presented a second time and participants were asked to share all thoughts that came to mind about the classroom situations and their relevance to classroom management. Participants received the prompt "We will play the video a second time. While the video is playing, please think aloud and express what you were thinking when you saw the video for the first time." During lapses in verbalizing their thoughts, participants were prompted to continue with questions such as "Do you have anything more you'd like to say?" or "Is there anything you'd like to add?", and they were allowed to express their thoughts for as long as they liked, even after the video had stopped. To replicate the time constraints of real-world classroom monitoring, the videos were played at normal speed and participants were not allowed to stop or slow the video.

2.4 Data Analysis

It is important to note that eye tracking data was collected simultaneously with the verbal data. The data concentrating on the eye movement measures and the visual processing of problematic classroom situations are reported elsewhere in a separate study (see Chapter 3). The present study concentrates on the verbal data and the cognitive processing involved in perceiving, interpreting, and articulating thoughts about classroom management in relation to the classroom situations.

Our analysis strategy breaks the perceptual and interpretive processing of classroom management events into several stages, in line with the hypotheses presented in the research questions listed above. The first stage analyzed teachers' perceptions and interpretations and involved identifying differences in what experts and novices noticed in the classroom videos. The second stage analyzed teachers' topical focus and identified how experts and novices combine visual information and knowledge to interpret particular aspects of the events they noticed. The third stage traced teachers' interpretations in terms of the timescale used to describe and connect events over time. The

fourth stage considered what experts and novices perceived, interpreted, and integrated within different situations, capturing how qualities of their cognitive processing differed. The fifth stage analyzed how teachers inter-relate events as interactions between and among students and between the teacher and students.

Participants' think aloud protocol were transcribed verbatim and coded using a validated coding scheme developed for identifying expert-novice differences concerning representations of classroom management events. Chapter 2 should be consulted for a thorough description of the coding scheme, its development, and the application of codes. The coding was conducted using the mixed methods data analysis program Dedoose (version 6.1.11; www.dedoose.com). The protocol was coded in a two-step process: first idea units, which represented complete thoughts centering around one clear idea, were identified. These were then coded for the 1) type of perception or interpretation, 2) thematic focus of the statement, 3) the timescale expressed in the statement, and 4) and relations mentioned between actors. Thereafter the whole utterance (rather than separate line-by-line idea units) was coded to qualify the cognitive processing expressed overall. In this study, Perception & Interpretation Codes address Hypothesis 1 (cf. Category 1 of original coding scheme); Theme & Focus Codes address Hypothesis 2 (cf. Category 2 of original coding scheme); Temporality Codes address Hypothesis 3 (cf. Category 3 of original coding scheme); and Cumulative Cognitive Processing Codes address Hypothesis 4 (cf. Category 4 of original coding scheme. Relational Codes refer to new codes that are not aligned with any of the original coding categories and address Hypothesis 5. See Figure 2 for descriptions and definitions of the modified supplementary codes.

Differences in the design of the current study as compared to that in which the original coding scheme was developed made an adaptation of the coding scheme necessary. First, the type of the video material differed: the current study presented longer episodes of classroom situations, with subtle, 'fuzzy', unrelated events as well as overtly problematic events. Second, the type of verbal reporting differed: in the current study participants were asked to think aloud about situations being viewed twice consecutively, rather than recall specific classroom scenes viewed earlier in the day. Furthermore, differences found in the perceptual attention of experts and novices (via eye tracking) were incorporated into the coding scheme to identify additional points of divergence in teachers' event processing. For example, experts monitored more areas showing students' bodies and movements, motivating the addition of the Theme and Focus code 'student posture/movements: noteworthy'. Experts also monitored more areas showing interactions between individual students and groups of students, motivating the creation of the Relational Codes category. This category offered a means of determining whether or not significant differences in teachers' visual perception would also appear as significant in their verbal interpretations.

	Code Label	Code Definition
Relational Codes	*Affect*	Making observations about the emotions, feelings, or moods of actors in the video [expressed through facial, vocal, or other visible gestures]
	Relation between Actors a. Student & Student b. Teacher & Student(s) c. Student(s) & Group of Students	Specifying a relationship between actors within the scope of an event (which may be ongoing) a. relation between two particular students b. relation between the teacher and a student or group of students c. relation between a student or students and other students, which may include the whole class
Perception & Interpretation Codes	*Sub-codes for Explanation or Reasoning* a. Quality of Instruction b. Lesson Structure or Classroom Climate	a. Comments evaluating the instructional and pedagogical choices of the teacher, often in relation to students, and how appropriate or not these choices are. b. Comments conveying thoughts about the organization or of the lesson structure, flow and pacing of the class, or conditions within the classroom environment overall
Theme & Focus Codes	*Student posture/movements: noteworthy*	Student posture or bodily movements explicitly or implicitly described as unusual or noteworthy [how a student is sitting, oriented, or their bearing, such as falling asleep in class]
	Teacher: Actions taken	Statements simply referencing what the teacher is saying or doing
Temporality Codes	*Continuation*	Specifies events (and actors) with duration: for example, recurring events that are continuing currently or will continue further into the future, or which span across past, current, and present timescales
Cumulative Cognitive Processing Codes	*Highly integrated perspective*	Reports on what is seen, heard, or understood to be happening expressing an interrelated perception of events, accounting for multiple concerns of relevance to classroom management, relating teacher and student interactions, conveying a progressing awareness of how classroom factors interrelate with one another, and expressing a clear goal related to principles of teaching and learning
	Semi-integrated perspective	Reports on what is seen, heard, or understood to be happening expressing an interrelated perception of events, accounting for multiple concerns of relevance to classroom management, and relating teacher and student interactions
	Non-integrated perspective	Reports on what is seen, heard, or understood to be happening focusing on a single aspect relevant to classroom management [Note: even if multiple events or students are referred to, they are isolated if no connections are described and the protocol overlooks the complexity of interactions]

Figure 2. Supplementary codes added adapted from the original coding scheme developed by Wolff et al., (2015).
Note. The column on the left denotes the coding category in which the codes appear. Full codes are denoted by boldface and sub-codes are preceded by a letter.

The consecutive viewing made it possible for participants to both remember and interpret what they saw in the first viewing. Hence, a new coding category for Relational Codes was developed. These captured any relations that participants mentioned between specific actors in the videos (i.e., the students and the teacher) and track the kinds of inter-actor relations drawn via specific sub-codes, and also note any affective information conveyed in teachers' verbalizations (see Relational Codes in Figure 2 above).

Modifications made to the Perception and Interpretation Codes were minor. Two sub-codes for the 'Explanation or Reasoning' code were added after open coding to detect whether or not there were specific expertise differences in explanations and reasoning about 1) the quality of the instruction and 2) the structure and classroom climate of the lesson. Two new codes were added to Theme and Focus Codes. One code was created based on analysis of teachers' eye movements when viewing the videos, as experts devoted significantly more fixations to areas showing students' posture and bodily movements: the 'student posture/movements: noteworthy' code. A second code denoting 'teacher: actions taken' emerged from a round of open coding to capture statements describing strictly what a teacher had done or said. Concerning Temporality Codes, the code 'continuation' was added to capture teachers' use of timescales suggesting ongoing events rather than referencing simply what preceded or followed, and better reflected the temporal continuity participants expressed during repeated viewings. A final modification addressed Cumulative Cognitive Processing Codes. Originally, participants' perspectives were evaluated as either integrated or non-integrated. In this study, however, a multi-layered distinction was made to assess whether participants' verbalizations offered 'highly integrated', 'semi-integrated' or 'non-integrated' perspectives (see definitions above in Figure 2).

Interrater Agreement. A series of interrater reliability tests comprising o 10% of all verbal data were conducted in Dedoose (version 6.1.17) to determine the level of interrater agreement between two independent coders. Pooled Cohen's κ was used to summarize the reliability across all coding categories (De Vries, Elliott, Kanouse, & Teleki, 2008). The mean Pooled Cohen's κ was 0.87 and the scores for the individual tests ranged between 0.84 and 0.90, indicating excellent agreement between both coders (Viera & Garrett, 2005).

3. RESULTS

Statistical analysis of the qualitative coding results were conducted with a mixed design analysis of variance (Mixed ANOVA). The frequency of code occurrences were quantified automatically within Dedoose and imported into SPSS (version 22) for analysis. Post hoc ANOVAs were conducted on all dependent variables to determine significance amongst specific does. In some cases the homogeneity of variance assumption

(Levene's Test) was violated, therefore we applied a more conservative, critical level of .02 in lieu of the conventional .05 level for determining significance for these variables in the univariate *F*-test (Tabachnick & Fidell, 2007).

3.1 Perceptions and Interpretations (Hypothesis 1)

There was a significant interaction between Perceptual/Interpretive Codes and expertise for both video types: $F(3.72, 234.62) = 10.05$, $p < .001$, $\eta^2 = .138$ (Fuzzy Events) and $F(2.55, 160.84) = 18.26$, $p < .001$, $\eta^2 = .225$ (Striking Events), indicating that experts and novices verbalizations' differed in terms of how they expressed their perceptions or interpretations of what they perceived depending on the type of video. There was also a significant main effect for expertise: $F(1, 63)= 24.30$, $p < .001$, $\eta^2 = .278$ for Fuzzy Event and $F(1, 63)=41.23$, $p < .001$, $\eta^2 = .396$ for Striking Events.

Post hoc ANOVAs showed significant differences for several codes across both Fuzzy and Striking Event videos: novices provided significantly more visual descriptions than experts, Fuzzy: $F(1, 63)= 5.61$, $p = .021$, $\eta^2 = .082$; Striking: $F(1,63) = 6.50$, $p = .013$, $\eta^2 = .094$, confirming Hypothesis 1a. In contrast, experts made more interpretative statements than novices, confirming Hypothesis 1b. Specifically, experts made more inferences about students, Fuzzy: $F(1, 63)= 7.33$, $p = .009$, $\eta^2 = .104$; Striking: $F(1,63) = 30.14$, $p < .001$, $\eta^2 = .324$; and more inferences about the teacher, Fuzzy: $F(1, 63)= 6.20$, $p = .015$, $\eta^2 = .090$; Striking: $F(1,63) = 9.83$, $p = .003$, $\eta^2 = .135$. Experts also provided more explanation and reasoning interpretations, Fuzzy: $F(1,63) = 29.18$, $p < .001$, $\eta^2 = .317$; Striking: $F(1,63) = 44.23$, $p < .001$, $\eta^2 = .412$; specific sub-codes for explanation/reasoning showed they made more interpretations about lesson structure and classroom climate, Fuzzy: $F(1,63) = 5.16$, $p = .027$, $\eta^2 = .076$; Striking: $F(1,63) = 19.49$, $p < .001$, $\eta^2 = .236$, and also about the quality of teaching they observed, Fuzzy: $F(1,63) = 15.74$, $p < .001$, $\eta^2 = .200$; Striking: $F(1,63) = 27.93$, $p < .001$, $\eta^2 = .307$. Experts also made more statements specifying missing information which would help them interpret further, Fuzzy: $F(1,63) = 5.05$, $p = .028$, $\eta^2 = .074$; Striking: $F(1,63) = 5.16$, $p = .026$, $\eta^2 = .076$. A notable difference between Fuzzy Event and Striking Event videos is that experts provided more explications of consequences for classroom management only in Fuzzy Event videos, $F(1, 63)= 11.07$, $p = .001$, $\eta^2 = .149$, whereas in Striking Event videos they provided more explications about behavioral consequences, $F(1,63) = 6.89$, $p = .011$, $\eta^2 = .099$. Thus, experts also analyzed and explained the consequences of events on either classroom management or behavior more than novices, depending on the type of problematic event they were viewing.

3.2 Theme and focus of statements (Hypothesis 2)

There was a significant interaction between Theme and Focus Codes and expertise for both video types. $F(8.20, 516.43)=5.62$, $p < .001$, $\eta^2 = .082$ (Fuzzy Events) and $F(6.90,$

434.88)=8.22, p < .001, η^2 = .115 (Striking Events), indicating that experts and novices focused on different themes that were relevant to classroom management irrespective of the type of problematic situation they viewed. There was also a significant main effect for expertise in both video types: $F(1, 63)=14.21$, p < .001, η^2 = .184 (Fuzzy) and $F(1, 63)=9.60$, p < .001, η^2 = .132 (Striking). Subsequent ANOVA analysis of specific codes within the Focus category showed a pattern of significant differences that held across both types of videos. Experts provided more statements referencing student learning, Fuzzy: $F(1, 63)= 55.31$, $p < .001$, η^2 = .468; Striking: $F(1,63) = 22.79$, p < .001, η^2 = .266, confirming Hypothesis 2a. Experts also focused more on: the type of situation, Fuzzy: $F(1, 63)= 17.79$, $p < .001$, η^2 = .220; Striking: $F(1,63) = 12.87$, p = .001, η^2 = .170; the role and influence of the teacher on classroom events, Fuzzy: $F(1, 63)= 16.13$, $p < .001$, η^2 = .204; Striking: F(1,63) = 47.38, p < .001, η^2 = .429; and they provided more contextualized commentary, Fuzzy: $F(1, 63)= 10.27$, $p = .002$, η^2 = .140; Striking: $F(1,63) = 26.73$, p < .001, η^2 = .298. Novices provided more statements focused on student discipline, Fuzzy: $F(1, 63)= 14.33$, $p < .001$, η^2 = .185; Striking: $F(1,63) = 19.49$, p < .001, η^2 = .236, confirming Hypothesis 2b.

3.3 Timescales expressed (Hypothesis 3)

There was a significant interaction between Temporal Codes and expertise for both video types. $F(1.98, 124.47)=6.91$, p < .001, η^2 = .099 (Fuzzy Events) and $F(1.41, 88.82)=6.27$, p = .01, η^2 = .091 (Striking Events), indicating that experts and novices differed in the way they referenced the timescales of events. There was also a significant main effect of expertise per type of video viewed: $F(1, 63)=13.78$, p < .001, η^2 = .179 (Fuzzy) and $F(1, 63)=13.59$, p < .001, η^2 = .177 (Striking). ANOVAs conducted on individual temporal codes showed that experts referenced more retrospective actors and events, $F(1, 63)= 11.40$, $p = .001$, η^2 = .153 only in Fuzzy Event videos, not in Striking Event videos. However, experts referenced more continual timescales between actors in events in both types of videos, Fuzzy: $F(1, 63)= 28.53$, $p < .001$, η^2 = .312; Striking: $F(1,63) = 39.23$, p < .001, η^2 = .384, confirming Hypothesis 3a . We predicted that novices would make significantly more contemporaneous references when describing classroom events, but the this was not the case, disconfirming Hypothesis 3b.

3.4 Cumulative cognitive processing (Hypothesis 4)

There was a significant interaction between Cumulative Cognitive Processing Codes and expertise for both video types. $F(5.53, 262.20)=23.83$, p < .001, η^2 = .274 (Fuzzy Events) and $F(4.56, 287.51)=24.92$, p < .001, η^2 = .283 (Striking Events). There was no significant main effect for expertise with Fuzzy Event videos, $F(1, 63)=3.08$, p = .084, η^2 = .047, but Striking Event videos did show a main effect for expertise, $F(1, 63)=10.58$, p = .002, η^2 = .144.

ANOVAs conducted on each cognitive processing code showed more specifically how expert and novice teachers differed in their thinking about the problematic situations presented in the videos and confirmed Hypothesis 4a and 4b. For Fuzzy Event videos, cognitive processing codes showed that novices described events more from a single viewpoint, $F(1, 63)= 57.14$, $p < .001$, $\eta^2 = .476$, expressed a non-integrated perspective of events, $F(1, 63)= 26.48$, $p < .001$, $\eta^2 = .296$, were more uncertain about what they were describing, $F(1, 63)= 5.97$, $p = .017$, and lacked continuity in their description of events, $F(1, 63)= 20.34$, $p < .001$, $\eta^2 = .244$. Experts, on the other hand, more often expressed multiple viewpoints, $F(1, 63)= 27.30$, $p < .001$, $\eta^2 = .302$, offered highly integrated perspectives, $F(1, 63)= 49.13$, $p < .001$, $\eta^2 = .438$, and expressed more certainty, $F(1, 63)= 4.57$, $p = .036$, $\eta^2 = .068$, and temporal continuity, $F(1, 63)= 4.57$, $p = .036$, $\eta^2 = .068$.

A similar pattern emerged in Striking Event videos, with several exceptions. Again, novices had more single viewpoint descriptions, $F(1,63) = 70.42$, $p < .001$, $\eta^2 = .528$, expressed more non-integrated perspectives than experts, $F(1,63) = 10.66$, $p = .002$, $\eta^2 = .145$, and expressed a lack of temporal continuity, $F(1,63) = 21.88$, $p < .001$, $\eta^2 = .258$. Contrary to Fuzzy Event videos, however, they also expressed more semi-integrated perspectives than experts, $F(1,63) = 11.02$, $p = .002$, $\eta^2 = .149$. There was no significant difference in terms of how certain or uncertain they were about the thoughts expressed. Experts again expressed more multiple viewpoints, $F(1,63) = 28.74$, $p < .001$, $\eta^2 = .313$, and provided more highly integrated perspectives, $F(1,63) = 30.31$, $p < .001$, $\eta^2 = .325$, but differences in certainty and temporal continuity expressed were not significant.

3.5 Relational Codes (Hypothesis 5)

There was a significant interaction between Relational Codes and expertise for both video types. $F(2.36, 195.82)=3.01$, $p = .04$, $\eta^2 = .046$ (Fuzzy Events) and $F(2.90, 182.98)=5.90$, $p = .001$, $\eta^2 = .086$ (Striking Events). There was also a significant main effect for expertise for Relational codes: $F(1, 63)=16.86$, $p < .001$, $\eta^2 = .211$(Fuzzy) and $F(1, 63)=37.75$, $p < .001$, $\eta^2 = .375$ (Striking). Thus, Hypothesis 5 was confirmed.

Separate ANOVAs on the dependent variables revealed significant differences for the following codes: 'Relations between actors', Fuzzy: $F(1, 63)= 8.4$, $p = .005$, $\eta^2 = .119$; Striking: $F(1,63) = 41.98$, $p < .001$, $\eta^2 = .400$. This was also true for nearly all sub-codes concerning the kinds of relations expressed: 'Student-to-student' relations, Fuzzy: $F(1, 63)= 9.55$, $p = .003$, $\eta^2 = .132$, but the difference was not significant for Striking Event videos; 'Student-to-group' relations, Fuzzy: $F(1, 63)= 7.91$, $p = .007$, $\eta^2 = .112$; Striking: $F(1,63) = 3.32$, $p = .009$, $\eta^2 = .105$; and 'Teacher-to-student' relations, Fuzzy: $F(1, 63)= 15.07$, $p = .001$, $\eta^2 = .193$; Striking: $F(1,63) = 7.37$, $p < .001$, $\eta^2 = .219$. The code for 'Affect' was not significant in Fuzzy Event videos, but showed significance for Striking Event videos, $F(1,63) = 4.65$, $p = .035$, $\eta^2 = .069$. In all videos experts expressed more relations between actors, especially between students and groups of students and between the teacher and students, but only Fuzzy Event videos showed a significant difference in

referencing relations between student-to-student, and only Striking Event videos showed a significant difference related to affect.

See Figure 3 below for an overview of significant main effects for coding categories and significant differences for specific codes per category.

Item of Statistical Significance in Videos Showing Problematic Classroom Events		Problematic situations showing Fuzzy Events	Problematic situations showing Striking Events
1)Perceptions and interpretations:			
Main effects for expertise		$p < .001$	$p < .001$
• Visual descriptions	N > E	$p = .021$	$p = .013$
• Inference about students	E > N	$p = .009$	$p < .001$
• Inference about teacher	E > N	$p = .015$	$p = .003$
• Explanation and reasoning	E > N	$p < .001$	$p < .001$
- about lesson structure and class climate		- $p = .027$	- $p < .001$
- about quality of teaching		- $p < .001$	- $p < .001$
• Explication: Classroom management	E > N	$p = .001$	*ns*
• Explication: Classroom behavior	E > N	*ns*	$p = .011$
• Specifying missing information	E > N	$p = .028$	$p = .026$
2)Theme and focus of statements:			
Main effects for expertise		$p < .001$	$p < .001$
• student learning	E > N	$p < .001$	$p < .001$
• student discipline	N > E	$p < .001$	$p < .001$
• type of situation	E > N	$p < .001$	$p = .001$
• contextualized suggestion/comment	E > N	$p < .001$	$p < .001$
• teacher influence	E > N	$p < .001$	$p < .001$
3) T*emporality expressed in statements*:			
Main effects for expertise		$p < .001$	$p < .001$
• continual	E > N	$p < .001$	$p < .001$
• retrospection	E > N	$p = .001$	*ns*
4) C*umulative cognitive processing*:			
Main effects for expertise		*ns*	$p = .002$
• single viewpoint	N > E	$p < .001$	$p < .001$
• multiple viewpoints	E > N	$p < .001$	$p < .001$
• highly integrated perspective	E > N	$p < .001$	$p < .001$
• semi-integrated perspective	N > E	*ns*	$p = .002$
• non-integrated perspective	N > E	$p < .001$	$p = .002$
• certainty	E > N	$p = .036$	*ns*
• uncertainty	N > E	$p = .017$	*ns*
• continuity	E > N	$p = .036$	*ns*
• non-continuity	N > E	$p < .001$	$p < .001$

Item of Statistical Significance in Videos Showing Problematic Classroom Events		Problematic situations showing Fuzzy Events	Problematic situations showing Striking Events
5) Relational codes:			
Main effects for expertise		$p < .001$	$p < .001$
• Relation between actors	E > N	$p = .005$	$p < .001$
• Student to student	E > N	$p = .003$	*ns*
• Student(s) to Group or Class	E > N	$p = .007$	$p = .009$
• Teacher to Student(s)	E > N	$p = .001$	$p < .001$
• Affect	E > N	*ns*	$p = .035$

Figure 3. Summary of the significant effects, shown as *p*-values, for classroom situations displaying Fuzzy and Striking problematic classroom events.
Note: E= expert group and N = novice group; '*ns*' denotes variables that were non-significant

4. DISCUSSION

This study investigated expertise differences in teachers' perceptions and interpretations of authentic problematic classroom events. The guiding research question was: How do expert and novice teachers process different types of problematic classroom events? A number of differences were identified to answer this question, particularly in the way experts and novices perceived, interpreted and explained the problematic situations with which they were presented. Similar to the presentation of results, our findings are discussed in relation to the hypotheses to which they correspond.

4.1 Perceptions and Interpretations

The Perceptions and Interpretation category showed a significant main effect for expertise and a significant interaction between codes and video type, indicating expert-novice differences in verbalizing what was perceived versus interpreting what was perceived. In both Fuzzy and Striking Event videos, novices expressed significantly more visual perceptions than novices, generally describing what they saw happening in a play-by-play manner without any additional interpretation. Experts offered significantly more interpretations expressed as: inferences about students, inferences about the teacher, and explanatory and/or reasoning statements. Sub-codes showed that in terms of their explanatory/reasoning statements, experts also had significantly more thoughts about lesson structure and classroom climate and also about the quality of the teaching they saw. This pattern was maintained irrespective of the type of video shown. However, some additional differences were isolated to the type of video shown: with Fuzzy Event videos experts offered significantly more explications of classroom management; with Striking Event videos they offered significantly more explications of classroom behavior.

Thus, Hypotheses 1a and 1b were both confirmed and additional interpretative differences were identified.

Clark and Peterson (1984) have suggested that expert teachers' elaborate knowledge structures are what allows them to meaningfully interpret classroom events, and that understanding experts' knowledge systems can provide a framework for distinguishing relevant cues for classroom event processing. Our findings imply that several kinds of cues are highly applicable to making sense of problematic events: contemplating (inferring) what students and teachers are thinking or feeling, noticing the kind and quality of instruction taking place, and considering a situation in terms of when it happens in the overall lesson structure and within the overall climate of the classroom. When the classroom problems were fuzzy, experts explicated consequences for classroom management and how situations might intensify and develop, but when the problems were strikingly obvious, they explicated behavioral consequences, addressing consequences of disruptive behavior directly. Experts, also described what they saw or heard in the classroom, but more often they transformed such sensory perceptions into interpretations relating to larger classroom concerns oriented around the teacher and students. These findings provide evidence that novices' limited experience and knowledge of classroom events impedes their ability to quickly process their perception of classroom events and convert them into more specific interpretations of the events and actors contributing to the situation. It could be useful for novices to learn to recognize and reflect upon problematic situations as smaller pieces in a larger puzzle of classroom management: the events and actors perceived are not meaningful in isolation, they are elements in a larger system intended to nurture and support learning, and are made meaningful when linked to the classroom system as a whole.

4.2 Themes and Focus

This coding category also showed significant main effects for expertise and a significant interaction between codes and video type, and confirmed that (a) experts expressed significantly more thoughts on the theme of student learning and that (b) novices expressed more thoughts about student discipline and classroom rules. This finding was maintained across both Fuzzy and Striking Event videos, suggesting that regardless of the type of problematic situation, student learning represents the core of experts' thinking about classroom management, and student behavior (or rather, misbehavior) is at the core of novices' thinking about classroom management. For experts, student learning represents the big picture, the purpose behind the skill of effective classroom management. Student behavior is but one element of the situation, a manifestation of a larger problem within the management system. For experts, the sorrow and pity of problematic situations is not actually the "bad" behavior appearing in the classroom, it is the disappearance or absence of learning in the classroom.

While it is undeniable that the demands of the classroom – such as the multidimensional, simultaneous, immediate nature of events – make it challenging for novices to make sense of what they perceive, it is important that classroom management goals remain connected to maintaining student learning and sustaining the learning environment (Doyle, 2006). Additional elements which experts focused on significantly more than novices included: the type of situation observed, contextualized commentary or suggestions related to the situation, and the teachers' role and influence on the situation. This pattern was found in both Fuzzy and Striking Event videos, suggesting that recognizing the typicality of an event within a situation may be necessary for responding to classroom events before they escalate from bad to worse, and that considering a situation in terms of its specific context is necessary to understand what is happening on a more profound level. Furthermore, the teacher, for experts at least, seems to both a cause and a solution to problematic situations. Experts emphasized different ways in which the teacher contributed to what made the lesson problematic: sometimes they were unclear in their instructions or expectations, sometimes they tolerated or ignored far too much off-task behavior or intervened after it was too late, or sometimes they were simply unprepared and failed to convey a sense of purpose and learning. At the same time, experts elaborated on how the teacher possesses power and agency to convert problematic situations into something more educative.

4.3 Timescale of Events

Once again, significant main effects for expertise and significant interactions between codes and the type of video were found. In both Fuzzy and Striking Event videos, experts referenced timescales conveying the ongoing continuation amongst events and actors, as predicted in Hypothesis 3a. With videos showing fuzzy events, they made significantly more references to preceding events. However, contrary to what was predicted in Hypothesis 3b, novices did not make more references to what was currently happening in the video they were viewing, and there was no significant difference in temporal continuity when classroom events were striking (cf. Chapter 2). We attribute novices' ability to track and reference preceding and subsequent events and actors to the consecutive viewing of classroom videos. Showing a situation twice in a row seems to support novices' ability to link perceptual information about what happened, to what was currently happening, and to what was going to happen as they thought about the classroom situations. While the repetition of the video situations did not allow them adequate time to think deeply beyond what they perceived, repeated viewing did aid them in creating a temporal chain of evolving events. This was the case when coding thought units. Coding of the whole utterance, however, showed that temporal aspects of novices' cumulative cognitive processing showed a significant lack of continuity across both types of problematic situations.

4.4 Cumulative Cognitive Processing

Both types of videos showed a significant interaction between expertise and video types, but only Striking Event videos showed a main effect for expertise. Nonetheless, strong patterns of specific cognitive processing codes were maintained in videos of both fuzzy and striking problematic events. In both video types, experts verbalized significantly more often using multiple points of view and expressed highly integrated perspectives, but there was only a significant difference in their certainty about their interpretation in Fuzzy Event videos. Contrastively, novices mainly used a single point of view, and expressed non-integrated perspectives in both types of video, however, only with Fuzzy Event videos did they express more uncertainty. Rather interestingly, with Striking Event videos they also expressed significantly more semi-integrated perspectives. Thus, Hypothesis 4a and 4b were both partially confirmed.

Sato et al., (1990) identified five defining features of the expert teacher thinking style: 1) efficient thinking-in-action (i.e., during a classroom situation, not after); 2) using multiple points of view and interactive perspectives; 3) being actively, deliberatively, and sensitively involved in a situation; 4) sustaining a tight relationship between content, cognition, and context; and 5) constructing and reconstructing thoughts framed in alignment with the teaching process. Our Cumulative Cognitive Processing and other findings reflect these features, yet they show that novices also exhibit features attributed to experts' thinking, namely their ability to integrate an interrelated perception of events and teacher and student interactions and to account for multiple concerns relevant to classroom management (primarily when the classroom situations are overtly perturbed and problematic). Again, this ability may be aided by the consecutive viewing design, allowing novices sufficient time to process their perceptions of events and connect them more directly to classroom interactions and management concerns. Seeing a situation unfold twice, in real time, may improve not only novices' awareness of what is happening in the classroom, but also their integration of events and actors.

4.5 Relational codes

These codes were created to account for differences not only in the quantity of interrelatedness noted by experts and novices, but also the kind of interactions considered pertinent to these interactions. Both Fuzzy and Striking Event videos showed a main effect for expertise and a significant interaction between codes and video type. Experts made more relations between actors irrespective of the type of events shown. Additional sub-codes specified that they noted significantly more student-to-group and teacher-to-student interactions in both video types, but student-to-student interactions were only significant in Fuzzy Event videos and the Affect sub-code was only significant for Striking Event videos.

These findings help clarify the relevance of classroom interactions to experts' interpretations of problematic classroom events, and offer important clues as to how experts maintain an integrated relationship between content, cognition, and context: by devoting thought and attention to the interactions unfolding in the classroom. In highly perturbed situations, they also presume the moods, feelings, and attitudes of the students. As described above, student learning is a core focal point in experts' interpretations of problematic events, and the teacher plays an important role in influencing the perpetuation or resolution of classroom problems. It is worth noting that the interactions of importance to experts are not only those between individual students or students and larger groups in the class; the interactions between the teacher and the students are also highly relevant. Speculatively, this may be an indication that expert teachers attribute classroom problems to the quality and effectiveness of teacher-student interactions, and that the affective disposition of the students is an important element when disruptive behavior is pronounced. In their conceptualization of classroom management, novice teachers can benefit from considering "the inseparable relationship between classroom management and instruction" and the way in which this influences students and their ability to learn (Woolfolk-Hoy & Weinstein, 2006, p.210), as experts seem to do.

4.6 Limitations

This research offers insight into classroom situations gone awry, but the emphasis on problematic situations overlooks differences that may exist when classroom management is functioning smoothly and students are engaged in learning. The findings are valid for situations with fuzzy and striking problems, but do not necessarily extend to other classroom situations. Similarly, the work forms shown in the videos makes our findings relevant for secondary level educational contexts employing direct teaching or pair-work, but whether or not teachers' perceptual and interpretative differences hold in other lesson formats is unclear. Cultural and interpersonal factors that may be particular to the Dutch educational system have not been accounted for, and it is unclear if our findings translate across different cultural settings (den Brok, Fisher, Wubbels, Brekelmans, & Rickards, 2006). Moreover, our findings have identified expert-novice differences when teachers are viewing situations of other teachers and students whom they do not know or teach. How perceptions and interpretations differ when reviewing one's own teaching practice, in familiar spaces with familiar faces, is worthy of consideration in the future, as this may alter the patterns we have identified in our study.

4.7 Conclusions

This research has confirmed the findings of previous research comparing expert and novice teachers' representations of classroom management events, emphasizing once

again that experts' concept of management is closely coupled with concerns about the learning taking places in the classroom while novices' concept is framed around (mis)behavior, disobedience, and discipline. Additionally, for experts, the teacher plays a decisive role in hindering or enhancing student learning, and the teacher is often interpreted as crucial factor, whether learning disruptions arise and recede subtly or escalate and become blatant problems (Hattie, 2012). Novices perceive students as key contributors to the problems which arise and escalate, and neglect the relevance of classroom interactions between students as well as between the teacher and students when considering classroom situations. Novices tell what they see, whereas experts extend their telling beyond what is seen, sharing their reasoning and explicating how and when problems emerge, foreseeing how situations are likely to play out, and how the context of the classroom and the choices of the teacher relate to the events constituting problems. When learning to teach, novices may benefit from exposure to experts' thinking, so that they might also begin to see management as a means to the important end goal of supporting learning, and so that they may begin to look past classroom problems and focus on the meaning of events in relation to the complexities of teaching and learning.

CHAPTER 5

Teachers' processing of classroom problems: A theoretical model for expert-novice interpretations of problematic situations and classroom management scripts

ABSTRACT

Experience in the classroom leads to differences in how teachers perceive and interpret events. It also impacts their decisions about when and how to act when problems arise. Dealing with the complexities of the classroom and the multiplicity of events, particularly those which are problematic, can be challenging for new teachers. Expert teachers have elaborate episodic knowledge of classrooms, and are better able to adaptively integrate their pedagogical knowledge of events, students, and classroom situations. Beginning teachers often miss relevant events and have difficulty predicting and preventing problems before they escalate. Research on classroom management often focuses on how to respond to common classroom problems, but lacks a theoretical model describing how teachers' knowledge and experience affects their perception and interpretation of problems. Such factors influence how teachers monitor problems and how they maintain an ongoing awareness of classroom situations. This study proposes a theoretical model for *classroom management scripts* that contrasts expert and novice teachers' awareness of problematic classroom situations. The proposed model offers a closer look at how teachers cognitively process classroom problems and how expertise influences teachers' professional vision. Classroom management scripts help clarify differences in the way expert and novice teachers recognize, represent, and respond to problematic situations. Such insights can be useful for enriching teachers' interpretations of problematic classroom events. These insights may also help prepare teachers to overcome problems so that they can devote their attention to the central purpose of classroom management, which is to facilitate and sustain learning in the classroom.

For anyone who has ever stood before a room full of students with the full weight and responsibility of managing and inspiring learning, the multi-layered complexity of teaching is apparent. In spite of extensive efforts from educational researchers and teacher educators – not to mention the rigorous efforts of teachers themselves – teacher training programs are frequently cited as falling short of preparing new teachers for the reality of the 21st century classroom (Berry, Daughtrey, & Wieder, 2010; Levin, 2003; Thematic Network on Teacher Education in Europe, 2000). A lack of understanding regarding what happens behind the scenes and within the heads of teachers is but one of many issues preventing teachers – those in training and those in development – from being fully prepared for the challenges of the classroom (Darling-Hammond, 2006). The context of where learning to teach happens – in classrooms – is an additional complicating factor, as teachers are confronted with the cognitive challenges of crowded, demanding environments within which they must acquire and develop professional knowledge and skills. Through experience in classrooms, teachers blend formal, professional knowledge with personal, practical knowledge, reinforcing the skills and practices necessary for effective performance in the classroom. Specific elements of this performance include: assessing classroom situations, deciding whether or not action needs to be taken, pursuing and action or sequence of actions, and metacognitive monitoring (Eraut, 2007). In essence, effectively managing classrooms relies on an ongoing awareness and monitoring of classroom events, recognizing who and what needs attention and what constitutes a problem (Doyle, 1990). Teachers new to the profession, novices, and those with highly attuned professional proficiency, experts, differ greatly in their knowledge of events in the classroom to achieve effective management, yet a model describing how this knowledge and cognition differs, particularly in problematic situations, is noticeably absent. In this article, we propose a theoretical model of classroom management scripts by contrasting expert and novice teachers' perceptions and awareness of problematic classroom situations. Such a model offers insight into how teachers cognitively process problems in the classroom, and how experience and expertise influences their professional vision and interpretations in the classroom.

Researchers have emphasized the importance of a more detailed understanding of the complex nature of teaching, and thus the complex nature of teachers' expertise (Berliner, 2004; Bromme, 2001; Hattie, 2012; Spalding et al., 2011; Tsui, 2003). Methods and approaches to measuring and describing relative differences between experts and novices have proved useful in this regard (Voss, Fincher-Kiefer, Green, & Post, 1986). As research builds upon this foundation and extends its implications, it is useful to review what is known about teacher expertise differences, and especially to consider ways in which they can develop and improve our theoretical explanations of how the processing and professional vision of expert and novice teachers differs. Currently, a model for knowledge organization for representing classroom problems and the simultaneous perception and interpretation of problematic situations is noticeably absent from the literature.

Despite many paradigmatic differences and lack of general consensus as to who and what an expert teacher is, which knowledge is essential for 'good' teaching, and how teachers can be better prepared to develop into competent professionals, there is agreement on the point that teachers have an undeniable impact on student learning (Darling-Hammond, 2006; Hattie, 2012; Stigler & Hiebert, 2009). Identifying expert teachers has not followed a consistent line of selection criteria, although the concept of 'expert teacher' has spread far and wide (Palmer et al., 2005). Issues of concern include: a definition for teacher expertise, insight into the factors which contribute to or inhibit expertise development, inconsistencies in terminology and characterizations within existing research, and inherent challenges to measuring teacher expertise that go beyond measures of student learning gains (Bromme, 2001). Understanding differences between novice and expert teachers in terms how they perceive and achieve well-managed classrooms, can offer important insights into how teachers organize their knowledge and apply their professional vision to classroom situations.

Classroom management and teacher expertise

When we speak of c*lassroom management,* we are referring to the actions teachers take to create, facilitate, and maintain an effective learning environment. As a system centered around supporting student learning, it relies to a large extent on perceptive teaching that prevents problems in the classroom, and to a lesser extent on disciplinary actions addressing student behavior that is disruptive to the management system (Brophy, 2006). Practically speaking, the main goal of classroom management is to optimize classroom learning, and a secondary purpose is minimizing actions and events that are disruptive to learning. Thus, successful teaching and learning depend on successful management: the content being taught and the means through which content is conveyed depend upon the pedagogical choices and practices of the teacher as well as the teachers ability to perform 'good teaching' (Brophy, 1999; Doyle, 1990; Fenstermacher & Richardson, 2005).

Classroom management also depends on a teachers' knowledge of classroom phenomena – the dynamic interactions arising in classrooms – and an ability to discern which classroom cues and events are relevant, which require attention, and which do not (Berliner, 1988; Emmer & Stough, 2001). Knowledge of classrooms and the events arising within classrooms can be considered essential pedagogical and professional knowledge for classroom management, and experts and novices differ in this regard. When commenting on classroom events, expert teachers assign meaning to classroom events, and their perceptions are more analytical and comprehensive; novices typically describe events in detail, but offer little evidence of deeper thought or analysis (Sabers et al., 1991). Expert teachers also tend to focus less on disruptive student behavior than novices, partially because they are able to prevent disruptions by recognizing behavioral and event cues early on and adjust their teaching activities accordingly (Westerman,

1991). Novices are less selective about the cues and events they attend to because they are still developing the mental strategies that would allow them to simplify the complexity of the classroom (Doyle, 1977). Differences in both the quality and depth of teachers' knowledge are linked to differences in how expert and novice teachers represent and process classroom management events (Wolff et al., 2015).

How experts and novices see and interpret the classroom

Teaching experience directly influences how classrooms are perceived and interpreted, including how teachers integrate and respond to the student interactions they observe (Behets, 1996; Hattie, 2003, 2012; Livingston & Borko, 1989; Sabers et al., 1991). Expert teachers have elaborate episodic knowledge of classrooms, are better able to adaptively integrate their pedagogical knowledge of types of events and students, and are more perceptive to the multidimensional complexity of classroom situations (Berliner, 2001; Doyle, 1990; Westerman, 1991). A well-noted difference between expert and novice teachers is the manner in which they interpret what occurs in classrooms, and how effectively they consciously deliberate and reflect upon classroom events (Bromme, 2001; Copeland et al., 1994; Tsui, 2003).

The *professional vision* of teachers – their skillfulness at observing, searching for, and making sense of classrooms – develops over time as they learn the visual practices particular to their profession (Goodwin, 1994; Sherin, 2001). Teachers' visual processing is an important element of the cognitive processing involved in understanding classroom events, and their professional vision guides how they notice and interpret classroom interactions, influencing the events teachers attend to, and how they process their perceptions into meaningful interpretations of what happens in classrooms (Colestock & Sherin, 2009).

Perception of the classroom requires recognizing what is important about a classroom scene, detecting and tracing connections between events and actors. Perception is a precondition for the ongoing cognitive processing that supports interpretation of classroom cues and events. *Interpretation* relates to how a teacher analyzes or makes sense of what is noticed, linking perceptions more broadly to goals of teaching and learning, and activating knowledge about the context of events in the classroom to reason about the situation (Van Es & Sherin, 2002). Experts' knowledge of classroom events plays a powerful role in interpreting situations. It affects: 1) how teachers recognize and devote attention to particular cues and events; what they identify as causal and contributing factors involved in an event; and how they relate this information to relevant issues of learning or classroom management. Interpretation guides on-going perceptual monitoring of new information to confirm or update understanding as events continue to unfold. Interpretations also advise teachers' thinking when they take time to reflect and reason about what happened in a particular situation and how it relates to their teaching practice. They inform deeper analyses about their actions and

students' interactions as they weigh and consider potential actions for future classroom situations, further enriching their knowledge.

Any given situation in the classroom affords a range of possible interpretations. A teacher must first recognize the importance of events, and then integrate their knowledge of events with their perceptions of the situation to holistically interpret the meaning of events in the context of the situation (Berliner, 1988). Information from the classroom environment combines with memories (knowledge) of previous classroom experiences for the teacher to develop a plausible interpretation, creating goals and expectations, and making projections about events that are likely to follow or that may require further observation. Although it has been established that experienced and inexperienced teachers differ in the ways they perceive and interpret classroom information, the kind of information that they perceive and find pertinent – and how this differs based on experience – remains a compelling research question (Carter, Cushing, Sabers, Stein, & Berliner, 1988; Doyle, 1990; van den Bogert et al., 2014). A theoretical model establishing a link between what teachers see in relation to how they interpret and represent classroom situations offers a valuable aid in answering questions about teachers' visual expertise, developmental differences between experienced and inexperienced teachers, and how such expertise may be improved through deliberate practice.

The role of experiential knowledge on classroom interpretations

Teachers' understanding of what happens in the class depends upon their representations of events and the relationships between events. *Representation* refers to the mental imagery, constructions, and interpretations of objects and events in the world (Hogan, Rabinowitz, & Craven, 2003). Teachers' knowledge of classroom problems, and the patterns inherent to the types of situations occurring within classroom scenes, are built up over time as teachers learn to recognize events and accumulate event knowledge. Over the long-term, they are organized and restructured through experience, changing as one gains knowledge about classroom events and acquires corresponding classroom management scripts. Teachers' *classroom management scripts* are mental representations consisting of a common sequence of actions or events necessary to achieving management goals in the classroom, including relevant actors, spatial locations, physical objects, and how these interact as events play out (Bromme, 2001; Zacks et al., 2007). These knowledge structures serve as a basis for interpreting classroom situations and deciding how to act and respond to problems; in other words, how to manage problematic situations. Scripts framed around classroom situations are important for perceiving and organizing visual information, thereby influencing perceptual attention and subsequent understanding and actions (Henderson, 2011; Leinhardt & Greeno, 1986). They develop through exposure to meaningful regularities across multiple experiences in the classroom. In terms of awareness, they drive the internal processing that feeds

cues about students' attention, behavior, and learning processes into teachers' interpretations (see Figure 1).

Expert teachers possess vast and elaborate scripts of the types of events associated with various classroom situations. These knowledge structures guide representations of pedagogy, students, subject matter, and the elements constituting an appropriate learning environment. This is what is meant by the *knowledge, conceptualizations, and experience in the classroom* mediating teachers representation of classroom problems (see Figure 1). For example, experts perceive classroom situations in terms of groups or areas of students rather than primarily focusing on individual students, whereas novices devote more time to individual students (van den Bogert et al., 2014). Experts are also more evaluative of classroom events, whereas novices are typically more descriptive: experts actively scan both teacher and student actions as they monitor classroom dynamics, while novices tend to perceive events from the teachers' point of view (Sabers et al., 1991). In their representation of classroom management events, the concept of student learning is central to experts, whereas novices emphasize behavioral concerns, generally actions of students as opposed to those of the teacher, focusing on issues related to discipline (Wolff et al., 2015).

While experts have the benefit of classroom management scripts to guide their problem representation and subsequent actions, novices cannot draw from such a deep well of organized knowledge. Instead, novices are engaged in a vital stage of knowledge accretion. In essence, they are building the knowledge structures that will serve to guide and inform their practice as they acquire expertise.

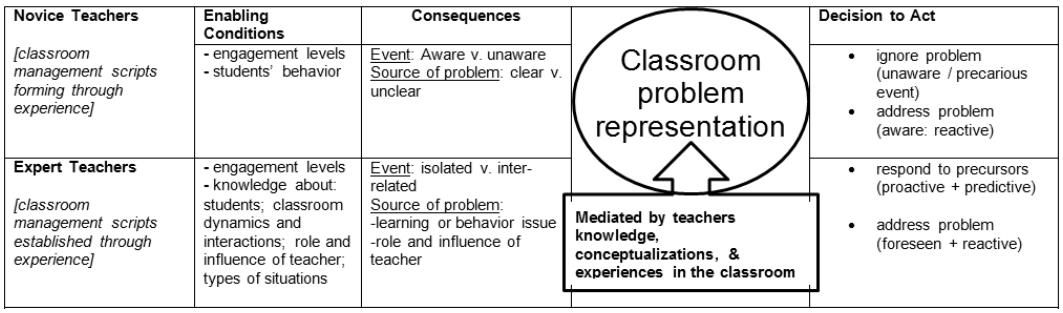


Figure 1. Activating classroom management scripts and deciding to act while interpreting problematic classroom situations

The classroom management scripts guiding expert teachers' responses to problematic classroom situations have several structural components. One component consists of *enabling conditions*, or the knowledge of conditions and constraints in which particular problems occur. Recognizing enabling conditions relies on merging external factors (the sensorial input from the classroom) with internal processing: the external combines with the internal to form an integrated awareness of the situation and what could or

should be done in response to it (cf. Boshuizen & Schmidt, 2008). Experts' enabling conditions have an expansive structure: they include student engagement levels and incorporate factors based on their knowledge of students, ample understanding of the dynamics of classroom interactions, the role and influence of the teacher on a situation, and the types of situation that frequently occur in classrooms. As shown in Figure 1, the structure of novices' enabling conditions is rather narrow in comparison to that of experts. To the extent that they are able to recognize enabling conditions, their recognition is tightly bound to their perception of student engagement levels and their focus on compliant, appropriate classroom behavior.

A second component consists of the pedagogical *consequences* of the problem: the signs and symptoms – or interactional cues and events – associated with the problem (cf. Boshuizen & Schmidt, 2008). Consequences account for having an awareness of a classroom problem and recognizing the interrelatedness between cues and events. For novices, this is connected to whether they recognize an event as relevant or not, as novices often miss cues and events that experts find meaningful and informative (Carter et al., 1988; Chi, 2006; Copeland et al., 1994; van den Bogert et al., 2014). The kinds of events that novices perceive focus more on student behavior, as the sources of classroom problems are often attributed to the students themselves, whereas experts consider the teacher as quite influential to the problems which arise (Tsui, 2009; Wolff et al., 2015). The degree to which the source of the problem is clear to novices affects their representation of the problem. For this reason, novices' identification of the source is relatively binary: either the source is clear or unclear, and, if it is clear, most likely it is linked in their minds to some behavioral digression of the students. Experts, however, focus more on concerns of student learning, and whether or not pedagogical goals are being attained, and their thinking about classroom events is more analytical and interpretative. For experts, an event may be interpreted as either occurring in isolation, disconnected from other events arising in the classroom, or as interrelated and interconnected with other events and interactions. When attributing a source to a classroom problem, they activate considerations related to both behavioral and learning concerns, factoring in the role and influence of the teacher on the context of the situation as they represent the problem (Wolff et al., 2015).

These components of enabling conditions and consequences converge to form the *classroom problem representation*, the understanding of what is actually at fault in the classroom situation. The problem representation is crucial to the ongoing situational assessment and decision-making, and drives the further structuring and re-structuring of teachers' interpretations. This, in turn, guides the recurring perceiving and interpreting that continues as the situation develops through time and space, moving forward. As opposed to the knowledge representations and scripts that build up over the long-term, the problem representation being constructed is more transient and short-term, and is frequently updated as a teacher detects and recognizes pertinent classroom information (see *problem representation* in Figure 1 and Figure 2).

More importantly for teaching practice, the problem representation directly relates to teachers *decision to act* in a given situation. The elaborate knowledge scripts of expert teachers make it possible for them to respond to classroom situations either in a predictive or reactive manner. A predictive response is based on the recognition of precursors to classroom situations before the situation has developed into a full-blown disruption demanding the full attention and resources of the teacher. Being predictive relies on the detection of nuanced, contextualized cues characterizing the early stages of an event, and rapid detection allows time to be proactive and preventing the escalation of a problem. A reactive response can take into account these precursors, but differs from a predictive response in that it involves reacting to a situation that has been recognized as fully problematic, as opposed to an event which is only potentially problematic. When experts address classroom problems the problems have been foreseen, and the decision to act is a reaction to this projected awareness. Unable to dip into the well of knowledge informing experts' representations and decisions, novices' decision to act is more limited. As explained above, novices' undeveloped store of integrated, relational knowledge linking situational cues and events means they miss information that experts account for, which constrains their ability to take predictive actions. Novices have either seen an event (likely an overt disruption) that demands their attention, or they are blissfully unaware of such an event. They may decide to ignore a problem, either because they are unaware that a problem exists, or because the situation is precarious, and managing or intervening with such a problem is too challenging. Alternatively, they may make the decision to address the problem and react to the situation, but are more likely to consider students as the source of the problem, rather than considering the role of the teacher and acknowledging pedagogical choices may be a contributing factor. When a problem is addressed, it is on a reactive basis, often once the problem has already escalated and disrupted the class.

Influence of classroom management scripts on withitness and situational awareness

A teacher's awareness of a classroom situation is a powerful cognitive tool for interpreting classroom events and managing classroom interactions. Kounin (1970) coined a term for describing teachers' ability to maintain and communicate an awareness of what is happening in the classroom at any given moment: *withitness*. Withitness underlines two important dimensions to teachers' classroom perception: 1) scanning and monitoring the classroom to perceive valuable informational cues for constructing an interpretation of what is happening (what the teacher sees) and 2) deciding to act in ways which conveys an astute understanding of unfolding events to the students (what the teacher does).

To look more closely at how teachers attain withitness, we turn to Endsley's (1995, 2006) theory of *Situational Awareness*, which provides a framework for unpacking the

knowledge processing that enables withitness in the classroom. Situational Awareness has been shown to play a crucial role in professional domains where there are multiple factors to attend to and monitor, particularly when these factors can change rapidly and interact together in complicated ways. There are three levels to situational awareness: 1) *perception*, which relies on the intake of environmental input; 2) *comprehension*, which requires that a person understand the meaning and relevance of the perceived information; and 3) *projection*, which is the ability to predict the dynamic implications of current events and anticipate future events. The quality of situational awareness has been shown to differ based on expertise. Novices typically become overloaded in their efforts to perceive information, understand its meaning, and respond appropriately. Moreover, their understanding of what is relevant and significant in a situation is often inefficient and error prone, mainly due to their lack of an experiential basis for interpreting professional situations and the limitations this imposes on their attention and working memory. Experts, however, have developed mental constructs for maintaining an effective awareness of a situation without the impediments characterizing novices. They have well-developed knowledge about relevant systemic aspects, which directs their perceptual attention more efficiently. Their experiential knowledge also supports the integration of different elements for interpreting the meaning of perceptual input, and this fuels the crucial capability of projecting future states of the situation.

The situational awareness involved in the perception and interpretation of classroom events requires integrating internal and external dimensions of the classroom. External factors are aspects of the classroom system outside the scope of the teachers' processing, i.e. the input from the classroom and school environment. It covers the full range of audial and visual input heard and seen in the classroom; input arising from the events occurring in the classroom. These are mainly concentrated on student interactions – what happens with a student or between students – but also includes student-to-teacher interactions, such as when students directly respond or communicate with the teacher and vice versa (cf. Chapter 3 and Chapter 4).

Toward a model of expertise differences in teachers' interpretations of classroom management problems

In our model, these external factors play a role in the second column, titled p*erception*, and the final column, titled *problem representation*: recognizing and mentally representing a classroom problem relies on the recognition and detection of relevant perceptual cues and events within the classroom. Recent research has demonstrated that experts' perceptual attention can be characterized as a focused, knowledge-driven search for classroom information, while novices' perceptual attention is more scattered and indiscriminate, characterized by image-driven processing (see Chapter 3). Novices' visual perceptions are directed across all potentially relevant information in the classroom, resulting in a scattered search for cues and events driven by visually salient fea-

tures of the classroom, and perceptions may lag and struggle to keep up with the flow of interactions. Experts' perceptions are engaged in a rapid, focused search for relevant cues and events driven by knowledge-based goals and expectations about the classroom that includes continual monitoring of specific areas of the classroom (see Chapter 3). The presence of knowledge driving perceptual processing highlights the internal factors influencing the external dimension of teachers' perception.

Figure 1 illustrates how classroom management scripts (knowledge), conceptualizations, and classroom experience impact the internal representation of problems in more detail. Internal factors comprise the cognitive processing of the teacher: how the teacher mentally perceives and interprets the range of informational cues and events arising from the classroom. Processing the classroom requires recognizing the situation for what it is, and this ability relies to a great extent on *classroom management scripts*, the knowledge structures that allow teachers to interpret the meaning of events and project these interpretations upon future states of the classroom situation. In Figure 2, below, internal factors play a role in all aspects of the model describing the influence of scripts on teachers' interpretations of problematic situations. Teachers' *knowledge organization* influences the *perception* and ensuing *situational awareness* of a teacher: how classroom events are perceived, comprehended, and projected as potential events. Increasing experience gradually leads to increasing efficiency in classroom monitoring, affecting the *mode of cognition* employed, the *problem representation*, and the successive perception of informative cues and events.

	Knowledge Organization	**Perception**	**Situational Awareness**	**Mode of Cognition**		**Problem representation**
Novices	Accumlating knowledge and classroom management scripts through experience (accretion)	Continual, image-driven scanning; lagging	Conscious monitoring of classroom activity and engagement in terms of student **behavior** - reactive	*Assessing the situation*	Prolonged analysis / delayed interpretation	•constrained detection and recognition, often missing relevant classroom information
		•scattered information search: image-driven		*Immediate decision making*	Deliberate/ naively intuitive	
Experts	Elaborate knowledge and classroom management scripts (aquired through experience)	Automatic scanning and monitoring of relevant patterns of cues and events; rapid	Efficient monitoring of classroom activity and engagement in terms of student **learning** - reactive + proactive	*Assessing the situation*	Pattern recognition / rapid interpretation	•Rapid detection and recognition of relevant classroom information
		•focused information search: knowledge-driven		*Immediate decision-making*	Instant / visceral	

Figure 2. The influence of classroom management scripts on expert and novice teachers' perception, awareness and interpretative processing of problematic classroom situations

Turning now to Eraut's (2007) theory of workplace learning, we address the *mode of cognition* applicable to the conditions and temporal demands of the classroom in more

detail (see Figure 2). The amount of processing time available and the 'crowdedness of the situation' – such as intensity and volume of cues and events, the number of students and their attention levels, the pacing of the lesson and quality of learning materials, and other considerations competing for teachers' attention – impact how classrooms and corresponding problems are processed (Eraut, 2004). Integrating and interrelating relevant cues and events in the act of teaching requires assessing and reassessing the classroom situation, recognizing whether or not a problem exists, determining whether or not action is required, deciding when and how to pursue a particular course of action, and metacognitive monitoring of thoughts, actions, and reflection upon events and the influence of one's actions. All teachers are confronted with the multidimensionality and simultaneity of classroom events – many actions and events occurring at the same time – and the immediacy of classroom situations, which demand decisions and reactions in the here and now (Doyle, 2006; Sabers, Cushing, & Berliner, 1991). However, the *mode of cognition* through which classroom events are perceived and interpreted diverges depending on teaching expertise.

Experience within classroom environments plays an important role in making sense of all available classroom information (Carter et al., 1988; Doyle, 2006). Such a fast-paced context bears heavily on how teachers sort out what is relevant from what is irrelevant, and how they process competing informational input (Haider & Frensch, 1996). Expert teachers are noted for their ability to fluently, almost effortlessly, manage the complexities of teaching. They do not need to actively contemplate or deliberate unless something out of the ordinary spurs such mental effort (Berliner, 2004). Assessing of classroom situations involves on-the-spot pattern recognition, leading to rapid interpretations; the immediate decision-making required in the situation is instantaneous and visceral, arising without deliberative thought. As teachers' scripts for specific classroom situations and events are activated, a routine, automatized response particular to the situation at hand comes into play.

For novices, the multidimensionality and simultaneity of interactions and events, combined with the immediacy demanded in the classroom, can be cognitively overwhelming. Without elaborate classroom management scripts to guide their processing, sorting through the dizzying amount of competing information becomes a difficult mental activity, and their perceptions are constrained by the lack of time available for the necessary information processing. Novices' assessment of the situation can be characterized as requiring a more prolonged, deliberate analysis: they must continue their teaching performance even without being able to fully interpret or understand the situation at hand. Their interpretations may arrive too little too late, allowing problems to escalate. Their ability to keep track of cues and events is not always in pace with the rapid flow of information flow, resulting in a delayed and often incomplete interpretation of the situation. Immediate decision-making is similarly slowed down by the deliberate, rational thought-processing, relying on a naïve, budding intuition that often fails to arrive at consistently effective classroom management solutions.

Although novices are exposed to the same audial and visual input, much of their attention is focused on the behavior of students and the degree to which the behavior they are viewing complies or conflicts with their expectations of normal, well-managed classrooms. They are often heavily focused on whether or not students seem to be paying attention and how well they are adhering to general rules of 'good' classroom behavior. Novices, like experts, possess conceptualizations framed around issues of pedagogy, students, subject matter, and the classroom environment. The scope of their knowledge is constrained because of their limited classroom experience, which further constrains their ability to differentiate between relevant and non-relevant events (Tsui, 2003). Novices may also be limited by an inability to consider classroom situations from the students' point of view, which is an important component of teachers' professional vision, and their conceptual blind spots for linking concepts of classroom management to student learning (Colestock & Sherin, 2009; Wolff et al., 2015).

Comparing cases: an expert and novice interpretation of a problematic classroom management situation

To support our model of classroom management scripts and the influence of these knowledge structures on the processing of problematic classroom events, it is useful to examine underlying differences in expert and novice teachers' perception and interpretation of problematic situations more closely (Wolff et al., submitted). Based on the results of both line-by-line and whole-utterance coding of teachers' verbalized thoughts about videos of problematic lesson situations, a number of significant differences in the cognitive processing of problematic classroom management events: they cognitively process events differently in terms of whose viewpoint they include in their descriptions and how highly integrated their perspective on events is; their conceptual focus differs greatly in terms of student learning (for experts) versus student behavior (for novices); they reference the timescale of events differently, as experts express the continuity between events and actors more often than novices; and they differ in their attention to the interactions between students and between the teacher and students.

Experts are characterized by demonstrating an ability to take on multiple points of view (their own, that of the teacher, and that of the students), offer highly-integrated perspectives on the situations, and maintain an evolving, temporal continuity of events by referring to events occurring before, during, and after what they were viewing. Contrastively, novices are characterized as expressing a single point of view (chiefly their own), offering only non- or partially-integrated perspectives on the situations, lacking in references of temporal continuity, and in situations lacking an obvious and prominent classroom disruption, expressing uncertainty about the accurateness of their interpretations. In other words, even though both expertise groups viewed the same situations and had access to the same array of classroom cues and events, the overall interpretation of these problematic situations were qualitatively different. We will unpack two

examples of the full think aloud verbalizations, one from an expert and one from a novice, to illuminate the differences further (see Figure 3).

Expert think aloud verbalization coded as expressing: multiple points of view, highly integrated perspectives, certainty, and continuity
This was a particular classroom lesson with a worksheet. Well, some students get (the worksheet) and some students don't, so that's a bad starting point. There is another big difference between students who pay attention in a peculiar way. On the rear left and right in the middle. That second to last, who regularly has her head on her arm, I would have said something there, gently and friendly. Those two in the middle, I would have obviously set apart, because they seriously distract one another and are definitely not giving their attention to the instruction or the worksheet. The fact that not all the pairs have the worksheet, it's simply accepted. The kids realize that it's accepted, and so it continues like that, instead of the instructor immediately giving them their own worksheet and at the same time a clear indication of what to do with it. At one point (the teacher) had a story like: we're going to start on the adverb and then she just went to work. So she did that without explaining the relevance of it, or indicating the word or discussing what an adverb is, she just continues. Therefore the students feel like they're not addressed, particularly those middle two, who have every opportunity to do other things besides what's intended. They should have had their worksheet long ago, to prevent that. Then then those students called out to help each other a little. I would have made a joke about of: yes, the big shot on the left helped by his buddy on the right, but then you have to help a little bit, because otherwise it's no use. I would give some compliments for the students left front, left rear, right rear on the way they are working. I would have asked the people what they noticed about the worksheet, because they are handing it to each other. I would now make a joke about that boy in the middle row who's giving the other guy the worksheet and "try" to keep the concentration on track. Right behind and also on the left side, where just a nose can be seen at the edge of the screen, he's distracted. It could also be that people are walking around outside in the hallway or in the square, but there is also little or nothing said about it. So if it frequently occurs, I would hang a curtain or a beautiful poster or whatever next time, so they do not look out…see what I mean, in the middle row, a bit of a joke, because that helps each other, to still do as good as possible in the situation. And now a compliment as they've started and then wish them success with continuing to work. And speak to them about it if that doesn't help.
Novice think aloud verbalization coded as expressing: single point of view, semi- integrated, certainty, non-continuity
Yeah, again the same boisterous classroom, where they're not really participating in a motivated way, I find. Those guys up front do everything except working together on the assignment. They also pay more attention to those who, I guess, are hanging around in the corridor than to what the teacher is saying. There I also (saw) quite a bit. Let's see, here I (noted) that boy right up front, who is also busy with something. Yes, he is busy with his pen, not the assignment. I think the students are supposed to read along, but they are, in the middle front, not doing it. And at some point I (noted) the girl that, uh, in the middle row, uh, is second because she's laying on the table. Um, yeah, those guys up front I would have long put apart, or at least seat them in a different place. Yes, one doesn't even have his stuff with him. Yeah, at a given moment those boys keep going. Here goes the boy in the right row with the red on his shirt, who is also, who becomes a bit involved. Now actually the teacher says something to them now. Yes, now you see those guys right up front, that these were being pulled into it. No, the girls in the back row on the right, they're actually doing something, just like the girl at the left front. Yeah, actually these four or five boys, they are constantly busy with something else. Yeah, I don't really know what I can say about it.

Figure 3. Two sample excerpts, one from an expert and one from a novice participant, highlighting different interpretations of the same strikingly problematic classroom situation.

From the moment the expert teacher begins his interpretation, he considers the pedagogical decision of the teacher as a source of what is not working well in the lesson fragment, namely the fact that not all students have the worksheet that the teacher is using in the lesson. He also notices the peculiar way in which some students are following along, implying that their attention is not likely to be directed solely on the learning material. *"This was a particular classroom lesson with a worksheet. Well, some students get [the worksheet] and some students don't, so that's a bad starting point. There is another big difference between students who pay attention in a peculiar way"*. Several inferences about students manner of interacting with the lesson content note atypical cues from students: they are not paying attention as the teacher would normally expect, one is exhibiting disengaged posture by resting her head on her arm, and two students in the center occupy their time with distracting behavior rather than the worksheet the class is using.

These are matters under the direct control of the teacher, and the lack of a clear explanation of what should be done with the worksheet contributes to the continuing problems in the class. *"The fact that not all the pairs have the worksheet, it's simply accepted. The kids realize that it's accepted, and so it continues like that, instead of the instructor immediately giving them their own worksheet and at the same time a clear indication of what to do with it. At one point (the teacher) had a story like: we're going to start on the adverb and then she just went to work. So she did that without explaining the relevance of it, or indicating the word or discussing what an adverb is, she just continues. Therefore the students feel like they're not addressed, particularly those middle two, who have every opportunity to do other things besides what's intended."*

In terms of *enabling conditions*, student engagement, classroom dynamics, and (a)typical student behavior are considered as conditional cues. In this case, *consequences* of these conditions are inter-related to the concept of the role of the teacher and how a lesson should proceed (see Figure 1). Since the teacher neither clearly explains the classroom activity nor assures that all students have the necessary learning materials, students feel that their participation is negotiable: they are not obligated to engage, and in several cases begin to seek activities apart from the lesson. He finds it odd that the teacher simply proceeds under these conditions, and even suggests how two competing problems – that of disengaged students and that of distracting students – could have been avoided through the teacher's *decision to act*. To improve engagement, *"They should have had their worksheet long ago, to prevent that."* And to deal with the distraction, *"Those two in the middle, I would have obviously set apart, because they seriously distract one another and are definitely not giving their attention to the instruction or the worksheet."*

For this expert, the teachers' decision not to act persists as a key source of the problem observed in the class. Another issue is the missed opportunities to help steer students' concentration back towards learning: by incorporating humor, acknowledging students who are positively engaged in the lesson, and actively seeking student partici-

pation. *"I would have made a joke about of: yes, the big shot on the left helped by his buddy on the right... I would give some compliments for the students left front, left rear, right rear on the way they are working. I would have asked the people what they noticed about the worksheet, because they are handing it to each other. I would now make a joke about that boy in the middle row who's giving the other guy the worksheet and 'try' to keep the concentration on track."*

Another source of the problems experienced in the lesson considers *external factors*, the continuing distractions coming from outside the classroom. Nonetheless, the teacher's decision to do or say little about this condition has consequences on the lesson. The expert offers an easy remedy to improving this element of the classroom environment and preventing it in the future. *"It could also be that people are walking around outside in the hallway or in the square, but there is also little or nothing said about it. So if it frequently occurs, I would hang a curtain or a beautiful poster or whatever next time, so they do not look out".*

Throughout the think aloud, this *problem representation* focuses on students' learning, links problems to the pedagogical choices of the teacher, and offers contextualized suggestions for managing the classroom in a clear, but not overly imposing, way. His sympathies seem to lie with the students, as he considers the teacher responsible for the interrupted flow of learning he normally expects in the classroom. The expert's final thoughts return to the idea of offering positive praise to students who are working, and finding positive ways of redirecting the attention of those who are not, before taking direct action and speaking with the students creating a disruption. In terms of the influence of *classroom management scripts* on interpretation, we see that the expert monitors engagement and learning by incorporating proactive and reactive decisions about how to act in the situation, evincing his *situational awareness*. Aided by the rapid recognition of event patterns and their meaning, the expert evaluates the situation on the fly, continually observing cues and events that support his interpretation. The interpretation offers a coherent story, guided by an evolving perception of the situation, and repeatedly constructed around the goal of optimizing student learning through good teaching practices.

In the interpretation of the novice, the recognition and representation of the problems in the classroom spin in a different direction. The novice launches her interpretation with a *perception* about the climate of the class, noting students' lack of engagement, describing *"…the same boisterous classroom, where they're not really participating in a motivated way."* Similar to the expert, she also acknowledges the two distracting students in the center, but instead of linking their misdirected attention to the quality or style of instruction, simply states that are doing *"…everything except working together on the assignment."* Her speculations about the *external factors* that might be drawing these boys off-task is somewhat noncommittal about the off-screen distraction and how it affects their attention, *"They also pay more attention to those who, I guess, are hanging around in the corridor than to what the teacher is saying."* Similar to the

thoughts of the expert, she also suggests a *decision to act* by moving the boys in the center to other seating arrangements, but unlike the expert she does not relate this to a concern about their learning engagement, nor to the pedagogical choices of the teacher; it is a suggestion to address their misbehavior. She also points out that the one of the students has not even come prepared for the lesson, implying that the source of the problem lies with the intent of the student.

Then she offers a play-by-play reporting of *conditions* she finds relevant to classroom management problems: a boy who is busy with his pen instead of the assignment, the observation that students are not reading along as they ought to, and the girl who is laying her head across her arm. Her monitoring is driven by overt behavior: the boys in the center continue their distraction, pulling a student in the adjacent row into the fray before the teacher finally says something about it. After re-confirmed her perceptions of what is happening, she clarifies which students are caught up in the disturbance and which students are not. She repeats her summary a final time before ending her think aloud on an ambiguous note, stating, *"Yeah, I don't really know what I can say about it".*

For this novice, the disturbance in the classroom is attributed to the students, with a focus on their unfavorable behavior, and the teacher hardly enters the story at all, except for when the teacher says something after the disturbance escalates. It comes across as a perceptual report with limited interpretative links between what is seen or heard and their relevance to teaching and learning goals. To the extent that she suggests how to address the problem, she mainly describes ways of reacting to behavioral concerns. The pedagogical and management choices of the teacher are not considered as contributing factors, nor are they offered as possible remedies for the problems. Mainly she repeats her perceptions of problems in step-by-step style, representing the events as continuing behavioral issues. She overlooks the role and influence of the teacher on the situation, and expresses no concern for whether or not students are learning. Instead, her *situational awareness* emphasizes whether students are working on the assignment or not. Her interpretation is delayed in the sense that it emerges only in response to overt misbehavior, rather than a recognition of predictive cues foretelling predictable outcomes.

Although these excerpts convey the perceptions and interpretations of just two participants, they can be considered characteristic of the cognitive processing expressed by the majority of experts and novices viewing this particular classroom situation. Student learning, which was an important element for experts, rarely emerged in the representations of the novices, who instead focused more thoughts on behavioral concerns as the core problem. Additionally, the responsibility of the teacher to manage the lesson and facilitate learning was often neglected by novices. While both expertise groups recognized similar cues of student engagement, the deeper meaning behind the events, their relationship to principles of teaching and learning, and context-specific recommendations for improving student engagement was a feature expressed chiefly by experts. These contrasting assessments of the situation and problem representations

are tightly bound to the situational awareness and modes of cognition attributed to experts and novices scripts, and reflect critical differences in the way their knowledge of classrooms is organized.

Thus, novices' representations of classroom problems are less rich as a result of their limited teaching experience. While novices have a functional collection of classroom management representations, much of their understanding of the classroom is oriented around perceptions of students, not perceptions of teachers or how teachers can manage problematic situations to optimize learning. Nonetheless, novices clearly have an understanding of how a classroom generally functions to guide their perception and awareness of the behavioral problems that classrooms may present. Novice teachers' processing differs mainly due to one key element: they lack elaborate knowledge about classroom events that is deeply integrated with pedagogical knowledge about managing classrooms to augment their withitness. This explains novices' corresponding absence of classroom management scripts and their inhibited awareness for perceiving, comprehending, and projecting events proactively, as experts often do . They are still constructing the event knowledge necessary for the rapid recognition of patterns associated with specific problematic situations (Berliner, 2004; Carter, 1994).

Implications

Considered in light of their potential to influence teacher training and professional development programs, however, their impact on teachers' practice becomes more realistic. By highlighting differences in experts and novices classroom management scripts for problematic situations, we have shed new light on ways in which beginner teachers' knowledge overlooks what is relevant to experts. For example, reframing classroom management problems as learning concerns rather than behavioral concerns is an area that teacher education programs could explore more thoroughly with novice teachers. Reinforcing the agency and influence of teachers on classroom situations may help novices overcome the tendency to finger students as the cause of problems. Given the highly visual nature of perceiving and interpreting classroom management events, the role of classroom management scripts can be considered when designing training activities to improve both perception and interpretation of classroom cues and events. Designing training videos which utilize experts ways of seeing and thinking about classroom events can support novices as they learn to make sense of complex classroom situations, and may enhance their withitness by supporting the three levels of situational awareness: perceptual, comprehension, and projection capabilities. Incorporating the theoretical understanding of how knowledge influences teachers' interpretations of problematic situations can support teachers capacity to manage the complex demands of the classroom environment by drawing attention to the cues and events that experts consider relevant, and which guide their professional vision.

Conclusion

In this article, we proposed a theoretical model contrasting expert and novice teachers' classroom management scripts, or lack thereof, and described how these classroom scripts influence perception, interpretation, and awareness of classroom situations. Together, the model developed here helps clarify the specific dimensions of the classroom that are organized as knowledge for representing classroom problems and provide details about ways in which experience mediates perception and deeper cognitive processing. This model offers insight into how teachers cognitively process classroom situations, how experience informs the professional vision teachers apply to problematic classroom management contexts, and how inexperience often falls short. As Hattie (2012) explains, "Learning is not always…easy; it requires over-learning at certain points, spiraling up and down the knowledge continuum, building a working relationship with others in grappling challenging tasks" (p.20). While there is no substitute for the practical knowledge that teachers develop through their own classroom experience, making teachers more aware of general expert-novice patterns in the perception and interpretation of classroom problems can help steer the training and development of their own professional expertise, offering deliberate practice points to improve their professional vision in classrooms, and strengthen their reflections as they think further about classroom situations.

CHAPTER 6

General discussion: Research insights and methodological considerations

This dissertation has been an effort to extend research findings related to conceptualizations of classroom management directly through the voices and vision of teachers. Repeatedly, it has been emphasized that interpreting the complexity of the classroom demands highly developed cognitive processing. It takes years of professional practice in the classroom to cultivate the knowledge and skills leading to substantial student learning gains (Berliner, 2001). How teachers perceive and interpret the complexity of classroom events and make sense of student interactions is an important element of this processing (Colestock & Sherin, 2009; Copeland et al., 1994). This processing relies on the visual perception of the classroom (noticing relevant information), supported by adequate knowledge of classroom events to interpret what is perceived.

When learning how to teach or acquiring new knowledge for classroom practice, teachers rely on mental representations – ways in which teachers mentally construct, symbolize, preserve, and interpret information about objects and events in the classroom. Representations access the way teachers internally process external realities, and they support teachers not only in familiar classroom situations encountered over the course of their classroom practice, they also help prepare teachers for situations they have yet to encounter. To carry on with the task of teaching it is important that teachers remain continuously aware of what is happening in the classroom: they must have and convey *withitness* (Kounin, 1970). Teachers' withitness is a critical element of their professional vision, which is tightly linked to what teachers say, do, and the kind of pedagogical decisions they make in the classroom. It is not enough for teachers to simply observe classroom events as they unfold, a teacher must also be able to interpret these events in a way that is meaningfully linked to the core task of teaching: promoting student learning (Doyle, 1990; Hattie, 2012; Sherin, 2001; Van Es & Sherin, 2002).

Chapters 2, 3, and 4 of this dissertation detail three empirical studies investigating teachers' representational and perceptual processing of classroom management events using short video fragments of actual lessons presenting genuine teaching challenges. In spite of the long history of research into teachers cognition and expertise (cf. Chapter 1), research on cognition in relation to classroom management – particularly in terms of representation and events in the classroom – has not deeply explored the cognitive processes of expert and novice teachers (Hogan et al., 2003). While we know that experienced teachers have valuable classroom knowledge about students and events that allows them to effectively discern and manage classroom complexity, we know little about how teachers perceive and make use of their classroom perceptions (Carter et al., 1988). Understanding expertise differences in teachers' recognition of relevant cues is similarly limited (van den Bogert et al., 2014). In their review of research on representation in teaching, Hogan et al. (2003) explicitly state that "A grand understanding of teacher cognition—specifically how expert and novice teachers perceive and subsequently represent educational events…remains unclear" (Hogan et al., 2003, p.235).

CHAPTER 6

FINDINGS AND INSIGHTS FROM THE CURRENT RESEARCH

In Chapter 2, the investigation of teachers' representations of classroom management events relied exclusively on verbal data to access and identify differences between expert and novice teachers. The results portrayed a number of ways in which teachers' cognitive processing diverged significantly based on expertise level. Differences between expert and novice teachers showed that although a core element of classroom management is facilitating student learning, novices rarely mentioned this theme in their representations of classroom management. Instead, novices focused more on issues of classroom behavior, particularly students' lack of adherence to classroom norms and rules: issues concerning discipline as opposed to management. Experts, on the other hand, focused on learning in the classroom and the teacher's ability to influence learning. Moreover, the overall cognitive processing expressed by experts and novice differed in several ways. Novices typically only expressed their own point of view, failed to integrate and elaborate on the relationship between events and actors, were uncertain about the validity of their descriptions of events, and spoke more of what was happening before their eyes instead of referring to preceding and subsequent events. Experts, however, generally expressed multiple point of views (their own, that of students, and that of the teacher), exhibited an integrated understanding of events and actors, were certain about what they were saying, and traced events with temporal continuity.

The research presented in Chapter 3 combined two data sources to investigate expertise differences in teachers' perception of problematic classroom events. Perceptions were explored primarily using eye tracking measures, and these results were supported by a quantitative textometry analysis of the thoughts teachers shared as their perceptions were tracked. A comparison of fixation dispersion averages showed that experts and novices focus their attention differently. Expert teachers' perception was more focused; novice teachers' attention was scattered across the classroom. This study also identified between-group differences by discerning classroom regions where experts and novices monitored classroom activity and regions where they did not look in the classroom. Here also, expertise significantly affected viewing. Experts looked repeatedly at more areas across the classroom whereas novices did not look at all, indicating that novices skipped many of the areas that were frequently viewed by experts. Specifically, experts monitored more areas showing cues from students' posture, body movements, and interactions between students: their perceptions were driven by their knowledge of classroom events. Novices, however, monitored areas that were visually salient, for example, where bright light and bright colors attracted their attention or where the motion of the teacher coming into view captured their attention: their perceptions were driven by the visual elements of the video image itself.

The approach used in Chapter 3, textometry, was heavily quantitative, and offered an innovative methodological approach for identifying basic structural differences in

expert and novice verbalizations. There was a significant relationship between expertise level and word usage. Experts, in contrast to novices, used more words associated with complex thinking and also perceptual and event processing. The textometry analysis supported conclusions drawn from teachers' visual perceptions, reinforcing the idea that knowledge-driven processing played an important role in experts' perceptions, but that novices were hindered in this regard, as they lacked a rich store of classroom event knowledge. However, this analysis did not look deeply into how the interpretations of classroom events differed between expert and novice teachers.

To deepen understanding of differences in expert and novice interpretations of events, the verbal data presented in Chapter 3 was analyzed more extensively in the Chapter 4 study. Chapter 4 considered the perceptions and interpretations with a more in-depth qualitative approach that showed more clearly how the classroom event knowledge influenced the thoughts teachers expressed. Two different kinds of problematic events – Fuzzy and Striking Events – were discussed by teachers, and the patterns identified in their perceptual and interpretive processing were generally sustained irrespective of the type of event. For example, novices offered more descriptions of what they saw while experts offered more interpretations. These interpretations included inferences about both students and teachers in the lessons shown, and also showed more explanatory reasoning about the lesson structure, classroom climate, and the quality of the teaching noticed in the problematic lesson situations. Similar to the results of the Chapter 2 study, novices were more focused on issues related to discipline and behavior. Experts were more concerned with the quality of student learning, the familiar situations they recognized, and the ways in which the teacher influenced classroom events, often because the teachers in the lessons missed opportunities to actively manage events and redirect learning efforts in the classroom.

Due to modifications, specifically differences in the experimental design and also to the coding scheme, the results of the study presented in Chapter 4 differed in several key ways from those of Chapter 2. An entirely new category of relational codes was added to detect differences in the relations and affect expressed by teachers. Regardless of the type of event shown, experts mentioned more relations between actors, specifically between certain students and larger groups of students (including the whole class), and between the teachers and students. When fuzzy classroom management events were presented, experts also made more student-to-student relations; when the classroom management events were striking, experts mentioned the emotions and mood of the students more often. The procedure for viewing classroom lesson videos allowed participants to view the same situation twice, consecutively, in contrast to the study presented in Chapter 2. This may have led to different outcomes in the temporal referencing detected between experts and novices, enhancing novices' ability to track the progress of events over time rather than concentrating their thoughts on what was currently appearing in the lesson videos as they did in the Chapter 2 study. Experts referenced the ongoing, continual nature of events more often than novices regardless

of the problematic event type shown, but the continuity expressed overall was only significant when events were fuzzy, not when they were striking. Nonetheless, novices' cognitive processing still showed a significant lack of continuity with both Fuzzy and Striking Events. Furthermore, novices mainly expressed a single point of view and offered non-integrated perspectives on events in both types of videos. Interestingly, when problematic events were striking, they also offered more semi-integrated perspectives, which evidences an ability to interrelate events and interactions that are relevant to classroom management, but falls short of conveying an awareness of how classroom factors evolve and relate to goals of teaching and learning. Contrastively, experts' perspectives were shown to be highly integrated with both fuzzy and striking events, evidencing a greater awareness of how classroom events and factors related to one another, and framed in terms of explicit teaching and learning goals. Experts also incorporated multiple points of view when interpreting events, but only showed more certainty than novices when events were fuzzy. Similarly, novices only expressed more uncertainty when events were . Seemingly, when classroom management events were striking, both experts' and novices' event processing was rather clear and certain about what was problematic for classroom management, even though the expertise groups differed in their interpretations of these events.

METHODOLOGY: AFFORDANCES AND LIMITATIONS

Combining eye tracking and verbal reporting to investigate expertise differences in teachers' cognitive processing of tasks can be considered an innovative approach to classroom management research, as studies applying these methodologies to classroom teaching are still fairly limited. One recent study identified expert-novice differences in the visual processing of events, but did not incorporate verbal reports in the analysis of teachers' visual attention (van den Bogert et al., 2014). Another investigated teacher awareness as recognition of targeted misbehavior (i.e., students who did not follow instructions to close their textbooks), but collected verbal reports only when teachers noticed the misbehavior (Yamamoto & Imai-Matsumura, 2013). Yet, in other research domains, this methodological combination of tracking and recording people's gazes as they view visual images and describe what they see and how they process what they see has delivered promising expertise insights into cognitive processing (Jaarsma, Jarodzka, Nap, van Merriënboer, & Boshuizen, 2015; Reingold & Sheridan, 2011). Nonetheless, issues associated with linking visual and verbal data can present challenges (Van Gog et al., 2005). Deciding how to triangulate data to achieve a unified understanding of teachers' visual processing implies balancing the affordances and limitations of both types of data.

Naturally, the objective measurement that eye tracking provides is appealing when investigating teachers visual perception. Measures such as fixation location, which typi-

cally indicates the area to which attention is allocated and from which information is extracted, were helpful in determining differences in where experts and novice teachers were focusing their attention in the classroom (Just & Carpenter, 1976). By comparing fixation dispersions, for example, it was shown that expert and novice teachers distribute their attention differently when viewing problematic classroom scenes. Experts' fixations were more focused than those of novices, indicating that their knowledge of classroom events guided their viewing of problematic events in the classroom whereas novices' fixations were more scattered. Repeated fixations provided insight into where teachers were returning time and time again to gather information and follow-up on cues and events that were relevant for classroom management. Fixation skips highlighted regions that experts and novices overlooked in the classroom, showing which areas went unnoticed by a given expertise group, and suggesting which information was irrelevant to the processing of classroom events. These insights helped establish the kinds of cues that expert and novice teachers were perceiving and finding informative as they made sense of the classroom scenes presented to them. They offered an innovative means of comparing expert and novice perceptions, and added more detailed insight into the general understanding of what experts and novices perceive as relevant for not only making sense of classroom management problems, but also for anticipating problems before they escalate and spread.

While eye tracking is attractive in the sense that it offers an objective means of measuring and tracing visual processing directly, a basic limitation is that "it is impossible to tell from eye tracking data alone what people think" (Holmqvist et al., 2011, p.71). Eye tracking allows us to detect the location of people's perceptions – *what* someone is looking at – but it does not tell us *why* they are looking there, nor what they are thinking about as they are looking there. This is the main reason that verbal data is so valuable to the triangulation process. Coupling eye tracking data with thoughts articulated in real-time makes it possible to gain crucial details as to what a teacher is thinking while looking at classroom events, and more importantly, it allows us to consider what their perceptions mean to them in relation to classroom management. Without teachers' verbalizations, it would be difficult to go beyond simply reporting what teachers did or did not see and how often they looked there. Although verbal data does not allow the direct access into teacher cognitions that eye tracking offers, it does allow us to access the underlying thoughts and knowledge that guide their perception. And, as has been shown throughout this dissertation, it is the knowledge teachers apply to their understanding of classrooms that demarcates the differences we find between expert and novice teachers.

One challenge encountered in the course of coupling eye movements with verbal data relates to our goal of identifying group patterns across unique, individual data sets, as between-group differences can be subtle and within-group differences are common (Carter et al., 1988). Given the absence of a clear and summarizing theoretical model of teachers' professional vision and perceptual processing, it was difficult to pinpoint pre-

cisely which words or longer verbal constructions should be measured and compared. This justified the exploratory approach employed, but these findings will require additional empirical testing to further establish the validity of the expert-novice differences reported. The dynamic nature of classrooms and the videos showing authentic classroom scenes presented an additional challenge to tracking eye movements of groups of expert and novice teachers, especially in determining where teachers look and what they monitor. In the absence of existing theory, it was not possible to presuppose which classroom areas or events participants would be looking at a particular moment in time. For this reason, an exploratory Area of Interest grid analysis was employed. This approach allowed us to identify differences in perceptual attention spatially over the course of an entire video fragment, but it sacrificed the ability to capture these perceptions across time and space as events played out in the classroom lessons. Similarly, the decision to analyze eye movements and verbal data separately as opposed to concurrently allowed us to identify similarities in perceptual processing and the deeper knowledge-driven processing behind visual perceptions. However, it did not capture the visual and interpretive processing across time and space. The similarities identified in this split analysis approach substantiates the link between visual and more global cognitive processing, but handling such data sets jointly will require further research to fine-tune the methodological approach in teacher research. While each participant viewed the classroom in their own distinct way, group patterns nonetheless emerged. The results of the exploratory analysis have helped identify the kind of cues which experts use to monitor classroom events, and helps predict which areas experts and novices attend to, and have contributed to a theory in how classroom knowledge influences problematic event processing and interpretation (cf. Chapter 5).

There is also another element of eye tracking measures that requires consideration. The strong formulation of Just and Carpenter's (1980) eye-mind hypothesis links eye fixations to overt attention, theorizing that there is no lag between what is fixated upon and what it processed. Shifts in fixations are coupled with shifts in attention, although attention (and fixations) can shift before information processing is finished (Holmqvist et al., 2011). While it is generally assumed that when a person fixates upon a particular location they are also actively thinking about and processing the information found there, this theory does not account for covert attention. Posner (1980) has pointed out that that there are shifts in attentional focus that are not accompanied by eye movements. It is possible to look at something without actually perceiving it, just as it is possible to stare off into space, pondering something very different from the object or event one’s eyes are fixated upon. Covert attention that occurs as eye movements are being recorded could mean that fixations are capturing only where the eye is looking, not what the mind is actually processing. In other words, the possibility that someone is looking at something without actively perceiving it, or may perceive something while shifting their attention elsewhere remains an inherent challenge to cognitive research. However, the verbal data collected during the recording of eye movements has helped

guard against the effects of covert attention. Participants' perceptual attention to cues and events was confirmed through their accompanying verbal think aloud reports.

Concerning the methodological approach to verbal data, there are also several issues to consider. The textometry method used to detect basic structural yet meaningful differences in expert and novice teachers' word usage was an effort to numerically access differences in how teachers expressed their perception of classroom events. As Tausczik and Pennebaker (2010) have pointed out, "Tracking language use such as tracking people's gaze can tell us where they are attending" (p.30). Knowing where and what a person is attending to gives us a deeper understanding of how they process an event or series of events. Computerized text analysis methods such as textometry offer a quick and easily quantifiable manner of detecting similarities and divergent elements of expert and novice teachers' processing. It proved useful in confirming that teaching experience was influential in the mental processing involved in perceiving classroom events, as well as in devoting attention to actions and events. Based on frequencies alone, it was possible to show an association between experience and word usage. Textometry helps to provide a quantitative overview of transcribed thoughts, delivering concrete figures for assessing cognitive complexity, attention to events, and content focus, and a structural overview of the ranking and ordering of particular words, whether verbs, nouns, or some other part of speech. Yet the deeper processing of teachers – the how and why of their thinking and interpreting – is difficult to access using such a heavily quantitative approach. Based on the results of this analysis, textometry can be recommended as a means of identifying differences in the ways word usage may differ between varying levels of teaching expertise, but to understand these differences to a fuller extent of content and meaning relies more on the interpretative insights provided through qualitative analysis of teachers' thoughts and understandings.

The coding scheme developed and validated in Chapter 2, and modified in Chapter 4, provides a more detailed method for analyzing the content of teachers' verbal report about classroom management. The grounded theory approach that produced this coding scheme is advantageous in the sense that the coding categories and the codes themselves surfaced through rigorous, iterative focus on the words of teachers' themselves. However, as with many qualitative approaches, the grounded theory procedure is time-intensive. The study in Chapter 4 supports the utility of this coding scheme, as it confirmed predictions about ways in which expert and novice teachers' thoughts and understandings differ as they interpret problems arising in the classroom. The modifications enhance the level of detail offered by the coding scheme, but the scheme is by no means exhaustive in its current state. It has been shown to be helpful in identifying differences in instances of problematic classroom events, but has not yet been applied to non-problematic events. Furthermore, the context of both of these studies analyzed interpretations of teachers' observing the teaching and classroom of others, not in the context of their own teaching, and this will also require additional testing and comparison.

NEXT STEPS

The model constructed in Chapter 5, together with its underlying theories, indicates why classroom management can be such a difficult task of teaching. Elements of the model provide clues for facilitating how teachers learn to both perceive and interpret challenging classroom situations, either through video analysis or in the context of actual teaching situations. While the groundwork for classroom management scripts and their role in perception and interpretation has been laid, this model can be expanded to cover a broader typology of classroom situations through which practice and experience can take shape. Our different analyses suggest that teachers' perceptions and interpretations of problematic classroom events transform as they gain classroom experience, and has identified relevant perceptual cues for interpreting classroom interactions. Initial steps are already underway for utilizing this research to create videos for supporting and training teachers' visual expertise skills by drawing upon the pedagogical knowledge of expert teachers. Thus, these findings hold potential for improving teachers' ability to perceive and, more importantly, understand and interpret classroom cues and events. They can be put to use for improving novice teachers visual processing and mental representations of classroom events in teacher training. Likewise, they can be used to support experienced teachers who struggle with these cognitive challenges. Nevertheless, research into teachers' professional vision still needs to be explored and tested empirically to enhance the knowledge and perceptual skills of teachers. While new light has been shed upon teachers' withitness in the classroom, the proverbial light at the end of the tunnel still remains somewhere off in the distance.

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Summary

Effective classroom management, which is key to effective teaching, relies heavily on acquiring and developing classroom knowledge directly related to classroom practice (Emmer & Stough, 2001). A crucial variable for effective management is teachers' *withitness* – the ability to maintain an ongoing awareness of what is happening in the classroom and the events taking place within it (Kounin, 1970). Withitness requires knowledge which is grounded in an understanding of the complexity of classroom events and what they mean for teaching and learning (W. Doyle, 1990). The role of teaching expertise exerts a strong influence on perceiving, representing, and interpreting classroom events, and how well-equipped a teacher is to manage classrooms and handle the various disruptions to learning that are bound to arise.

Chapter 1 provides an introduction to the dissertation. The relationship between classroom management and teacher expertise is described. The role of withitness in the perception and interpretation of classroom events is also explained. This is followed by an overview of the dissertation goals and the chapter topics.

Chapter 2 investigates the role of teacher expertise on the representations of classroom events in detail. Classroom management represents an important skill and knowledge set for achieving student learning gains, but poses a considerable challenge for beginning teachers. Understanding how teachers' cognition and conceptualizations differ between experts and novices is useful for enhancing beginning teachers' expertise development. This chapter describes the creation of a coding scheme developed through the grounded theory methodology. This coding scheme was used to analyze expert and novice teachers' verbalizations about classroom events and how they are relevant for classroom management. Four categories of codes emerged. These referred to perceptions/interpretations, thematic focus, temporality, and cognitive processing expressed. Mixed method analysis of teachers' verbalizations yielded a number of significant effects related to participants' expertise levels. Notably, teachers' cognitive processing diverged significantly based on expertise level. Differences in focus included themes such as student learning, student discipline, and teacher interaction and influence. Experts focused on learning in the classroom and the teacher's ability to influence learning, whereas novices were more concerned with maintaining discipline and behavioral norms.

Chapter 3 investigates the visual expertise of teachers, identifying differences in their perception of problematic classroom events. Teachers' visual expertise is an important professional skill, particularly the ability to simultaneously perceive and interpret students' behavior. This complex skill supports effective classroom management, and develops through experience. Using eye tracking measurements and verbal think aloud, we investigated differences in how expert and novice teachers perceive problematic classroom scenes. Sixty-seven teachers participated, 35 experienced secondary school teachers (experts) and 32 teachers-in-training (novices). Participants viewed videos of authentic lessons and their eye movements were recorded as they verbalized thoughts about what they had seen in the lesson and how it was relevant to classroom

management. Two different types of videos were viewed: lesson fragments showing (1) multiple events depicting disengaged students with no overt disruptions and (2) conspicuous disruptions related to a single, obvious event affecting the class. Analysis of eye movements showed that novices' viewing was more dispersed whereas experts' was more focused. Irrespective of the video type, experienced teachers focused their attention on areas where relevant information was available, while inexperienced teachers' attention was scattered across the classroom. Experts' viewing was more knowledge-driven whereas novices' was more image-driven. Our findings offer new insights into teachers' perceptions and professional vision. They also help identify useful cues for interpreting classroom interactions that can support the training and development of teachers' visual expertise.

Chapter 4 specifies significant differences in how expert and novice teachers cognitively process different types of problematic classroom events. Teachers' knowledge and experience in the classroom influences how they conceptualize, and interpret the events occurring in the classroom. The coding scheme developed in Chapter 2 was used to test predicted differences in expert-novice teacher cognition in terms of how they made sense of two different types of problematic classroom event videos. One video type displayed multiple, unrelated problems such as disengaged, off-task students (Fuzzy Events). The other displayed multiple, interrelated problems connected to a blatant classroom disruption affecting many students or the whole class (Striking Events). Expert and novice interpretations were coded line-by-line and as whole utterances to identify between-group differences and confirm or reject expected differences. All coding categories showed significant main effects for expertise, and most showed interaction effects for the type of problematic events. Group differences for specific codes were also identified. Novices offered more visual descriptions and focused more on issues of behavior and discipline. Experts expressed more interpretive processing, and focused more on student learning, stressing the influential role of the teacher on the problematic events in the classroom. Experts also mentioned more relations between actors in the video: those between students and those between the teacher and students. Overall, the cognitive processing of experts was more elaborate and integrated than that of novices.

Chapter 5 offers a theoretical model to describe how expert and novice teachers' process problems in the classroom. Experience in the classroom clearly makes a difference in how teachers perceive and interpret events. It also impacts their decisions about when and how to act when problems arise. Dealing with the complexities of the classroom and the multiplicity of events, particularly those which are problematic, can be especially challenging for new teachers still developing their classroom management knowledge and skills. Expert teachers have elaborate episodic knowledge of classrooms, and are better able to adaptively integrate their pedagogical knowledge of events, students, and classroom situations. Beginning teachers often miss relevant events and have difficulty predicting and preventing problems before they escalate. Research on

classroom management often focuses on how to respond to common classroom problems, but lacks a theoretical model describing how teachers' knowledge and experience affects the perception and interpretation of problems. Such factors influence how teachers monitor problems and how they maintain an ongoing awareness of classroom situations. Thus, this chapter proposes a theoretical model for *classroom management scripts* that contrasts expert and novice teachers' awareness of problematic classroom situations. The proposed model offers a closer look at how teachers cognitively process classroom problems and how expertise influences teachers' professional vision. Classroom management scripts help clarify differences in the way expert and novice teachers recognize, represent, and respond to problematic situations. Such insights can be useful for enriching teachers' interpretations of problematic classroom events. Additionally, these insights may help prepare teachers to overcome problems so that they can devote their attention to the central purpose of classroom management, which is to maintain and facilitate learning in the classroom.

Chapter 6 offers a general discussion of the dissertation, the research findings, and their contribution to research on teacher expertise and teacher cognition. Affordances and limitations of the methodologies employed in the research are also discussed. Implications and applications of the research are also provided in this chapter.

Samenvatting

De sleutel tot effectief lesgeven schuilt in effectief klassenmanagement. Om dit te bereiken is het voor de beginnende leraar nodig kennis over de klaspraktijk te verwerven en die te ontwikkelen (Emmer & Stough, 2001). Cruciaal hierin is de *withitness* van de leraar: zijn vaardigheid om zich voortdurend bewust te zijn van gebeurtenissen in de klas (Kounin, 1970). *Withitness* steunt op een begrip van de complexiteit van deze gebeurtenissen in de klas en hun betekenis voor het lesgeven en het leerproces (Doyle, 1990). Expertise in het lesgeven hangt in belangrijke mate samen met verschillen in waarnemen, representeren en interpreteren van gebeurtenissen in de klas, en met de vaardigheid van de leraar om klassen te managen en storende factoren die het leren in de weg staan aan te pakken.

Hoofdstuk 1 geeft een inleiding op het proefschrift. Het verband tussen klassenmanagement en lerarenexpertise wordt beschreven. Ook de rol van withitness in de perceptie, representatie en interpretatie van gebeurtenissen in de klas wordt toegelicht. Daarna volgt een overzicht van de gestelde onderzoeksdoelen en de thema`s die behandeld zullen worden in de volgende hoofdstukken.

In hoofdstuk 2 wordt in detail de rol van lerarenexpertise bij representaties van gebeurtenissen in de klas onderzocht. Klassenmanagement is gebaseerd op vakkennis. Het is een belangrijke vaardigheid om het leerproces van de leerlingen te optimaliseren en vormt een aanzienlijke uitdaging voor beginnende leraren. Om de expertiseontwikkeling van beginnende leraren te verbeteren is het nuttig te begrijpen hoe beginners en experts verschillen in kennis en begrip van gebeurtenissen in de klas. Dit hoofdstuk beschrijft de opzet van een codeerschema dat ontwikkeld werd met gebruik van *grounded theory.* Dit codeerschema werd gebruikt om de beschrijvingen door experts en beginners te analyseren van zulke gebeurtenissen en hoe deze relevant zijn voor het klassenmanagement. Het codeerschema bevat vier categorieën die respectievelijk refereren naar de beschreven waarnemingen/interpretaties, thematische focus, tijdsaspecten en cognitieve processen. *Mixed-method analyse,* toegepast op de beschrijvingen van de leraren, toont enkele significante effecten van het expertiseniveau. Cognitieve processen vertonen een significant verschil tussen expertiseniveau. Verschillen in focus zijn onder andere waarneembaar ten aanzien van het leren dat plaatsvindt, de discipline in de klas, de lerareninteractie met de klas, en de invloed hiervan op de gebeurtenissen in de klas. Experts focussen op het leren in de klas en de bekwaamheid van de leraar om dit te beïnvloeden, terwijl beginnende leraren meer bezig zijn met disciplinehandhaving en gedragsnormen.

Hoofdstuk 3 onderzoekt de visuele expertise van leraren, en is gericht op verschillen in de wijze waarop leraren problematische gebeurtenissen in de klas waarnemen. Visuele expertise van leraren, met name de bekwaamheid om leerlingengedrag gelijktijdig op te merken en te interpreteren, is een belangrijke professionele vaardigheid. Deze complexe vaardigheid ondersteunt effectief klassenmanagement en wordt ontwikkeld door ervaring. Door gebruik van *eye tracking* metingen en *verbal think-aloud* onderzoeken we de verschillen in hoe experts en beginnende leraren problematische klassi-

tuaties waarnemen. Zevenenzestig leraren namen deel aan het experiment: 35 ervaren leraren (experts) en 32 leraren-in-opleiding (beginners). Deelnemers keken naar videofragmenten van authentieke lessen. Hun oogbewegingen werden geregistreerd, terwijl ze hun gedachten verbaliseerden over wat ze in de les zagen en hoe dat relevant was voor het klassenmanagement. Twee verschillende soorten video's werden getoond. De eerste categorie toonde lessituaties waarin leerlingen bij voortduring storend gedrag vertonen en niet bij de les zijn, terwijl de tweede categorie video's opvallende verstoringen van het klasgebeuren tonen die een duidelijk aanwijsbare oorzaak hebben. Een analyse van de oogbewegingen toonde aan dat de blik van beginners meer gespreid is, terwijl de focus van experts duidelijk meer geconcentreerd is. Onafhankelijk van het soort video, focusten ervaren leraren hun aandacht meer op gebieden waar relevante informatie voorhanden was, terwijl de aandacht van onervaren leraren zich over de hele klas verspreidden. Het kijken van de experts werd meer door kennis bepaald, terwijl het kijken van de beginners zich liet afleiden door opvallende zaken in het beeld. Onze bevindingen bieden nieuwe inzichten in de perceptie en de professionele waarneming van leraren. Ze helpen ook om handige signalen te identificeren voor het interpreteren van interacties in de klas die het trainen en ontwikkelen van visuele expertise bij beginnende leraren kunnen ondersteunen.

Hoofdstuk 4 gaat dieper in op de verschillen in de manier waarop beginners en experts problematische klassensituaties cognitief verwerken. Kennis en ervaring met een klas beïnvloeden hoe leraren dit soort situaties verklaren, conceptualiseren en interpreteren. Het codeerschema dat we in Hoofdstuk 2 hebben ontwikkeld, werd gebruikt om de voorspelde verschillen in cognitie tussen experts en beginners te testen op de manier waarop zij video's van verschillende klassensituaties interpreteren. Het eerste type video toonde meerdere niet-gerelateerde problemen, zoals onaandachtige, onoplettende leerlingen (*Fuzzy Events*). Het andere type video toonde meerdere gerelateerde problemen die alle verband houden met een duidelijk identificeerbare flagrante verstoring in de klas waarbij meerdere leerlingen of zelfs de hele klas betrokken zijn (*Striking Events*). De interpretaties van experts en beginners werden per zin en als gehele uitspraak gecodeerd om groepsverschillen te onderzoeken en de verwachte verschillen al dan niet te bevestigen. Alle codeercategorieën toonden een significant hoofdeffect op expertise en vele specifieke codes toonden interactie-effecten op het type van problematische gebeurtenissen. Expertiseverschillen voor specifieke codes werden ook vastgesteld. Beginners gaven meer visuele beschrijvingen en focusten vaker op gedrag en discipline. Experts gaven meer interpretaties en focusten meer op het leren van de leerlingen. Ze legden meer nadruk op de invloedrijke rol van de leraar bij problematische gebeurtenissen in de klas. Ook benoemden ze meer relaties tussen de deelnemers in de video: de relaties tussen leerlingen onderling en die tussen leraar en leerlingen. De algehele cognitieve verwerking bij experts was veel uitgebreider en meer geïntegreerd dan bij beginners.

Hoofdstuk 5 biedt een theoretisch model om te beschrijven hoe experts en beginnende leraren omgaan met problemen in de klas. Ervaring in de klas bepaalt in belangrijke mate het waarnemen en interpreteren van gebeurtenissen. Het heeft ook invloed op hun beslissing wanneer en hoe te handelen wanneer er zich problemen voordoen. Omgaan met de complexiteit van de klas en de veelheid van gebeurtenissen, in het bijzonder de problematische, kan vooral een uitdaging zijn voor nieuwe leraren die bezig zijn hun kennis en vaardigheden betreffende klassenmanagement te ontwikkelen. Experts hebben uitgebreide episodische kennis van klassenmanagement en zijn beter in staat om hun pedagogische kennis over gebeurtenissen, leerlingen en situaties in de klas te integreren. Beginners merken relevante gebeurtenissen vaak niet op, en hebben moeite met het voorspellen en voorkomen van problemen voordat ze escaleren. Onderzoek naar klassenmanagement richt zich vaak op hoe te reageren op gewone problemen in het klaslokaal, maar mist een theoretisch model dat beschrijft hoe de kennis en ervaring van leraren de perceptie en interpretatie van problemen beïnvloedt. Deze factoren beïnvloeden hoe leraren problemen monitoren en hoe zij zich voortdurend bewust zijn van (veranderende) klassensituaties. Daarom wordt in dit hoofdstuk een theoretisch model voorgesteld van scripts voor klassenmanagement dat toont hoe experts en beginnende leraren zich bewust zijn van problematische situaties in klaslokalen. Het gepresenteerde model biedt een nadere kijk op hoe leraren op een cognitieve manier omgaan met problemen en hoe expertise de professionele waarneming van leraren beïnvloedt. Scripts voor klassenmanagement helpen de verschillen te verduidelijken in de manier waarop experts en beginnende leraren problematische situaties herkennen, weergeven en erop reageren. Deze inzichten kunnen nuttig zijn voor het verrijken van de interpretatie van leraren bij problematische klassensituaties. Bovendien kunnen ze helpen om leraren erop voor te bereiden problemen te overwinnen, zodat zij hun aandacht kunnen richten op het centrale doel van klassenmanagement: het in stand houden en faciliteren van het leren in de klas.

Hoofdstuk 6 bevat een algemene discussie van het proefschrift en de bijdrage van het onderzoeksresultaat aan onderzoek over expertise en cognitie bij leraren. Mogelijkheden en beperkingen van de methoden die gebruikt zijn in het onderzoek worden besproken, evenals de implicaties en toepassingen.

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