



Exploring preservice, beginning and experienced teachers' noticing of classroom management situations from an actor's perspective

Sharisse van Driel ^{a,*}, Frank Crasborn ^b, Charlotte E. Wolff ^c, Saskia Brand-Gruwel ^d, Halszka Jarodzka ^a

^a Department of Online Learning and Instruction, Faculty of Educational Sciences, Open Universiteit, the Netherlands

^b Department of Teacher Education, Fontys University of Applied Sciences, the Netherlands

^c School of Education, University of Iceland, Iceland

^d Zuyd University of Applied Sciences, the Netherlands

HIGHLIGHTS

- Teachers' noticing of salient classroom management situations during teaching.
- In-action signaling and front-view video to capture actor-perspective teachers' noticing.
- Coding system and temporal heat maps to clarify aspects of teachers' noticing.
- Stage-wise development of teachers' noticing in classroom management questionable.
- Combining in- and on-action methods essential to investigate teachers' noticing.

ARTICLE INFO

Article history:

Received 3 September 2020

Received in revised form

18 June 2021

Accepted 29 June 2021

Available online 17 July 2021

Keywords:

Teacher noticing

Classroom management

Teacher expertise

Multi-method approach

Teacher knowledge

Teachers' professional vision

ABSTRACT

We investigated preservice ($n = 21$), beginning ($n = 17$) and experienced ($n = 19$) teachers' noticing of salient classroom management situations during teaching. Teachers wore a front-view camera while teaching. A two-method approach was used to identify salient situations and verbalizations of accompanying cognitions: hand-signals while teaching and stimulated-recall interview. Mixed-method analysis showed that teacher groups noticed similar amounts and types of situations distributed across the lesson time. Preservice teachers identified more situations than beginners in interviews, whereas beginners identified more situations by hand-signaling while teaching. Findings indicate non-linear professional development of teachers' noticing and the value of a two-method approach to capture teachers' noticing.

© 2021 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

1. Introduction

Classroom management (CM) is a crucial and highly challenging component of teaching (Van Tartwijk et al., 2011; Zuckerman, 2007). As inadequate development of CM skills is associated with an increasing risk for burn-out (Otero López et al., 2008) and teacher attrition (Buchanan et al., 2013), it is very important for teachers to learn how to be effective classroom managers. The

challenge of effective CM is prescribed to the complexity of classroom environments, characterized by the immediacy, multidimensionality, simultaneity and unpredictability of events (Doyle, 2006). Due to these complex features, CM consists for a large part of immediate teaching behavior encompassing the teacher's need to immediately decide whether and how to act (Dolk, 1997; Eraut, 1995; Hayes, 1999). To proceed to effective actions, teachers need to be able to notice those situations that are salient for their CM (Brophy, 1988; Colestock & Sherin, 2009). Within information-dense classrooms this is particularly difficult for teachers with little experience (Van den Bogert et al., 2014). To adequately support teachers in developing their CM skills, it is important to understand what kind of situations teachers themselves notice as salient for

* Corresponding author. Department of Online Learning and Instruction, Faculty of Educational Sciences, Open Universiteit, P.O. Box 2960, 6401, DL Heerlen, the Netherlands.

E-mail address: sharisse.vandriel@ou.nl (S. van Driel).

their CM and how these situations occur while teaching their own (internship) classes.

Teachers' noticing has been studied within the context of professional vision (Goodwin, 1994) and refers to the process in which teachers identify and interpret salient classroom situations within the complexity of their classroom environment (Seidel & Stürmer, 2014; Sherin, 2007; Van Es & Sherin, 2002). 'Identifying' refers to how teachers direct their attention to classroom situations they perceive as salient, while 'interpreting' refers to the knowledge used to understand situations (Sherin & Van Es, 2009). The activities of identifying and interpreting are assumed to occur simultaneously and to be interwoven, guided by both the teachers' knowledge and environmental cues (Scheiner, 2016). Situations that teachers identify as salient trigger specific knowledge that they use for their interpretations. In turn, teachers' knowledge provides a filter for defining whether or not a certain situation is recognized as salient (Sherin & Van Es, 2009). The identification and interpretation of salient situations highly interact with teachers' decision-making and actions in dynamic classrooms (Scheiner, 2016).

Teachers' noticing is assumed to change throughout teachers' careers, because the knowledge they base their noticing upon, also changes in nature and organization (Berliner, 2001; Wolff et al., 2021). How teachers' noticing of CM situations unfolds with years of teaching experience has not been extensively investigated, yet. Recent research has investigated how preservice and experienced teachers identify and interpret CM situations using videos of other teachers' teaching (e.g., Van den Bogert et al., 2014; Wolff et al., 2015, 2017). Although these studies reported valuable insights with respect to expertise differences, by using an observer's perspective they disconnected teachers' noticing from the situated nature of teaching and the immediate need to act. Moreover, what is noticed depends on whether teachers comment on (video-recordings of) their own or other teachers' actions (Gaudin & Chaliès, 2015; Kleinknecht & Schneider, 2013). Hence, it is obvious that these results only capture a limited aspect of teachers' noticing in their own authentic CM situations (Sherin et al., 2008; Xu et al., 2019).

The goal of the present study is to explore preservice, beginning and experienced teachers' noticing of salient CM situations from an actor's perspective during their own teaching at secondary school level. Although various methods exist that can be used to capture in-action (i.e., during teaching) or on-action (i.e., after teaching) actor-perspective teachers' noticing, each method carries particular methodological strengths and challenges (Crasborn et al., 2010). To harness known methodological affordances, the current study reports on a two-method approach combining an in-action method (i.e., providing a hand-signal during teaching) and an on-action method (i.e., participating in a stimulated-recall interview after teaching) to capture teachers' noticing of salient CM situations from an actor's perspective.

1.1. Teachers' noticing for CM

CM has been studied by various disciplines resulting in many different conceptualizations (Emmer & Sabornie, 2015). Although consensus is still lacking, definitions shifted over time from maintaining order and discipline to a more comprehensive view that centralizes students' academic and social learning as the main goals of CM (Emmer & Sabornie, 2015; Evertson & Weinstein, 2006; Henley, 2010). To support learning, the emphasis of effective management lies on preventive strategies such as defining rules, supporting students' engagement, classroom monitoring, providing clear planning and a well-organized classroom space, as well as reactive strategies in response to student (mis)behavior

(Bear, 2015; Brophy, 2006; Evertson & Poole, 2008; Glock & Kleen, 2019; Little & Akin-Little, 2008). Hence, rather than merely dealing with student behavior, CM should facilitate learning, instructional decision-making, and positive teacher-student relations (Brophy, 2006; Pianta, 2006; Piowar et al., 2013). In the present study, we share this comprehensive view and define CM as "actions taken to create and maintain a learning environment conducive to attainment of the goals of instruction" (Brophy, 1988, p. 2).

A basis for effective management concerns teachers' ability to notice salient CM situations within the complexity of a classroom environment (Brophy, 1988; Colestock & Sherin, 2009). As many situations occur simultaneously, are often interconnected, and continuously changing, teachers' noticing requires a continuous awareness of all that is happening in the classroom. Various concepts exist that refer to teachers' awareness. Kounin (1970) introduced the concept of withitness. More recent work refers to the construct of situation awareness, as defined by Endsley (1995), and discusses its importance for research on teachers' noticing (Scheiner, 2016; Wolff et al., 2021).

Scheiner (2016) explains the complexity of teachers' noticing in dynamic classrooms by drawing parallels to the construct of situation awareness. Endsley (1995) defined situation awareness as "the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning and the projection of their status in the near future" (p. 36). Scheiner (2016) argues that although both teachers' noticing and situation awareness include the activities of perceiving the classroom and identifying and interpreting situations salient for the teaching activity, situation awareness emphasizes the need for teachers to fully comprehend the overall teaching situation in relation to their goals to define the saliency of situations. Moreover, situation awareness includes projecting upcoming situations based on the present state of events informing their decision-making. A complexity of teaching is that the saliency of situations is defined by the highly dynamic, ever-changing contexts. With respect to teachers' noticing this means that the saliency of situations often depends on the specific moment of their occurrence (Scheiner, 2016). As a consequence, teachers' ability to notice requires them to continuously modify their management goals and decision-making according to what they perceive and interpret, all while maintaining in-the-moment situation awareness (Wolff et al., 2021; Scheiner, 2016).

In the present study, the term *teachers' noticing* refers to the interwoven processes of identifying and interpreting classroom situations that teachers themselves experience as being salient for their CM within their own specific and dynamic teaching context. In line with this definition, salient CM situations refer to those situations that teachers themselves identify as being important to their own CM during teaching. This approach omits a prescriptive perspective about what should be noticed during teaching. Instead, it assumes that teachers act according to their experience-based perception and interpretation of classroom events and situations (Wolff et al., 2021). In literature this is referred to as an 'emic' or 'insider' perspective, which outweighs the teachers' perspective over that of the researcher as an 'outsider' (e.g., Marland & Osborne, 1990; Mathijssen, 2006; Parker-Katz & Bay, 2008). This perspective takes the stance that people act in accordance to what they value as important at a certain moment, rather than what seems to be most effective (Wardekker, 1999; as cited in Mathijssen, 2006).

1.2. Teachers' noticing in different phases of their career

Previous studies have shown that teachers' noticing, including the identification and interpretation of classroom situations, proceeds differently in various career phases (Carter, 2008; Clarridge & Berliner, 1991; Sabers et al., 1991). As teachers' noticing is guided by

knowledge on teaching and learning (Palmeri et al., 2004; Stürmer et al., 2013), differences are associated with the developmental phase of teachers' knowledge organization in long-term memory (Berliner, 2001). Expertise theories state that knowledge-organization is a non-linear process, in which various critical developmental phases can be distinguished (Boshuizen & Schmidt, 2008). While research on teaching expertise often only compares novices with experienced or expert teachers, research in other professional domains, such as medical reasoning, has revealed that an intermediate phase of expertise is characterized by unique domain-specific cognitive developments (Boshuizen & Schmidt, 2008).

As the transition of beginning teachers from study to workplace is accompanied with many persistent challenges (Le Maistre & Paré, 2010; Tynjälä & Heikkinen, 2011), this can be considered as an important intermediate phase in the teaching career. While preservice teachers are still enrolled in teacher training institutes and teach lessons under supervision of an experienced mentoring teacher, beginning teachers gain full independence and responsibility over their classrooms (Le Maistre & Paré, 2010; Tynjälä & Heikkinen, 2011). This contrast is associated with the "reality shock" that many beginning teachers experience (Veenman, 1984). To draw appropriate conclusions for professional training, it is crucial to also take the intermediate phase related to the teaching domain into account. Based on Boshuizen and Schmidt (2008), we define the following three levels of teachers' professional development in the present study: preservice teachers (i.e., novices) who are still enrolled in formal teacher education (third or fourth year students), beginning teachers (i.e., intermediates) who fully transitioned to the teaching practice, and experienced teachers with over ten years of teaching experience.

Each of these developmental phases has particular characteristics concerning knowledge organization in long-term memory and its accessibility for teachers' noticing (Borko & Livingston, 1989). Experienced teachers generally have knowledge bases that are extensive, well-integrated, and readily accessible, which support their fast and flexible recognition of salient situations and their understanding of ongoing classroom interactions (Berliner, 2001; Borko & Livingston, 1989; Putnam, 1987; Wolff et al., 2021). They have acquired well-developed practical knowledge of CM issues based on experience in the teaching practice, which facilitates analyzing classroom situations from a knowledge-driven (top-down) perspective (Meijer et al., 2002; Wolff et al., 2016). Preservice and beginning teachers have not yet developed such sophisticated knowledge (Borko & Livingston, 1989). Preservice teachers typically have fragmented knowledge bases that contain theoretical knowledge learned in teacher education and practical knowledge acquired during internship phases (Borko & Livingston, 1989; Meijer et al., 2002). Fragmented knowledge is associated with difficulties in the recognition and interpretation of relevant CM situations (Wolff et al., 2016). Such knowledge bases are assumed to develop into more interconnected knowledge networks of beginning teachers due to increasing classroom experience, which in turn supports their ability to recognize, understand, and make decisions about CM issues (Wolff et al., 2021). Although both preservice and beginning teachers often have to actively search for relevant cues to understand classroom situations, this process becomes less cognitively demanding with increasing experience due to better developed and accessible knowledge structures (Wolff et al., 2021; Berliner, 2001; Borko & Livingston, 1989).

Previous research has shown that preservice, beginning and experienced teachers differed in their perceptions and interpretations of classroom situations when observing video recordings of other teachers' lessons (Sabers et al., 1991). Similar results were found in the context of CM. Van den Bogert et al. (2014)

showed that experienced teachers identified more salient CM situations compared to preservice teachers when viewing short problematic CM video-clips of other teachers. When experienced teachers identified a salient CM situation in the video they kept monitoring the classroom, whereas preservice teachers focused on the identified situation and missed other relevant situations. Additionally, Wolff and colleagues showed that preservice and experienced teachers differed in terms of what they focused on and how they interpreted the meaning of events identified in these CM video-clips. Experienced teachers focused more on themes such as students' learning and the teacher's role in supporting this, while preservice teachers focused more on students' behavior and maintaining order (Wolff et al., 2015, 2017). In line with these studies, we assume that the frequency and focal points of what CM situations teachers notice change as teachers develop knowledge and skills in the classroom.

1.3. Studying teachers' noticing from the actor's perspective

Studies investigating teachers' noticing of CM situations from the observer's perspective have some limitations. When using videos of other teachers' classroom practices, an important issue is that simply observing others disconnects teachers' thoughts from their actions. This is problematic because they both affect each other during classroom teaching: teachers' thoughts can influence their actions; teachers can think during an action or actions themselves can change existing thoughts or activate new thoughts (Richardson, 1996). Another difference between observing a video and noticing classroom situations during teaching is, where the teacher's attention is allocated. During their own teaching, teachers have to spread their attention very differently from when they observe a video (Stürmer et al., 2017). Moreover, when observing classroom videos from others, teachers lack the knowledge they normally would have when teaching their own class (e.g., lesson planning, goals, students) (Kleinknecht & Schneider, 2013). Hence, studying teachers' noticing from the actor's perspective in their own authentic classrooms contributes to a broader and more comprehensive understanding of the cognitions involved in classroom teaching.

But how to capture teachers' noticing during their own teaching? Various in-action (i.e., during teaching) and on-action (i.e., after teaching) methods exist (Van Hout-Wolters, 2000; Veenman, 2005), which can be used to capture teachers' noticing from an actor's perspective. Although in-action methods are ideally being used, many of those methods (e.g., think aloud) interrupt the lesson flow or are additional tasks for teachers, which they might incidentally forget to perform (e.g., using a clicking device) (Crasborn et al., 2010). In contrast, on-action methods (e.g., post-hoc interviews) enable the continuation of authentic actions by measuring cognitions in retrospect, but might result in teachers not remembering their exact thoughts or, when videos are used, reporting on additional thoughts triggered by the video material (Calderhead, 1981; Yinger, 1986). As all methods have their advantages and disadvantages (for an overview see Crasborn et al., 2010), it is recommended to use a multi-method approach to capture cognitions (Van Hout-Wolters, 2000; Veenman, 2005). In particular, Crasborn et al. (2010) suggest based on an inventory of existing methods to capture 'reflective moments' (i.e., in the current study teachers' noticing of CM situations) in authentic contexts by combining an in-action method (e.g., clicking device) and a stimulated-recall interview as an on-action method.

To our knowledge, only two case studies explored teachers' noticing, or professional vision, from an actor's perspective while using an emic approach to capture salient classroom situations (Sherin et al., 2008; Xu et al., 2019). These studies were not

conducted in the context of CM. Sherin et al. (2008) used a clicking device that the teacher pushed during teaching as an in-action method to capture the occurrence of noticed classroom situations. In contrast, Xu et al. (2019) captured those situations after the lesson by using a stimulated-recall interview as an on-action method. Both studies captured the teachers' actor-perspective cognitions that accompanied the noticed situations during a stimulated-recall interview after the lesson. To improve the activation of actor-perspective cognitions during this interview, they used videos made from the teachers' own perspective during teaching, instead of general classroom videos. Such front-view videos allow teachers to relive their lesson 'through their own eyes' by only showing those situations teachers actually attended to during teaching (Sherin et al., 2008; Xu et al., 2019).

1.4. The present study

As stated earlier, the goal of the present study is to explore preservice, beginning and experienced teachers' noticing of salient CM situations from an actor's perspective during their own teaching at secondary school level. We investigate teachers' noticing in terms of frequency, distribution in the lesson time, and nature of noticed CM situations.

To capture teachers' noticing of salient CM situations from an actor's perspective, we used a two-method approach: 1) as an in-action method, teachers provided a hand-signal during teaching when they noticed a salient CM situation, 2) as an on-action method, they identified during a stimulated-recall interview any salient CM situation in their front-view lesson videos that they had noticed but forgot to signal while teaching. To identify the nature of noticed CM situations, teachers reported during this same interview on their accompanying actor-perspective cognitions.

The two-method approach helped to address the research questions below, which were dealt with using a combination of qualitative and quantitative analysis strategies.

- 1A. What are the frequencies and distributions within the lesson time of CM situations preservice, beginning and experienced teachers noticed during their own teaching? And how are they related to the in- and on-action methods to capture them?
- 1B. (How) do the frequencies of noticed CM situations and the occurrence of the in- and on-action methods differ between teacher groups?
- 2A. What is the nature of CM situations preservice, beginning and experienced teachers noticed during their own teaching?
- 2B. (How) does the nature of noticed CM situations differ between teacher groups?

The current study contributes in various ways to previous research conducted in this discipline. First, the focus is on what teachers themselves experience as salient CM situations while teaching their own mainstream classrooms. Second, the focus on the actor's perspective allows for studying teachers' noticing while their thoughts and actions co-occur, resulting in more ecologically valid results. Third, we use an innovative two-method approach, including an in-action and on-action method based on front-view teaching videos, to capture teachers' noticing from an actor's perspective. Fourth, the present study goes beyond the common comparison of preservice and experienced teachers by also including beginning teachers who fully transitioned to the workplace. Inclusion of a beginner's group provides a more nuanced understanding of how teachers' noticing gradually develops and differs as practical experience is acquired. The cumulative results

from our study provide an empirical foundation for analyzing and training preservice and beginning teachers' noticing that supports knowledge and skills for CM.

2. Method¹

2.1. Research design

An explorative mixed-method design was used to answer the research questions. Johnson and Onwuegbuzie (2004) define mixed-method research as "the class of research where the researcher mixes or combines quantitative and qualitative research techniques, methods, approaches, concepts or language into a single study." Given the explorative nature of the current study, qualitative methods (i.e., in- and on-action signaling methods and stimulated-recall interviews) were used to collect the data, and were then analyzed using a combination of qualitative and quantitative analysis strategies. This combination of approaches within and across different research stages is referred to by Johnson and Onwuegbuzie (2004) as a mixed-model design. Qualitative analyses allowed the emergence of characteristics regarding the identification (in-action vs on-action methods; first research questions) and the nature (second research questions) of noticed CM situations. Quantitative analyses enabled the exploration of within-group characteristics and the use of statistical analyses to explore any significant between-group differences.

2.2. Participants

Participants were 58 teachers teaching in schools for secondary education throughout the Netherlands. One outlier was excluded based on the number of noticed CM situations.² The data of the remaining 57 participants (21 preservice; 17 beginning; 19 experienced teachers) were used for further analyses. The preservice teachers ($M_{age} = 22.81$; $SD = 2.71$; 53% female) were third ($n = 8$) or fourth ($n = 13$) year students enrolled in teacher training colleges. In the Netherlands preservice teachers have to independently teach classes in the final phase of their education to experience and learn from the real teaching practice. During this phase they are assigned to specific classes at their internship school. Beginning teachers had on average two and a half years of teaching experience after receiving their teaching certificate ($M_{experience} = 2.51$; $SD = 1.31$; $min = 0.5$; $max = 5$; $M_{age} = 25.82$; $SD = 2.94$; 41% female). Experienced teachers had at least ten years of teaching experience in secondary education ($M_{experience} = 17.61$; $SD = 4.60$; $min = 12$; $max = 25$; $M_{age} = 45$; $SD = 8.82$; 53% female). Teachers' backgrounds comprised all major disciplines including Dutch, English, French, German, Mathematics, Biology, Chemistry, Physics, History, Geography, Art, Philosophy and Latin.

Participating classes covered all three of the main levels of the Dutch system for secondary education: pre-vocational secondary education (students in the age of 12–16; four years; grade 7–10), senior general secondary education (age 12–17; five years; grade 7–11), and pre-university education (age 12–18; six years; grade 7–12). All classes that participated were from grades 7–10, except for one grade 11 classroom.

All teachers, students, parents and school boards received an information letter that informed them about the research goals and procedure. Teachers and school boards signed informed consents.

¹ A detailed description of the data set can be found in Van Driel et al. (2021)

² Box plots showed one extreme outlier, with a value of more than three box lengths from the edge of the box, in the group of preservice teachers regarding the number of noticed CM situations.

The research project was approved by the ethical committee of the Open Universiteit.

2.3. Materials

We used SMI eye tracking glasses (60 Hz) to register teachers' noticing of CM situations (see Fig. 1). Teachers taught a lesson while wearing the eye tracking glasses. The device contains a front-view camera that is situated within the frame and records a classroom video from the teacher's actor's perspective. A microphone captures the teacher's speech and sound within the classroom environment.

2.4. Data collection

A two-method approach to identify noticed CM situations. We used a two-method approach to identify CM situations teachers noticed during their own teaching. This included an in-action method during teaching and on-action method after teaching.

In-action hand-signaling method. The in-action method concerned teachers giving an *in-action* hand-signal to the front-view camera of the eye tracking glasses when consciously noticing a salient CM situation during teaching (see Fig. 2, left). The camera registered the hand-signal, which was visible in the video recording of the lesson (see Fig. 2, right). The first author repeated the instructions for the in-action hand-signaling method verbally to the teacher right before the lesson start. Teachers were instructed to provide a hand-signal to the front-view camera of the eye tracking glasses when they “experienced a classroom situation themselves as being important for their CM during teaching” (i.e., salient CM situation). To remind teachers to give the hand-signal during the lesson, a small poster with an emoji was placed on their classroom desk. Then, the front-view camera (i.e., eye tracking glasses) was placed on the participant followed by a three-point calibration. After the researcher gave a verbal instruction to the students in the classroom, the teacher taught their lesson with the front-view camera.

On-action stimulated-recall method. For the on-action method, teachers were asked in a stimulated-recall interview immediately after the recorded lesson, to supplement their identification of noticed CM situations by adding situations they had forgotten to signal during teaching. To support the recall of forgotten noticed CM situations, teachers viewed the front-view videos of their lesson in accelerated rate. They were instructed to indicate when

they recognized in the video stimuli a CM situation they had noticed during teaching as being salient for their CM, but which they forgot to identify with the hand-signal.

During the same interview teachers viewed the front-view videos of all situations they had identified with the in-action and on-action method, using the software program SMI BeGaze 3.7.40 (see Fig. 3). For all noticed CM situations, teachers reported what was on their mind during these specific moments in the lesson. These verbalizations formed the basis for defining the nature of noticed CM situations.

2.5. Data-analysis

2.5.1. Frequencies of noticed CM situations

We defined the total frequencies of noticed CM situations and the frequencies and percentages of the identification method used (i.e., in-action hand-signaling and on-action stimulated-recall) for each of the three teacher groups. Situations that teachers identified in-action were recognizable in the video-recordings by their hand-signal. These situations received the label ‘identified in-action’. All situations that teachers identified while viewing the video during the simulated recall interview received the label ‘identified on-action’. The lesson lengths varied per teacher (group): ranging from 37,0 to 59,9 minutes ($M = 46,9$) for preservice teachers; 36,3 to 61,0 minutes ($M = 49,3$) for beginning teachers; 36,5 to 64,9 minutes ($M = 52,4$) for experienced teachers. We computed the number of noticed CM situations and the occurrence of the identification methods per participant per minute to be able to compare between groups.

Three Kruskal-Wallis Tests were conducted to explore significant differences among teacher groups in the frequencies of total noticed CM situations and the type of identification method used, all defined per minute. We used a non-parametric test because box-plot analysis showed some non-significant outliers spread over variables and teacher groups and because one of the independent variables showed evidence of non-normality. The Kruskal-Wallis test is assumed to be less sensitive for both issues compared to a parametric test (Chan & Walmsley, 1997; Field, 2009). The assumptions of a Kruskal-Wallis test were met as observations were independent, dependent variables were measured on a continuous level and independent variables concern three categorical independent groups (Mangiafico, 2016). We calculated the global effect sizes using the squared epsilon (ϵ^2) (small effect < 0.08; medium effect < 0.26; large effect ≥ 0.26) (Mangiafico, 2016), which is considered to be an appropriate measure for the Kruskal-Wallis test (Tomczak & Tomczak, 2014).

2.5.2. Distributions of noticed CM situations

For each of the noticed CM situations, we defined the moment in time within the lesson when teachers noticed the situation. When a situation was identified with the in-action hand-signaling method, we registered the moment in time that the hand-signal was visible in the lesson recordings. When a situation was identified with the on-action stimulated-recall method, we registered the start time of the video-clip in the lesson recording showing the noticed CM situation.

Following Van den Bogert et al. (2014), we developed temporal heat maps to present the distribution of noticed CM situations within the lesson time per teacher group. Temporal heat maps consist of a timeline representing the course of a lesson, in which colored bars give information on the number of CM situations a teacher group noticed within a particular time within a lesson (see Fig. 5 in the Results section). Each colored bar represents 2 minutes of lesson time. For instance, a red bar shows that a teacher group noticed at least six CM situations in a specific 2-minute lesson



Fig. 1. The picture shows the SMI eye tracking glasses that were used in the present study and the position of the front-view camera in the frame of the device.

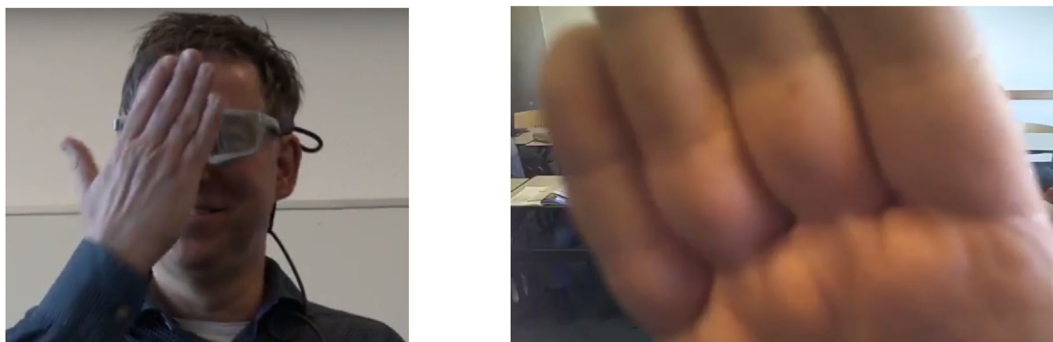


Fig. 2. The pictures show the hand-signal teachers made during teaching to identify the noticed CM situations (left) and how this signal is traceable in the lesson recordings (right).

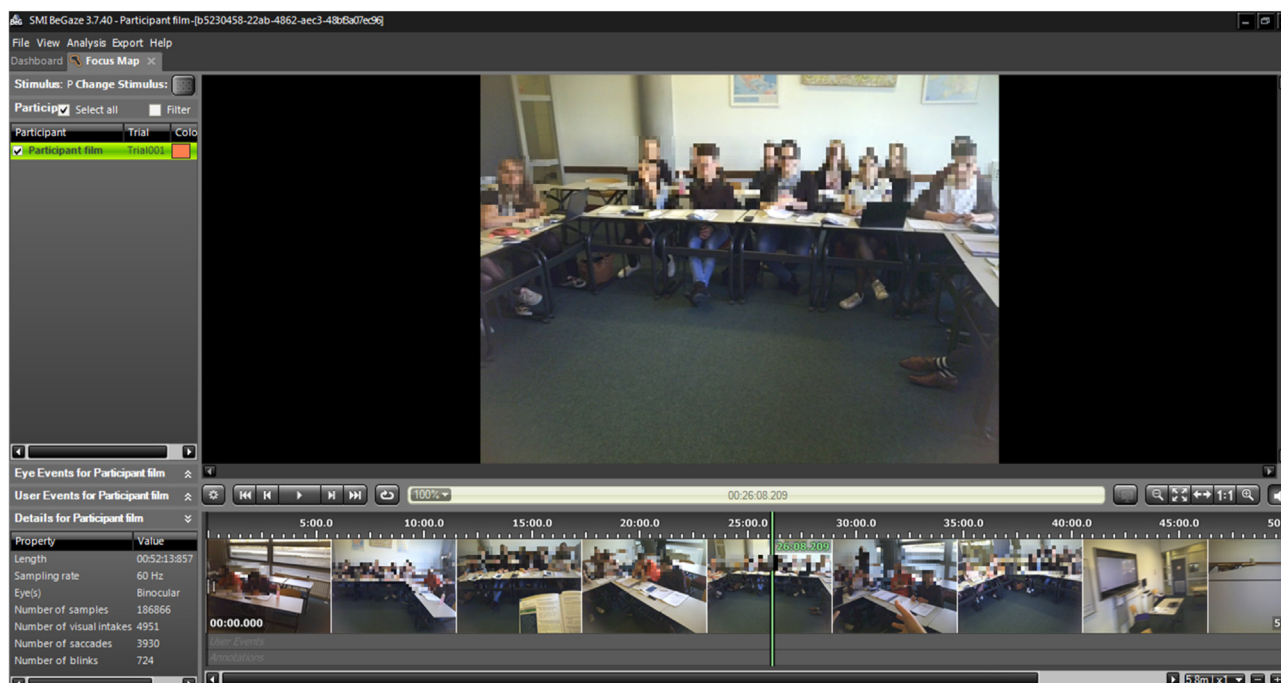


Fig. 3. Screen of the front-view videos in SMI BeGaze 3.7.40 that was used for the stimulated-recall interviews.

interval. Because the duration of the recorded lessons varied per teacher, we developed the heat maps based on the relative time that a situation was noticed during a lesson compared to the longest lesson that was recorded (i.e., 64.9 minutes).

2.5.3. Nature of noticed CM situations

Mixed-method analysis was used to investigate per teacher group the nature of noticed CM situations and differences between groups.

Qualitative analysis. Teachers' verbal protocols collected during the stimulated-recall interviews were used to develop a coding scheme for defining the nature of noticed CM situations. We developed the coding scheme using content analysis, which allows coders to stay close to the data and combine inductive and deductive coding strategies while also providing quantitative frequencies for post-coding statistical analysis for further interpretation (Bos & Tarnai, 1999; Elo & Kyngäs, 2008). In line with the explorative nature and the situational perspective on teacher behavior of the current study, the coding scheme was mainly developed inductively by relying on teachers' verbalizations about the CM situations they noticed as the basis for analysis rather than

applying theories or codes from prior research. When applicable, terminology to label and define coding categories and associated codes was adopted from existing research.

Based on the data quality, we randomly selected the verbal protocols of twelve participants (4 preservice, 4 beginning; 4 experienced teachers). The unit of analysis concerned a whole verbalization accompanying one noticed CM situation reflecting the teachers' cognitions during teaching. Because the verbalizations accompanying a noticed CM situation had strict boundaries set by the in-and-on-action approach, there was no need to define agreement in segmentation (Strijbos et al., 2006).

As a first step in the coding process, the first author conducted a round of inductive coding on the verbalizations in the selected protocols to develop a first set of codes. Within each verbalization, the nature of the situation that formed the basis for teachers' noticing received a code. During iterative rounds of coding, codes were merged, adapted and combined into categories. We developed a coding manual including an overview of categories and codes, descriptions of each code and coding instructions.

Secondly, the manual was checked and discussed with an experienced mixed-method coder (the third author) resulting in

further refinements. This coding process resulted in four categories of codes: 1) Classroom and Lesson Organization, 2) Teaching Strategies, 3) Student Behavior, and 4) Interpersonal Relations and Classroom Climate. Fig. 4 presents the coding scheme including the categories and codes, code descriptions and examples of each code.

Thirdly, to define the reliability of the coding process, a second coder unfamiliar with the data coded the twelve protocols (including 121 noticed CM situations) that were used to develop the

coding scheme (27% of the total number of noticed CM situations). The second coder participated in a training session to become familiar with the coding manual. Then, in two rounds, interrater reliability tests were conducted with the software program Dedoose (version 8.3.35), which uses Pooled Cohen's Kappa to define the agreement in coding. First, we performed two tests of each three transcripts resulting in Pooled Cohen's Kappa's of 0.79 and 0.88. These scores are considered to be substantial and

	Code	Code description	Example
Category 1 Classroom and Lesson Organization	Lesson Planning	Situations focusing on the lesson planning, the lesson content (without centralizing the role of instructional strategies), time management or administrative aspects.	<i>At this moment, I noticed that I was very chaotic during the assignment of homework. So, lately I try to make sure that I take a clear moment for that. That's why I indicated this moment: I was very focused on asking for a quiet moment now. But also that it is clear for them when and what the homework exactly is. (...) (Beginning teacher)</i>
	Physical Classroom Organization	Situations focusing on the organization of the classroom environment including furniture and students' seating arrangements, the distribution and organization of (teaching and learning) materials and technical issues.	<i>Okay, messing around with the screen. She [i.e., preservice teacher's mentoring teacher] kept trying and I was thinking like, if it doesn't work, than we have to search for another solution. As long as the group can start working. But no, we continued with that screen, we were going to break it. And I was telling the students that they had to remain seated. (...) (Preservice teacher)</i>
	Transition Moment	Situations focusing on transition moments in the lesson including the lesson entrance, start or ending, changing work forms or changing activities within a work form.	<i>Yes, here I ended the lesson. First with the comment about, yes the notes in their notebook and then with the compliment that they eventually worked very well, worked very quietly. And the clear message that they had to remain seated on their own chairs until the school bell starts ringing. (...) (Preservice teacher)</i>
Category 2 Teaching Strategies	Giving Instruction ^a	Situations focusing on teachers' instruction regarding the lesson content or their expectations regarding student behavior.	<i>Yes, during the instruction I try to explain my expectations. And I discuss all questions to check whether they understand everything and I shortly discuss the words I expect them to find difficult. There were not that many in this case. By doing so, I try to make sure that everyone understands what they have to do. (...) (Preservice teacher)</i>
	Supporting/Activating Students ^a	Situations focusing on teacher actions to positively activate students' involvement in the lesson activity or to support students in their learning process.	<i>Oh yes that's why I briefly look at the girls. Here I briefly make sure the girls become involved and I make a little joke to remind them that it is also fun. And then they are engaged again you know. So for a brief moment I move away from the boring instruction, make a small joke and then we continue again. (...) (Beginning teacher)</i>
	Monitoring/Controlling Student Behavior ^a	Situations focusing on teacher's role in monitoring or controlling student behavior or checking up on their involvement in the lesson activity.	<i>I make those rounds on multiple occasions. I don't stay seated on my chair and say that they have to start working. I keep walking around, I monitor them, in the hope that they think that they have to do something. And sometimes that really works and they start working. (...) (Preservice teacher)</i>
	Regulating Problematic Student Behavior ^a	Situations focusing on teacher's role or actions in regulating problematic student behavior.	<i>Yes, here I think it is wise that I wrote down the names of all students who did not do their homework or did not manage to bring their books. I do this every lesson, even though it takes me a few minutes. But I believe that everyone should do their homework. If they don't do that, then they will be punished. (Preservice teacher)</i>
Category 3 Student Behavior	Student Discipline ^b	Situations focusing on student discipline including student behavior described as strange, distracted, problematic, or against expectations.	<i>I really wanted to discuss what was going on and I see in a flash that Eva has put her feet on the chair of the neighbor in front of her. And yes I think that they have to use the furniture in the classroom in an appropriate way. (...) (Experienced teacher)</i>
	Student Engagement ^b	Situations focusing on (a) student(s) who is/are involved in the lesson activity and listen or interact with the teacher or follow up on teacher instruction.	<i>Here they all get started and I always think that is important for classroom management that they are working on something instead of simply listening. That they have to sort stuff out themselves and I noticed at this moment that they were actually doing that. (...) (Experienced teacher)</i>
Category 4 Interpersonal Relations and Classroom Climate	Classroom Relations	Situations focusing on the interpersonal relation between teacher and student(s) or on the learning climate characterized by concepts as (classroom) climate, peace, safety, order.	<i>This is the moment when they come to me to talk about the test. And then I discuss with them how they think it went. Yes I know that they did it well, but to calm them down, I said trust that you did it well. And I especially tried to calm her down. She was almost bouncing. (...) (Preservice teacher)</i>

Note. ^a Inspired by Richter (2020). ^b Adapted from Wolff et al., (2015).

Fig. 4. Overview of the coding scheme for defining the nature of noticed CM situations, including categories and codes, code descriptions and examples of each code.^aInspired by Richter (2020). ^bAdapted from Wolff et al. (2015).

excellent agreement (Viera & Garrett, 2005). Furthermore, a final test was conducted using six transcripts also resulting in an excellent agreement with a Pooled Cohen's Kappa of 0.83 (Viera & Garrett, 2005). Thereafter, the primary coder (first author) continued coding the remaining transcripts (73% of the data).

Quantitative analysis. To gain insight into the nature of noticed CM situations per teacher group, we first computed and analyzed the frequencies and percentages of the occurring categories and codes. To explore any statistical differences in the category and code occurrence among teacher groups, we defined how often a category or code occurred with respect to the total number of codes provided per teacher (i.e., relative category and code occurrence). This was followed by multiple non-parametric Kruskal-Wallis tests because various variables showed signs of non-normality and included outliers (Field, 2009). The data met the assumptions of the Kruskal-Wallis test as previously discussed.

3. Results

3.1. Frequencies and distributions of noticed CM situations by identification method

3.1.1. Within-group characteristics

Frequencies. Table 1 presents the frequencies of total noticed CM situations per teacher group and the occurrence of the identification methods. Preservice teachers identified more CM situations through the on-action stimulated-recall method, while beginning and experienced teachers identified more CM situations through the in-action hand-signaling method.

Distributions. Fig. 5 shows temporal heat maps for each teacher group presenting the distribution of noticed CM situations and the occurrence of the identification methods within the lesson time. The heat map of the preservice teachers shows many red and orange bars throughout the course of the lesson time representing clusters in which they noticed many CM situations. The on-action stimulated-recall method occurred most often and throughout time, whereas the in-action hand-signaling method occurred less often during the second half of the lesson time. The heat map of beginning teachers showed that they noticed more CM situations toward the middle and during the second half of the lesson time and fewer during the beginning. The occurrence of the in-action method dominated throughout time. The heat map of experienced teachers shows that they noticed more CM situations during the first three quarters of the lesson time and fewer toward the lesson ending. Although experienced teachers identified most situations through the in-action method, both methods occurred steadily throughout the lesson time.

3.1.2. Between-group comparison of frequencies of noticed CM situations and occurrence of identification methods

Table 2 shows the results of Kruskal-Wallis tests conducted to explore group differences in the frequency of noticed CM situations and the occurrence of identification methods per minute. No significant differences were found between teacher groups for the total number of noticed CM situations per minute. Teacher groups showed significant differences for both the occurrence of the in-action hand-signaling method per minute and the on-action stimulated-recall method per minute (see Table 2). Dunn-Bonferroni post-hoc tests revealed that after Bonferroni adjustments beginning teachers identified significantly more situations per minute through the in-action hand-signaling method compared to preservice teachers, while preservice teachers

identified significantly more situations through the on-action stimulated-recall method per minute compared to beginning teachers (see Table 2). The accompanying effect sizes are medium (Mangiafico, 2016).

3.2. Nature of noticed CM situations

3.2.1. Within-group characteristics

Table 3 presents the frequencies and percentages per teacher group of the category and code occurrence describing the nature of noticed CM situations. All teacher groups shared similar characteristics regarding the three main occurring categories (i.e., Student Behavior, Teaching Strategies and Classroom and Lesson Organization), while they noticed CM situations on Interpersonal Relations and Classroom Climate the least.

Preservice teachers. On category level, preservice teachers noticed most CM situations showing Student Behavior, followed by situations on Classroom and Lesson Organization and Teaching Strategies. On code level, they noticed most situations showing Student Discipline, followed by Transition Moments. In the category Teaching Strategies, they focused slightly more often on Monitoring/Controlling Student Behavior compared to the other strategies.

Beginning teachers. On category level, beginning teachers noticed CM situations showing Student Behavior most, followed by situations on Teaching Strategies and Classroom and Lesson Organization. On code level, they noticed CM situations showing Student Discipline most, followed by Transition Moments. In the category Teaching Strategies, they focused slightly more often on Supporting/Activating Students.

Experienced teachers. On category level, experienced teachers noticed CM situations centered on Teaching Strategies and Classroom and Lesson Organization most, followed by situations showing Student Behavior. On code level, they noticed CM situations showing Student Discipline most, followed by Transition Moments. In the category Teaching Strategies, they focused slightly more often on Supporting/Activating Students.

3.2.2. Between-group comparison

Table 4 shows the results of Kruskal-Wallis tests that were conducted to explore differences between teacher groups in relative category and code occurrence. There were no significant differences between the teacher groups.

4. Discussion and conclusion

The goal of the present study was to explore preservice, beginning and experienced teachers' noticing of salient CM situations from an actor's perspective during their own teaching at secondary school level. Teachers wore a front-view camera during teaching. We captured teachers' noticing of CM situations from an actor's perspective by combining an in-action hand-signaling and on-action stimulated-recall method. We analyzed the frequency and distribution of noticed CM situations per teacher group, as well as the occurrence of the identification methods, and explored statistical differences between groups. Moreover, we developed a coding scheme based on teachers' verbal protocols to define the nature of noticed CM situations followed by quantitative analysis to explore characteristics within and statistical differences between teacher groups.

Table 1
Frequencies and percentages of total noticed CM situations and the occurrence of the identification methods per teacher group.

	Teacher groups		
	Preservice (n = 21)	Beginning (n = 17)	Experienced (n = 19)
In-action hand-signaling	60 (38.46%)	115 (76.67%)	88 (63.31%)
On-action stimulated-recall	96 (61.54%)	35 (23.33%)	51 (36.69%)
Total noticed CM situations	156 (100.00%)	150 (100.00%)	139 (100.00%)

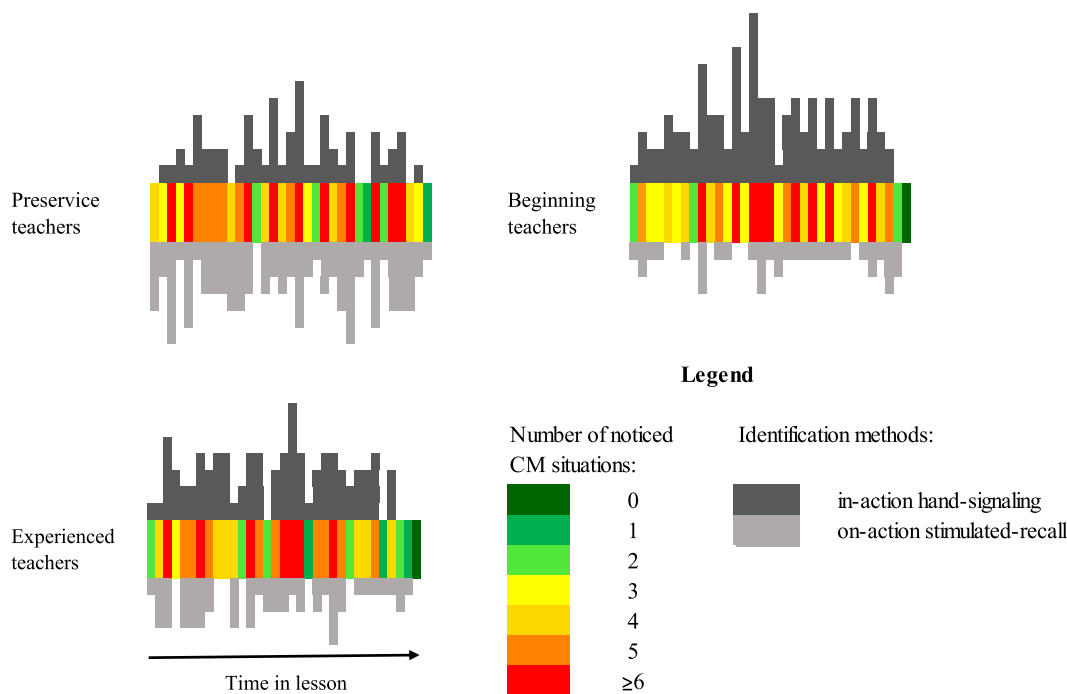


Fig. 5. Temporal heat maps (based on Van den Bogert et al., 2014) showing the distribution of noticed CM situations within the lesson time and the occurrence of identification methods per teacher group.

Table 2
Differences between teacher groups regarding the total number of noticed CM situations and the occurrence of the identification methods (p/m).

	Teacher groups			Kruskal-Wallis and Dunn-Bonferroni Post-Hoc Tests				
	Preservice (n = 21)	Beginning (n = 17)	Experienced (n = 19)	χ^2	df	2-sided Sig. (p-value) ^a	ϵ^2	Dunn-Bonferroni Post-Hoc ^{a/b}
	Mean Rank	Mean Rank	Mean Rank					
Number of noticed CM situations	29.71	32.15	25.39	1.55	2	.462	.028	ns
In-action hand-signaling method	21.76	36.62	30.18	7.68	2	.022	.137	P vs. B (p = .018)
On-action stimulated-recall method	37.48	22.00	25.89	9.18	2	.010	.164	P vs. B (p = .013)

^a The significance level is .05.

^b ns = Not statistically significant; P vs. B = Preservice versus Beginning teachers.

4.1. Frequencies and distributions of noticed CM situations

The first research questions addressed the frequencies and distributions of CM situations preservice, beginning and experienced teachers noticed during their own teaching and how this relates to the in- and on-action methods to capture them. In addition, it also addressed how the frequencies of noticed CM situations and the occurrence of the in- and on-action methods differ between teacher groups. In contrast to previous research using other teachers' classroom videos (Van den Bogert et al., 2014), we found no differences regarding the frequency in which teacher groups noticed CM situations during teaching. All groups noticed an almost similar amount of salient CM situations throughout their

lessons. Although beginning teachers seemed to notice slightly fewer situations during the start of the lesson and experienced teachers fewer toward the end of the lesson, noticed CM situations were distributed throughout the lesson time. This finding is, however, consistent with a prior study showing that regardless of experience the majority of teachers' 'bumpy moments' during teaching are CM issues (Romano, 2006). In line with this, our study seems to point out that CM is a concern for teachers throughout their careers and that teachers are able to remain consciously engaged with CM situations during their lessons.

Regarding the methods used to capture teachers' noticed CM situations, we found that preservice teachers identified more situations through the on-action stimulated-recall method and

Table 3
Frequencies and percentages of category and code concurrence within teacher groups reflecting the nature of noticed CM situations.

	Teacher groups		
	Preservice (%) (n = 21)	Beginning (%) (n = 17)	Experienced (%) (n = 19)
Classroom and Lesson Organization	48 (30.77)	40 (26.67)	46 (33.09)
Lesson Planning	8 (5.13)	7 (4.67)	13 (9.35)
Physical Classroom Organization	12 (7.69)	5 (3.33)	12 (8.63)
Transition Moment	28 (17.95)	28 (18.67)	21 (15.11)
Teaching Strategies	38 (24.36)	41 (27.33)	47 (33.81)
Giving Instruction	8 (5.13)	6 (4.00)	12 (8.63)
Supporting/Activating Students	7 (4.49)	16 (10.67)	19 (13.67)
Monitoring/Controlling Student Behavior	17 (10.90)	9 (6.00)	15 (10.79)
Regulating Problematic Student Behavior	6 (3.85)	10 (6.67)	1 (0.72)
Student Behavior	58 (37.18)	62 (41.33)	40 (28.78)
Student Discipline	51 (32.69)	58 (38.67)	30 (21.58)
Student Engagement	7 (4.49)	4 (2.67)	10 (7.19)
Interpersonal Relations and Classroom Climate			
Classroom Relations	12 (7.69)	7 (4.67)	6 (4.32)
Total	156 (100.00)	150 (100.00)	139 (100.00)

beginning and experienced teachers through the in-action hand-signaling method. The findings differed significantly between preservice and beginning teachers. Consistent with expertise literature (Boshuizen & Schmidt, 2008; Wolff et al., 2021), this suggests that beginning teachers, compared to preservice teachers, use less cognitive resources to notice CM situations due to their more developed knowledge network. Hence, beginners seem to have more mental capacity available for additional tasks during teaching such as an in-action hand-signal, while preservice teachers depend more on on-action methods. The absence of significant differences between experienced teachers and the other teacher groups indicates a non-linear development in this respect (Dall’Alba & Sandberg, 2006). The fact that experienced teachers’ noticing was captured more often by the on-action stimulated-recall method than beginners, but less than preservice teachers, might be the result of the automaticity that they have acquired for using their cognitive skills during teaching (Hattie, 2003). Overall, findings regarding the occurrence of identification methods imply the relevance of including the group of beginning teachers. Although at first sight the occurrence of the in- and on-action methods seem to show a comparable pattern for preservice and experienced teachers, data from the group of beginning teachers

suggest that different underlying processes are involved in the identification of CM situations in all teacher groups.

The heat maps illustrate the validity of the methods used to capture teachers’ noticing of CM situations from an actor’s perspective. The results indicate that teachers maintain a continuous awareness to notice and identify salient CM situations throughout the lesson time. Moreover, the heat maps show that both the in-action hand-signaling and on-action stimulated-recall method occur throughout the course of the lesson in all teacher groups. This finding suggests that teachers can readily remain aware and continuously identify salient CM situations with an in-action method during teaching, but that this method alone does not suffice for capturing all of their noticed CM situations. Thus, this finding underlines the outcome of previous research emphasizing the value of using a multi-method approach to register actor-perspective cognitions (Crasborn et al., 2010; Veenman, 2005). More specifically, our study shows the need to combine in-action and on-action methods to draw a complete picture of teachers’ noticing of CM situations during teaching.

Table 4
Differences between teacher groups regarding the relative category and code occurrence reflecting the nature of noticed CM situations.

	Teacher groups			Kruskal-Wallis Tests			
	Preservice (n = 21)	Beginning (n = 17)	Experienced (n = 19)	χ^2	df	2-sided Sig. (p-value) ^a	ϵ^2
	Mean Rank	Mean Rank	Mean Rank				
Classroom and Lesson Organization	29.10	26.15	31.45	.92	2	.630	.016
Lesson Planning	27.26	29.68	30.32	.56	2	.757	.010
Physical Classroom Organization	29.12	25.82	31.71	1.56	2	.459	.028
Transition Moment	29.19	28.65	29.11	.01	2	.994	.000
Teaching Strategies	25.52	29.44	32.45	1.77	2	.412	.032
Giving Instruction	28.93	28.03	29.95	.19	2	.909	.003
Supporting/Activating Students	24.29	31.29	32.16	3.36	2	.186	.060
Monitoring/Controlling Student Behavior	29.36	24.12	32.97	3.12	2	.210	.056
Regulating Problematic Student Behavior	29.81	32.24	25.21	3.55	2	.169	.063
Student Behavior	31.52	30.97	24.45	2.18	2	.336	.039
Student Discipline	31.90	31.32	23.71	2.95	2	.229	.053
Student Engagement	29.95	27.29	29.47	.42	2	.810	.008
Interpersonal Relations and Classroom Climate							
Classroom Relations	29.48	28.62	28.82	.04	2	.978	.001

^a The significance level is .05.

4.2. Nature of noticed CM situations

The second research questions addressed the nature of CM situations preservice, beginning and experienced teachers noticed during their own teaching and how teacher groups differ in this respect. Four main categories of codes were established through a process of coding investigating the nature of teachers' noticed CM situations. The categories Classroom and Lesson Organization, Teaching Strategies, and Student Behavior dominated in all three teacher groups, while the category Interpersonal Relations and Classroom Climate only occurred occasionally. In line with theories and research on CM as discussed in the theoretical framework (Brophy, 1988, 2006), all teacher groups seem to share a comprehensive understanding of what their salient CM situations entail without restricting their focus to (dealing with) behavioral issues. Moreover, in line with Pianta (2006), all teacher groups noticed, albeit only occasionally, situations about student-teacher relations and classroom climate as being salient for their CM.

Findings regarding the frequencies in which categories and codes occurred showed similarities between and some minor characteristics within teacher groups. The main focus of all teacher groups was on situations related to student discipline. The majority of these situations concerned minor disciplinary issues such as distracted students, while more serious disturbances or misconduct occurred less often. In line with previous studies (Wolff et al., 2015, 2017), preservice teachers showed a consistent focus on these disciplinary issues. Beginning teachers showed a similar focus. CM situations noticed by experienced teachers were more divided across the dominating categories and corresponding codes, indicating that they are either less concerned with disciplinary issues and/or their teaching generates fewer opportunities for distraction or disruption (Westerman, 1991). Another shared focus across teacher groups was on transition moments. Transitions are known to be challenging situations for many teachers, as they can easily decline towards misconduct and affect learning time (Coddling & Smyth, 2008; McIntosh et al., 2004).

Noticed CM situations in the category of teaching strategies indicate a main focus on proactive (monitoring students, giving instruction), rather than reactive (regulating student behavior) strategies for all teacher groups. In line with Westerman (1991), we found that experienced teachers focused slightly more on supporting or activating students, compared to the other strategies, suggesting that they undertake or value actions that positively engage students in learning activities. Beginning teachers showed a similar result. The finding that preservice teachers focused slightly more on monitoring or controlling student behavior, compared to the other strategies, supports prior work showing that novices often rely on controlling skills as a somewhat 'naïve' approach to manage their students' behavior (Martin et al., 2006; Rosas & West, 2009).

We found no statistical differences in category or code occurrence between teacher groups. This contradicts with previous studies that investigated teachers' noticing from an observer's perspective while watching other teachers' CM video-clips (Wolff et al., 2015, 2017). They showed that preservice teachers focused more on disciplinary issues and experienced teachers on student learning and ways to support this. Explanations for the different results are threefold. One explanation is that we investigated teachers' noticing regarding own-teaching instead of others-teaching, which is known to change teachers' perceptions and interpretations of events (Kleinknecht & Schneider, 2013; Seidel et al., 2011). Moreover, while prior research used short, problematic video-clips (Wolff et al., 2015, 2017), we investigated teachers' noticing while teachers taught a whole lesson, often without blatantly problematic management events. Such differences may

explain the greater variety of noticed CM situations in our study. A third explanation concerns the relatively small differences between expertise groups in our sample. Prior studies compared preservice teachers in their first stage of teacher training to selected expert teachers, our sample included preservice teachers in their final stage of teacher college who had gained teaching experience in their internship schools, beginning teachers who transitioned to the workplace and experienced teachers instead of experts. Less drastic expertise distinctions between teacher groups may dilute cognitive differences (Wolff et al., 2021).

4.3. Limitations and future research

Our study has several limitations. First, participation in the study was voluntary, therefore the risk of self-selection bias and overrepresentation of qualified people exists (Costigan & Cox, 2001; Robinson, 2014). It is likely that participating teachers already had effective CM skills, or at least had high self-efficacy in this respect. Future studies should investigate how participation in this type of research can facilitate the inclusion of teachers that are struggling with the topic of investigation. Second, teachers chose which class they would be teaching when they participated in this study. As being recorded or observed can be stressful for teachers (e.g., Carter, 2008; Praetorius et al., 2017), many may have chosen a class they felt comfortable with rather than one that posed a challenge for their CM. Future research on teachers' noticing of CM situations could broaden the research scope by including challenging or problematic classroom practices. Third, the act of teaching with eye tracking glasses and providing the hand-signal may affect the authenticity of the teaching context. As is the case for all in-action methods (Crasborn et al., 2010), this might have caused minor disturbance in the teaching process. However, the impression from data collection is that the benefits of capturing teachers' noticing in-action surpasses the drawbacks. As we did not use a sensitive method to investigate teachers' noticing of CM situations, interference of the hand-signal with the presented data is expected to be minimal. We recommend that future research using a similar methodological design also includes data about teachers' experiences regarding how the method influences the authenticity of the teaching process.

This study focused on the cognitions involved when teachers notice salient CM situations during teaching, but did not investigate cognitions in relation to teachers' actual responses. An interesting direction for future research investigating (potential) differences across teacher groups in different career phases in terms of both CM cognitions and actions could be to link the cognitions captured during the interview with the actions performed while teaching (as recorded in the front-view videos). An additional extension could be to investigate the relationship between teaching experience and visual perception of salient CM situations by analyzing in-action eye movements alongside CM cognitions.

The absence of statistical differences between teacher groups regarding the frequency and nature of noticed CM situations seems to point toward the direction of a more cyclical development of expertise in this respect, rather than a gradual development through established stages (Dall'Alba & Sandberg, 2006). According to Dall'Alba and Sandberg (2006), professionals develop their knowledge and skills based on an "understanding of, and in, practice". They state that this development is not restricted to the acquisition of new knowledge and skills, but by adjusting and deepening of that what was already learned through experience in practice. With respect to the current study this might indicate that teacher groups noticed similar CM situations during their lessons, but that the cognitions involved in the noticing process might differ on a deeper level through experience in the teaching practice. We

have initiated an additional study to shed light on this issue. Future studies using a longitudinal approach are necessary to gain a better understanding of how teachers' noticing of CM situations develops over time.

To conclude, the current study shows that preservice and beginning teachers do not differ greatly from experienced teachers when it comes to the amount, nature, and distribution of salient CM situations as noticed from an actor's perspective when teaching their own mainstream secondary classrooms. Moreover, this study indicates the methodological importance of combining in-action and on-action methods to capture actor's perspective teachers' noticing, alongside the value of studying teacher groups in three distinct phases of their career.

The two-method approach and front-view videos can be used in teacher training programs to support teachers' noticing as an innovative professional development option. The finding that the in-action method for identifying salient CM situations during teaching appeared more challenging for preservice teachers may serve as a caution for training programs that place the emphasis on learning in authentic situations: such contexts might limit or reduce the learning capacity of many preservice teachers. Additional support may be necessary to make the authentic teaching practice more meaningful.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Declaration of competing interest

The authors declare that there is no conflict of interest.

References

- Bear, G. G. (2015). Preventive and classroom-based strategies. In E. T. Emmer, & E. J. Sabornie (Eds.), *Handbook of classroom management* (2nd ed., pp. 15–38). Routledge/Taylor & Francis.
- Berliner, D. C. (2001). Learning about and learning from expert teachers. *International Journal of Educational Research*, 35(5), 463–482. [https://doi.org/10.1016/S0883-0355\(02\)00004-6](https://doi.org/10.1016/S0883-0355(02)00004-6)
- Borko, H., & Livingston, C. (1989). Cognition and improvisation: Differences in mathematics instruction by expert and novice teachers. *American Educational Research Journal*, 26(4), 473–498. <https://doi.org/10.3102/00028312026004473>
- Boshuizen, H. P. A., & Schmidt, H. G. (2008). The development of clinical reasoning expertise. In J. Higgs, M. A. Jones, S. Loftus, & N. Christensen (Eds.), *Clinical reasoning in the health professions* (3rd ed., pp. 113–121). Butterworth-Heinemann/Elsevier.
- Bos, W., & Tarnai, C. (1999). Content analysis in empirical social research. *International Journal of Educational Research*, 31(8), 659–671. [https://doi.org/10.1016/S0883-0355\(99\)00032-4](https://doi.org/10.1016/S0883-0355(99)00032-4)
- Brophy, J. (1988). Educating teachers about managing classrooms and students. *Teaching and Teacher Education*, 4(1), 1–18. [https://doi.org/10.1016/0742-051X\(88\)90020-0](https://doi.org/10.1016/0742-051X(88)90020-0)
- Brophy, J. (2006). History of research on classroom management. In C. M. Everston, & C. S. Weinstein (Eds.), *Handbook of classroom management: Research, practice, and contemporary issues* (2nd ed., pp. 17–43). Routledge/Taylor & Francis.
- Buchanan, J., Prescott, A., Schuck, S., Aubusson, P., Burke, P., & Louviere, J. (2013). Teacher retention and attrition: Views of early career teachers. *Australian Journal of Teacher Education*, 38(3), 112–129. <https://doi.org/10.14221/ajte.2013v38n3.9>
- Calderhead, J. (1981). Stimulated recall: A method for research on teaching. *British Journal of Educational Psychology*, 51(2), 211–217. <https://doi.org/10.1111/j.2044-8279.1981.tb02474.x>
- Carter, V. K. (2008). Five steps to becoming a better peer reviewer. *College Teaching*, 56(2), 85–88. <https://doi.org/10.3200/CTCH.56.2.85-88>
- Chan, Y., & Walmsley, R. P. (1997). Learning and understanding the Kruskal-Wallis one-way analysis-of-variance-by-ranks test for differences among three or more independent groups. *Physical Therapy*, 77(12), 1755–1761. <https://doi.org/10.1093/ptj/77.12.1755>
- Clarridge, P. B., & Berliner, D. C. (1991). Perceptions of student behavior as a function of expertise. *Journal of Classroom Interaction*, 26(1), 1–8.
- Codding, R. S., & Smyth, C. A. (2008). Using performance feedback to decrease classroom transition time and examine collateral effects on academic engagement. *Journal of Educational and Psychological Consultation*, 18(4), 325–345. <https://doi.org/10.1080/10474410802463312>
- Colestock, A., & Sherin, M. G. (2009). Teachers' sense-making strategies while watching video of mathematics instruction. *Journal of Technology and Teacher Education*, 17(1), 7–29.
- Costigan, C. L., & Cox, M. J. (2001). Fathers' participation in family research: Is there a self-selection bias? *Journal of Family Psychology*, 15(4), 706–720. <https://doi.org/10.1037/0893-3200.15.4.706>
- Crasborn, F., Hennissen, P., Brouwer, N., Korthagen, F., & Bergen, T. (2010). Capturing mentor teachers' reflective moments during mentoring dialogues. *Teachers and Teaching: theory and practice*, 16(1), 7–29. <https://doi.org/10.1080/13540600903475462>
- Dall'Alba, G., & Sandberg, J. (2006). Unveiling professional development: A critical review of stage models. *Review of Educational Research*, 76(3), 383–412. <https://doi.org/10.3102/00346543076003383>
- Dolk, M. (1997). *Onmiddellijk onderwijsgedrag: Over denken en handelen van leraren in onmiddellijke onderwijsituaties [Immediate teaching behavior]* (Doctoral dissertation). Utrecht University.
- Doyle, W. (2006). Ecological approaches to classroom management. In C. M. Everston, & C. S. Weinstein (Eds.), *Handbook of classroom management: Research, practice, and contemporary issues* (2nd ed., pp. 97–125). Routledge/Taylor & Francis.
- Elo, S., & Kyngäs, H. (2008). The qualitative content analysis process. *Journal of Advanced Nursing*, 62(1), 107–115. <https://doi.org/10.1111/j.1365-2648.2007.04569.x>
- Emmer, E. T., & Sabornie, E. J. (2015). Introduction to the second edition. In E. T. Emmer, & E. J. Sabornie (Eds.), *Handbook of classroom management* (2nd ed., pp. 3–12). Routledge/Taylor & Francis.
- Endsley, M. R. (1995). Toward a theory of situation awareness in dynamic systems. *Human Factors*, 37(1), 32–64. <https://doi.org/10.1518/001872095779049543>
- Eraut, M. (1995). Schon shock: A case for refraining reflection-in-action? *Teachers and Teaching*, 1(1), 9–22. <https://doi.org/10.1080/1354060950010102>
- Everton, C. M., & Poole, I. R. (2008). Proactive classroom management. In T. Good (Ed.), *21st century education: A reference handbook* (1st ed., pp. 131–140). SAGE.
- Everton, C. M., & Weinstein, C. S. (2006). *Handbook of classroom management: Research, practice, and contemporary issues*. Routledge/Taylor & Francis.
- Field, A. (2009). *Discovering statistics using SPSS*. SAGE.
- Gaudin, C., & Chaliès, S. (2015). Video viewing in teacher education and professional development: A literature review. *Educational Research Review*, 16, 41–67. <https://doi.org/10.1016/j.edurev.2015.06.001>
- Glock, S., & Kleen, H. (2019). Teachers' responses to student misbehavior: The role of expertise. *Teaching Education*, 30(1), 52–68. <https://doi.org/10.1080/10476210.2018.1444023>
- Goodwin, C. (1994). Professional vision. *American Anthropologist*, 96(3), 606–633. <https://doi.org/10.1525/aa.1994.96.3.02a00100>
- Hattie, J. (2003). *Teachers make a difference, what is the research evidence?* [Paper presentation]. Melbourne, Victoria, Australia: Australian Council for Educational Research Annual Conference on Building Teacher Quality.
- Hayes, D. (1999). Decisions, decisions, decisions: The process of 'getting better at teaching'. *Teacher Development*, 3(3), 341–354. <https://doi.org/10.1080/13664539900200090>
- Henley, M. (2010). *Classroom management: A proactive approach*. Pearson.
- Johnson, R. B., & Onwuegbuzie, A. J. (2004). Mixed methods research: A research paradigm whose time has come. *Educational Researcher*, 33(7), 14–26. <https://doi.org/10.3102/0013189X033007014>
- Kleinknecht, M., & Schneider, J. (2013). What do teachers think and feel when analyzing videos of themselves and other teachers teaching? *Teaching and Teacher Education*, 33, 13–23. <https://doi.org/10.1016/j.tate.2013.02.002>
- Kounin, J. S. (1970). *Discipline and group management in classrooms*. Holt, Rinehart & Winston.
- Le Maistre, C., & Paré, A. (2010). Whatever it takes: How beginning teachers learn to survive. *Teaching and Teacher Education*, 26(3), 559–564. <https://doi.org/10.1016/j.tate.2009.06.016>
- Little, S. G., & Akin-Little, A. (2008). Psychology's contributions to classroom management. *Psychology in the Schools*, 45(3), 227–234. <https://doi.org/10.1002/pits.20293>
- Mangiafico, S. S. (2016). *Summary and analysis of extension program evaluation in R* Version 1.18.1. <http://rcompanion.org/handbook/>
- Marland, P., & Osborne, B. (1990). Classroom theory, thinking, and action. *Teaching and Teacher Education*, 6(1), 93–109. [https://doi.org/10.1016/0742-051X\(90\)90010-3](https://doi.org/10.1016/0742-051X(90)90010-3)
- Martin, N. K., Yin, Z., & Mayall, H. (2006). *Classroom management training, teaching experience and gender: Do these variables impact teachers' attitudes and beliefs toward classroom management style?* [Paper presentation]. Annual conference of the southwest educational research association.
- Mathijssen, I. C. (2006). *Denken en handelen van docenten [Teachers' cognitions and actions]* (Doctoral dissertation, Utrecht University). Utrecht University Repository. <https://dspace.library.uu.nl/bitstream/1874/8884/16/title.pdf>
- McIntosh, K., Herman, K., Sanford, A., McGraw, K., & Florence, K. (2004). Teaching transitions: Techniques for promoting success between lessons. *Teaching Exceptional Children*, 37(1), 32–38. <https://doi.org/10.1177/004005990403700104>
- Meijer, P. C., Zanting, A., & Verloop, N. (2002). How can student teachers elicit experienced teachers' practical knowledge? Tools, suggestions, and significance. *Journal of Teacher Education*, 53(5), 406–419. <https://doi.org/10.1177/1043426902237811>

- 002248702237395
- Otero López, J. M., Santiago, M. J., Godás, A., Castro, C., Villardefrancos, E., & Ponte, D. (2008). An integrative approach to burnout in secondary school teachers: Examining the role of student disruptive behaviour and disciplinary issues. *International Journal of Psychology and Psychological Therapy*, 8(2), 259–270.
- Palmeri, T. J., Wong, A. C., & Gauthier, I. (2004). Computational approaches to the development of perceptual expertise. *Trends in Cognitive Sciences*, 8(8), 378–386. <https://doi.org/10.1016/j.tics.2004.06.001>
- Parker-Katz, M., & Bay, M. (2008). Conceptualizing mentor knowledge: Learning from the insiders. *Teaching and Teacher Education*, 24(5), 1259–1269. <https://doi.org/10.1016/j.tate.2007.05.006>
- Pianta, R. C. (2006). Classroom management and relationships between children and teachers: Implications for research and practice. In C. M. Everston, & C. S. Weinstein (Eds.), *Handbook of classroom management: Research, practice, and contemporary issues* (2nd ed., pp. 685–709). Routledge/Taylor & Francis.
- Piwowar, V., Thiel, F., & Ophardt, D. (2013). Training inservice teachers' competencies in classroom management. A quasi-experimental study with teachers of secondary schools. *Teaching and Teacher Education*, 30(1), 1–12. <https://doi.org/10.1016/j.tate.2012.09.007>
- Praetorius, A.-K., McIntyre, N. A., & Klassen, R. M. (2017). Reactivity effects in video-based classroom research: An investigation using teacher and student questionnaires as well as teacher eye-tracking. *Zeitschrift für Erziehungswissenschaft*, 20(1), 49–74. <https://doi.org/10.1007/s11618-017-0729-3>
- Putnam, R. T. (1987). Structuring and adjusting content for students: A study of live and simulated tutoring of addition. *American Educational Research Journal*, 24(1), 13–48. <https://doi.org/10.3102/00028312024001013>
- Richardson, V. (1996). The role of attitudes and beliefs in learning to teach. In J. Sikula (Ed.), *Handbook of research on teacher education* (2nd ed., pp. 102–119). MacMillan.
- Richter, T. (2020). *De klas is onrustig... Wat nu? [The class is restless... Now what?]* (Master's thesis, Open Universiteit). Digital Archive Open Universiteit. <https://research.ou.nl/en/studentTheses/de-klas-is-onrustig-wat-nu>.
- Robinson, O. C. (2014). Sampling in interview-based qualitative research: A theoretical and practical guide. *Qualitative Research in Psychology*, 11(1), 25–41. <https://doi.org/10.1080/14780887.2013.801543>
- Romano, M. E. (2006). "Bumpy moments" in teaching: Reflections from practicing teachers. *Teaching and Teacher Education*, 22(8), 973–985. <https://doi.org/10.1016/j.tate.2006.04.019>
- Rosas, C., & West, M. (2009). Teachers beliefs about classroom management: Preservice and inservice teachers' beliefs about classroom management. *International Journal of Applied Educational Studies*, 5(1), 54–61.
- Sabers, D. S., Cushing, K. S., & Berliner, D. C. (1991). Differences among teachers in a task characterized by simultaneity, multidimensional, and immediacy. *American Educational Research Journal*, 28(1), 63–88. <https://doi.org/10.3102/00028312028001063>
- Scheiner, T. (2016). Teacher noticing: Enlightening or blinding? *ZDM Mathematics Education*, 48(1), 227–238. <https://doi.org/10.1007/s11858-016-0771-2>
- Seidel, T., & Stürmer, K. (2014). Modeling and measuring the structure of professional vision in preservice teachers. *American Educational Research Journal*, 51(4), 739–771. <https://doi.org/10.3102/0002831214531321>
- Seidel, T., Stürmer, K., Blomberg, G., Kobarg, M., & Schwindt, K. (2011). Teacher learning from analysis of videotaped classroom situations: Does it make a difference whether teachers observe their own teaching or that of others? *Teaching and Teacher Education*, 27(2), 259–267. <https://doi.org/10.1016/j.tate.2010.08.009>
- Sherin, M. G. (2007). The development of teachers' professional vision in video clubs. In R. Goldman, R. Pea, B. Barron, & S. J. Derry (Eds.), *Video research in the learning sciences* (2nd ed., pp. 383–395). Routledge/Taylor & Francis.
- Sherin, M. G., Russ, R. S., Sherin, B. L., & Colestock, A. (2008). Professional vision in action: An exploratory study. *Issues in Teacher Education*, 17(2), 27–46.
- Sherin, M. G., & Van Es, E. A. (2009). Effects of video club participation on teachers' professional vision. *Journal of Teacher Education*, 60(1), 20–37. <https://doi.org/10.1177/0022487108328155>
- Strijbos, J. W., Martens, R. L., Prins, F. J., & Jochems, W. M. G. (2006). Content analysis: What are they talking about? *Computers & Education*, 46(1), 29–48. <https://doi.org/10.1016/j.compedu.2005.04.002>
- Stürmer, K., Seidel, T., Müller, K., Häusler, J., & Cortina, K. S. (2017). What is in the eye of preservice teachers while instructing? An eye-tracking study about attention processes in different teaching situations. *Zeitschrift für Erziehungswissenschaft*, 20(1), 75–92. <https://doi.org/10.1007/s11618-017-0731-9>
- Stürmer, K., Seidel, T., & Schäfer, S. (2013). Changes in professional vision in the context of practice. *Gruppendynamik und Organisationsberatung*, 44(3), 339–355. <https://doi.org/10.1007/s11612-013-0216-0>
- Tomczak, M., & Tomczak, E. (2014). The need to report effect size estimates revisited. An overview of some recommended measures of effect size. *TRENDS in Sport Sciences*, 1(21), 19–25.
- Tynjälä, P., & Heikkinen, H. L. (2011). Beginning teachers' transition from pre-service education to working life. *Zeitschrift für Erziehungswissenschaft*, 14, 11–33. <https://doi.org/10.1007/s11618-011-0175-6>
- Van den Bogert, N., Van Bruggen, J., Kostons, D., & Jochems, W. (2014). First steps into understanding teachers' visual perception of classroom events. *Teaching and Teacher Education*, 37, 208–216. <https://doi.org/10.1016/j.tate.2013.09.001>
- Van Driel, S., Jarodzka, H., Crasborn, F., Van Strien, J., & Brand-Gruwel, S. (2021). Capturing and characterizing teachers' noticing as basis for their classroom management in different career stages: A data paper. Manuscript submitted for publication.
- Van Es, E. A., & Sherin, M. G. (2002). Learning to notice: Scaffolding new teachers' interpretations of classroom interactions. *Journal of Technology and Teacher Education*, 10(4), 571–596.
- Van Hout-Wolters, B. (2000). Assessing active self-directed learning. In P. R. J. Simons, J. van der Linden, & T. Duffy (Eds.), *New learning* (pp. 83–101). Kluwer.
- Van Tartwijk, J., Veldman, I., & Verloop, N. (2011). Classroom management in a Dutch teacher education program: A realistic approach. *Teaching Education*, 22(2), 169–184. <https://doi.org/10.1080/10476210.2011.567847>
- Veenman, S. (1984). Perceived problems of beginning teachers. *Review of Educational Research*, 54(2), 143–178. <https://doi.org/10.3102/00346543054002143>
- Veenman, M. V. J. (2005). The assessment of metacognitive skills: What can be learned from multi-method designs? In C. Artelt, & B. Moschner (Eds.), *Lernstrategien und Metacognition: Implikationen für Forschung und Praxis [Learning strategies and metacognition: Implications for research and practice]* (pp. 75–97). Waxmann.
- Viera, A. J., & Garrett, J. M. (2005). Understanding interobserver agreement: The kappa statistic. *Family Medicine*, 37(5), 360–363.
- Westerman, D. A. (1991). Expert and novice teacher decision making. *Journal of Teacher Education*, 42(4), 292–305. <https://doi.org/10.1177/002248719104200407>
- Wolff, C. E., Jarodzka, H., & Boshuizen, H. P. A. (2017). See and tell: Differences between expert and novice teachers' interpretations of problematic classroom management events. *Teaching and Teacher Education*, 66, 295–308. <https://doi.org/10.1016/j.tate.2017.04.015>
- Wolff, C. E., Jarodzka, H., & Boshuizen, H. P. A. (2021). Classroom Management Scripts: a Theoretical Model Contrasting Expert and Novice Teachers' Knowledge and Awareness of Classroom Events. *Educational Psychology Review*, 33, 131–148. <https://doi.org/10.1007/s10648-020-09542-0>
- Wolff, C. E., Jarodzka, H., Van den Bogert, N., & Boshuizen, H. P. A. (2016). Teacher vision: expert and novice teachers' perception of problematic classroom management scenes. *Instructional Science*, 44(3), 243–265. <https://doi.org/10.1007/s11251-016-9367-z>
- 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. <https://doi.org/10.1177/0022487114549810>
- Xu, L., Widjaja, W., & Ferguson, J. (2019). Seeing through the eyes of the teacher? Investigating primary school teachers' professional noticing through a video-based research methodology. *International Journal of Research and Method in Education*, 42(5), 470–484. <https://doi.org/10.1080/1743727X.2018.1499016>
- Yinger, R. J. (1986). Examining thought in action: A theoretical and methodological critique of research on interactive teaching. *Teaching and Teacher Education*, 2(3), 263–282. [https://doi.org/10.1016/S0742-051X\(86\)80007-5](https://doi.org/10.1016/S0742-051X(86)80007-5)
- Zuckerman, J. T. (2007). Classroom management in secondary schools: A study of student teachers' successful strategies. *American Secondary Education*, 35(2), 4–16.