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Comparing the effects of a specific task instruction and prompts on pre-service teachers' noticing of classroom management situations

Sylvia Gabel · **Özün Keskin · Andreas Gegenfurtner**

Abstract Attending to relevant information in complex classroom situations can be a challenging task for pre-service teachers which is why teacher education programs often use authentic classroom videos to scaffold pre-service teachers' professional vision. However, to date, it remains unclear which instructions can guide pre-service teachers' attention toward classroom management situations to promote the early development of teacher professional vision. This mixed-methods study ($n = 85$ pre-service teachers) compared effects of (a) a specific task instruction before watching a classroom video and (b) prompts during the classroom video on noticing—indicated by the number, velocity, and relevance of identified classroom management situations. Controlling for mental effort and pedagogical-psychological knowledge, t-Tests showed both types of instruction to have a similar attention-guiding effect. Qualitative analyses of retrospective interviews revealed that pre-service teachers identified verbal reactive classroom management strategies more easily than nonverbal strategies when observing experienced teachers in the classroom videos. We discuss specific task instructions as an economic alternative to the use of prompts in video-based teacher education and—based on our qualitative findings—provide directions for future research.

Keywords Professional vision · Noticing · Classroom video · Prompts · Specific task instruction · Classroom management

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Der Vergleich einer spezifischen Aufgabenstellung und Prompts zur Förderung der professionellen Unterrichtswahrnehmung von Lehramtsstudierenden im Kontext des Klassenmanagements

Zusammenfassung Die Aufmerksamkeit auf relevante Informationen in komplexen Unterrichtssituationen zu lenken, kann für angehende Lehrkräfte eine große Herausforderung darstellen. Aus diesem Grund werden in der Lehrkraftausbildung häufig Unterrichtsvideos eingesetzt, um die professionelle Wahrnehmung angehender Lehrkräfte zu fördern. Bislang ist jedoch noch unklar, welche Instruktionen die Aufmerksamkeit der angehenden Lehrkräfte auf Klassenmanagement-Situationen lenken können, um die frühe Entwicklung einer professionellen Unterrichtswahrnehmung zu fördern. Diese Mixed-Methods Studie ($n = 85$ angehende Lehrkräfte) verglich die Effekte einer spezifischen Aufgabenanweisung vor der Betrachtung eines Unterrichtsvideos und von Prompts während des Unterrichtsvideos auf die professionelle Unterrichtswahrnehmung – gemessen durch die Anzahl, Geschwindigkeit und Relevanz der identifizierten Klassenmanagement-Situationen. Unter Kontrolle der mentalen Anstrengung und des pädagogisch-psychologischen Wissens zeigten t-Tests, dass beide Arten von Anweisungen einen ähnlichen aufmerksamkeitslenkenden Effekt aufweisen. Qualitative Analysen retrospektiver Interviews ergaben, dass angehende Lehrkräfte bei der Beobachtung erfahrener Lehrkräfte in den Unterrichtsvideos verbale, reaktive Klassenmanagement-Strategien eher identifizieren konnten als nonverbale Strategien. Abschließend diskutieren wir spezifische Aufgabenanweisungen als ökonomische Alternative zum Einsatz von Prompts in der videobasierten Lehrerausbildung und entwickeln – basierend auf unseren qualitativen Ergebnissen – Anregungen für zukünftige Forschung.

Schlüsselwörter Professionelle Unterrichtswahrnehmung · Aufmerksamkeit · Unterrichtsvideos · Spezifische Aufgabenstellung · Prompts · Klassenmanagement

1 Introduction

Professional vision is a key competence of the teaching profession (Blömeke 2024; Gegenfurtner 2024; Grub et al. 2020; Seidel et al. 2024; van Es and Sherin 2021; Seidel and Stürmer 2014). Originating from a socio-cultural perspective, the term refers to the socially situated ability to recognize and interpret relevant events (Goodwin 1994; König et al. 2022). Applied to the teaching profession, researchers often focus on teachers' *noticing* (van Es and Sherin 2002, 2008) as a sub-dimension of professional vision (Seidel and Stürmer 2014). Referring to noticing on a cognitive-psychological perspective (König et al. 2022), teachers should be able to direct their attention to relevant events in the classroom. Grounded in the cognitive theory of visual expertise (Gegenfurtner 2024; Gegenfurtner et al. 2023), we define noticing as the ability of teachers to decide on the relevance of visual information in the classroom. The cognitive theory of visual expertise holds that teacher professional vision consists of several interrelated processes, including the *selecting of visual information* (when teachers allocate their attention toward relevant visual information

in the classroom), *ignoring of visual information* (when teachers shift attention away from irrelevant visual information in the classroom), and *knowledge-based noticing* (when teachers decide how relevant visual information is for managing particular classroom situations). Reasons to notice and to decide what is relevant and what can be ignored vary substantially, and the present study aims to understand the reasons of pre-service teachers when watching authentic classroom videos.

Previous studies documented systematic differences between pre-service and in-service teachers in their noticing (Gabel et al. 2023; Keskin et al. 2024; Stahnke and Blömeke 2021; Stahnke and Gegenfurtner in press; Stürmer et al. 2017; Wolff et al. 2016, 2021). Research indicates that pre-service teachers tend to often focus on irrelevant aspects and have difficulty in noticing significant situations (Martin et al. 2022). Based on the cognitive theory of visual expertise, this may be due to qualitative differences in the underlying visual processes: pre-service teachers' noticing is associated with stimulus-driven processing, whereas in-service teachers are able to select relevant information and ignore irrelevant information more rapidly thanks to their rich repertoire of knowledge and experiences (Gegenfurtner 2024; Gegenfurtner et al. 2023). This knowledge-driven expertise is important for noticing not only visually relevant events, but also learning-relevant events; these latter events may relate more to deep structures of learning and instruction which may not (or at least not completely) be directly observable.

The ability to notice task relevance in classroom situations is an important mediator competence between disposition and performance (Blömeke et al. 2015; Seidel et al. 2024). Initial studies showed that professional vision mediates the effect-chain from subject-specific knowledge to teaching behaviors (Blömeke et al. 2022; Meschede et al. 2017). For this reason, it is important to promote the early development of pre-service teachers' professional vision and thus, teachers' noticing competences. Here, classroom videos are widely used as they offer the opportunity to notice simultaneous situations occurring in the classroom and other teachers' verbal and nonverbal classroom management strategies (Gaudin and Chaliès 2015; Sherin and van Es 2005; Seidel and Thiel 2017; van Es and Sherin 2002). Unlike text-based formats, classroom videos can improve pre-service teachers' noticing, and relatedly, their self-efficacy beliefs (Gold et al. 2017). Through this type of cognitive activation, pre-service teachers can be made aware of the complexity of the teaching process at an early stage of their teaching careers (Kramer et al. 2017; Sherin 2004). which can be important to notice critical situations in classroom management that would require particular kinds of teaching interventions (Gold et al. 2021). However, the complexity of situations shown in classroom videos can be overwhelming for pre-service teachers. To reduce mental effort and to direct visual attention, it thus seems commendable to embed classroom videos in specific instructional formats aimed at directing attention to relevant aspects shown in the videos (Gabel et al. 2023; Grub et al. 2022a, b; Larison et al. 2024; Martin et al. 2023). Without further evidence, however, it is premature to conclude how to design instructional formats to enhance the noticing skills of pre-service teachers. Grub et al. (2022b) and Martin et al. (2023) showed that specific tasks before watching a classroom video can scaffold noticing. Another option to scaffold noticing are prompts shown at particular intervals during a classroom video (Bannert 2009). Because prompts

need to be timed and inscripted into a video presentation and are thus more complex to implement in the instructional design of video-based teacher education, providing specific tasks before watching a classroom video tends to require fewer temporal and technical resources and would thus prove to be an economic alternative to prompts for teacher educators. Embedded in a mixed-method approach, this study therefore aimed to compare the effects of a specific task instruction and prompts on pre-service teachers' noticing of classroom management events.

2 Theory

2.1 Instructional designs to scaffold pre-service teacher noticing

Previous research examined different kinds of instructional designs to scaffold pre-service teacher noticing, including specific task instructions and prompts. First, specific task instructions are provided before watching classroom videos to help pre-service teachers direct their attention to particular aspects of the video—such as student disruptive behavior or reactive strategies of a teacher. In order to identify relevant situations in the videos, the specificity of the task can help reduce the complexity of what happens in class simultaneously. The assumption is that a specific task activates context-specific schemata which, in turn, promote top-down processing of visual information (Gilboa and Marlatte 2017; Pressley et al. 1992). By evoking specific schemata before watching a video, pre-service teachers' noticing can be guided from a bottom-up to a top-down processing (Grub et al. 2022a), which is considered a hallmark of teacher visual expertise (Gegenfurtner et al. 2023; Stahnke et al. 2016; Wolff et al. 2021). For example, Grub et al. (2022a) examined the difference between a specific task and a general task in a minimal intervention study with 85 pre-service teachers. Participants were instructed to identify aspects relevant for classroom management and to press a button whenever they noticed such aspects. Grub et al. (2022a) reported no significant differences between the general and specific task instruction which they attributed to the lack of specificity of the task. In a follow-up study, Grub et al. (2022b) replicated their previous results and used eye-tracking to track the gaze of pre-service and in-service teachers. Their findings showed that, receiving a specific task instruction, pre-service and in-service teachers showed a higher number of fixations and a higher number of visits to aspects relevant for classroom management-independent of expertise. Another study on task specificity was an experiment by Martin et al. (2023) with 85 pre-service teachers. The experimental groups received either texts about pedagogical-psychological theories or about the subjects' didactics in the video and the control group received a text on general guidelines when watching classroom videos. The findings tend to indicate that specific information of both the experimental groups before watching a classroom video seems to activate knowledge and direct attention to relevant information more than general information. In summary, this evidence implies that specific task instructions are an effective instructional strategy for scaffolding pre-service teacher noticing.

Prompts are another widely used instructional strategy. Especially in complex situations, prompts activate cognitive schemata and improve learning performance (Demetriadis et al. 2008). As a strategy of scaffolding, prompts can support the learning processes through specific cues. As Bannert (2009, p. 139) notes: "They are all based on the central assumption that students already possess the concept and/or processes, but do not recall or execute them spontaneously". In the context of teacher professional vision, prompts can be presented as cues that stimulate certain attentional activities to identify relevant aspects or situations in classroom videos (Kramarski et al. 2013). Thanks to the scaffolding through focused cues, information can be actively processed (Santagata and Angelici 2010; Santagata and Guarino 2011; Wylie and Chi 2014).

There are many types of prompting procedures (e.g. least-to-most prompting, simultaneous prompting, constant time delay prompting; Collins et al. 2018). Constant time delay prompts, for example, are presented after a certain time period has elapsed and then fade out as the teaching session unfolds (Walker 2008). Previous studies demonstrated that time delay prompts are effective in guiding attention to specific stimuli (Brown and Cariveau 2024; Cengher et al. 2018; Walker 2008). Nevertheless, implementing prompts in instructional designs is complex and resource-intensive, as they need to be matched and tailored to the learning tool and learner characteristics. It would thus be interesting to explore more economic alternatives to prompts, such as specific task instructions, to efficiently scaffold teacher noticing.

2.2 Noticing classroom management situations

Since teacher noticing focuses on important classroom events, classroom management is a suitable thematic context for observation. Knowledge about classroom management is a subcomponent of teachers' pedagogical-psychological professional knowledge (König et al. 2014) and a basic dimension of teaching quality, along with cognitive activation and constructive support (König and Kramer 2016). A prominent description of classroom management is defined as "the actions teachers take to create an environment that supports and facilitates both academic and social-emotional learning" (Evertson and Weinstein 2006, p. 4). Here, classroom management involves the teacher coordinating and directing all classroom activities to ensure maximum learning time for students (Emmer and Stough 2001). Noticing competence is required to identify relevant situations quickly and accurately and decide if these situations are relevant for classroom management. The earlier disruptions and problems are identified, the more effectively these situations can be handled (Gold et al. 2017). This classroom management perspective demonstrates the aim of guiding and building academic and social learning. However, classroom management is multifaceted and means more than just this: it is also intended to create a protected space in which students can develop personally and grow up with values such as appreciation, equality and respect (Elias and Schwab 2006; Nucci 2006). A teacher needs to protect and enforce these caring values and to discipline students who compromise this safety and other students' physiological and psychological well-being (Elias and Schwab 2006; Fenwick 1998). On the other side, it is also intended to protect teachers' well-being. Classroom management is a common cause of teacher

stress and can be—at the same time—an important resource to prevent and reduce this stress through effective strategies (McCarthy et al. 2015).

Regarding these aims, the central task of the teacher is therefore to prevent disruptions and to directly control interactions (Ophardt and Thiel 2017). Monitoring is a preventive strategy and is characterized by attentive observation of classroom interactions, with the teacher demonstrating *overlapping and withitness* by giving the students the feeling that they have an overview of all the activities going on at the same time in the classroom (Kounin 1970). Through effective monitoring, disruptions can be identified early and effectively addressed (Emmer and Gerwels 2006). A further preventive strategy is *smoothness and momentum*—the teacher ensures smooth transitions in the classroom and thus prevents disruptions (Kounin 2006). It is important that different activities can be clearly separated from each other, but that transitional pauses are not too long, as these phases are prone to disruption and can affect learning time and social order (Doyle 1984). In addition, disruptions can be prevented through transparent communication of rules and routines, thus ensuring positive relationships in the classroom (Ophardt and Thiel 2017). These act as general management by establishing behavioral procedures to coordinate situation-specific behaviors and control teaching processes in the classroom (Emmer and Gerwels 2006).

However, classroom activities can be compromised or even disrupted through unpredictable disturbances. Here, teachers need reactive classroom management strategies to maintain a productive learning environment again (Ophardt and Thiel 2017). These interventions can occur verbally and nonverbally (Atici 2007; Zeki 2009). For example, making eye-contact or shaking the head slightly are nonverbal strategies, whereas raising the voice or directly asking to stop are verbal strategies for managing with disruptive student behavior.

In summary, there are several classroom management strategies that create and maintain a positive learning environment. In terms of enhancing noticing competences, pre-service teachers need to identify relevant classroom management events, which can be categorized in preventive and reactive events (Kounin 2006; Ophardt and Thiel 2017). To date, it is unclear to what extent different classroom management situations are more or less salient to pre-service teachers and therefore easier to notice (Grub et al. 2022b). Previous research show that pre-service teachers tend to notice more reactive classroom management events (Reupert and Woodcock 2010; Stahnke and Blömeke 2021; Wolff et al. 2016). Grounded in this evidence, we analyzed verbal data qualitatively to investigate how pre-service teachers perceive reactive classroom management strategies.

3 The present study

This mixed-methods study addressed two aims. A first aim was to examine the effects of two different instructional conditions—a specific task instruction and prompts—to promote pre-service teachers' noticing of events relevant for classroom management. Noticing was operationalized in three dimensions as the number, velocity, and relevance of identified classroom management events. Based on previous research (Grub

et al. 2022a, b; Martin et al. 2023), we expected that both instructional conditions would result in top-down processing of visual classroom information by activating relevant knowledge schemata. Our hypothesis was: compared to prompts, a specific task instruction would result in a similar number (Hypothesis 1), velocity (Hypothesis 2), and relevance (Hypothesis 3) of identified classroom management events. If both conditions prove to show comparable effects, then these findings would contribute to the discussion of resource economy, granted that a specific task instruction can be implemented with fewer temporal and technical resources than prompts.

A second aim of the study was to explore how pre-service teachers perceive classroom management events. For this purpose, we analyzed pre-service teachers' qualitative verbal data in response to two reactive classroom management strategies—verbal and nonverbal—to explore and re-construct how pre-service teachers experienced the usefulness of these two strategies of the experienced teachers' management of disruptive behavior.

4 Methods

4.1 Participants

A total of 85 pre-service teachers (66 women, 19 men; $M_{Age} = 21.3$ years; $SD_{Age} = 2.9$) enrolled in a teacher education program of a large university in Southern Germany participated in this study in the summer term 2022. The majority of pre-service teachers were in their second (49.4%) or fourth semester (30.6%). Participants were recruited in seminars and received course credit as compensation. Anonymity and confidentiality were guaranteed for all responses.

4.2 Procedure

This study followed a parallel mixed-method intervention design (QUAN+qual) (see Fig. 1; Hagenauer et al. 2023). Pre-service teachers were invited to individual sessions in the lab. They first read an instruction on a 15″ TFT LCD screen (1024×768 px) and then watched two classroom videos on an adjacent 27″ TFT LCD monitor (1920×1080 px). The first video showed a mathematics lesson in 10th grade (4:30 min) and the second video showed a nature and technology lesson in 5th grade in (3:00 min). These videos were selected by two experienced teacher educators based on four dimensions of classroom management (Kounin 2006; Ophardt and Thiel 2017): (a) smoothness and momentum, (b) withitness and overlapping, (c) general management and control of teaching processes, and (d) teachers' management of disruptive student behavior.

Before watching the videos, participants were tasked to click a mouse button whenever they identified a relevant classroom management situation. These clicks created concrete time stamps which have been used as an indicator of teacher noticing in previous studies (Grub et al. 2022a; 2022b; Stahnke and Blömeke 2021; van den Bogert et al. 2014). The pre-service teachers were randomly assigned to one of

Fig. 1 Mixed-methods study design
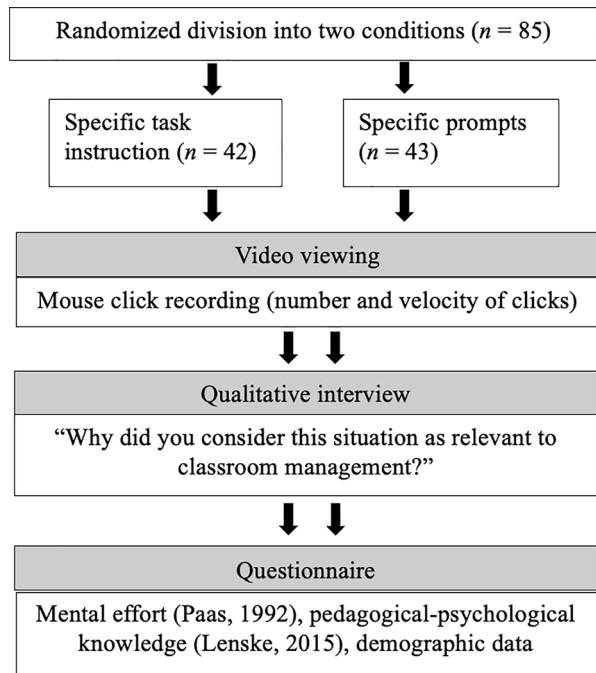
two conditions: condition 1 with a specific task instruction ($n = 42$) and condition 2 with prompting ($n = 43$).

The instruction in condition 1 included specific elements of classroom management (Kounin 2006; Ophardt and Thiel 2017) and was: "Regarding classroom management, which good elements and elements that could be improved do you see in the video? Pay attention to the smoothness and momentum, the withitness of the teacher, and the teacher's management of disruptive behavior."

The instruction in condition 2 was: "Regarding classroom management, which good elements and elements that could be improved do you see in the video?" Following a constant time delay prompting strategy (Brown and Cariveau 2024), a prompt appeared on the 15″ screen every 60 s after video onset. The prompts used the exact wording used in condition 1; they were: "Pay attention to the smoothness and momentum" (Prompt 1), "Pay attention to the withitness of the teacher" (Prompt 2), and "Pay attention to the teacher's management of disruptive behavior" (Prompt 3).

After watching the videos, the pre-serve teachers in both conditions were interviewed and asked to explain why they considered the situations as relevant for classroom management. For this interview, the participants re-watched both videos which stopped each time the pre-service teachers had clicked. They were asked: "Why did you consider this situation as relevant for classroom management?".

After the interview, the pre-service teachers were asked to complete a questionnaire including items measuring their mental effort (Paas 1992) and pedagogical-

psychological knowledge (Lenske et al. 2015). Overall, the sessions for data collection lasted between 35 to 45 min.

4.3 Measures

Measures included the number, velocity, and relevance of identified classroom management events as dependent variables as well as mental effort and pedagogical-psychological knowledge as control variables.

Number of identified classroom management events. From the click data, we counted the number of identified classroom management events while watching the videos.

Velocity of identified classroom management events. Two experienced teacher educators determined the onset of each relevant classroom management event. Pre-service teachers' velocity of identifying relevant events was calculated as the time difference (in sec) between the onset of the event and the time stamp of the mouse click.

Relevance of identified classroom management events. For each participant, we calculated the proportion of clicks for relevant events divided by the number of all clicks while watching the videos.

Mental effort. Mental effort while watching the videos and identifying relevant classroom management situations was measured with a single item (Paas 1992) on a 7-point Likert scale ranging from 1 = "very, very low mental effort" to 7 "very, very high mental effort".

Pedagogical-psychological knowledge. Pre-service teachers' pedagogical-psychological knowledge (PPK) was measured using the ProWIN test (Lenske et al. 2015). The ProWin test uses 25 tasks and case examples on classroom management, teaching methods, individualization, performance assessment, and feedback to measure teachers' declarative and procedural PPK. In sum, they could reach a test value between 0 and 1.

4.4 Data analysis

To address the first aim of the study—comparing the effects of a specific task instruction and prompts on the number, velocity, and relevance of identified classroom management events—in our sample of pre-service teachers, we performed a series of *t*-tests using the SPSS Statistics 28 software program. Although the students were in different semesters, they did not differ in terms of their knowledge base, which is why we tested the student sample as a whole and did not create different subgroups in terms of their study progress.

To address the second aim of the study—exploring how pre-service teachers perceive classroom management events—with the qualitative verbal data, one event of each video (A7 and B3; see in Appendix) was selected. These events were selected because in both events, students disrupt the teachers' instruction, and the teachers intervene nonverbally (A7) and verbally (B3). Pre-service teachers' answers in the qualitative interview were transcribed verbatim. The transcripts were then entered into a textual narrative synthesis (Lucas et al. 2007) which helped arrange

the participant reactions into homogenous subgroups to identify patterns across interviews.

5 Results

5.1 Quantitative results

In a first step, we tested the extent to which the two control variables—mental effort and pedagogical-psychological knowledge—were different across conditions to rule out any effects these two variables might have on the dependent variables. Table 1 presents mean and standard deviations for both variables in both conditions. Results of the *t*-Tests indicated that, across conditions, pre-service teachers did not differ regarding their mental effort, t (83)=0.43, p=0.33, and their pedagogical-psychological knowledge, t (83)=0.16, p=0.44. Hence, we do not expect that the participants' levels of mental effort and prior knowledge would contribute to any group differences.

Table 1 shows the mean and standard deviation estimates for the three dependent variables across conditions. A series of *t*-Tests revealed that the pre-service teachers in both conditions did not differ significantly in terms of their number, t (83)=−0.59, p=0.55, velocity, t (82)=−0.58, p=0.57, and relevance of identified classroom management events, t (82)=0.01, p=0.99. These findings suggest that both conditions had a similar effect on pre-service teachers' noticing. Participants with a specific task instruction before watching classroom videos identified a similar number of relevant events with a similar velocity than participants with prompts during watching classroom videos. Hypotheses 1 to 3 can be confirmed.

Table 1 Means, standard deviations, and t-test results of all variables

		Specific task instruction			Prompts					
		N	*M*	*SD*	*N*	*M*	*SD*	*t*	*Df*	*p*
Control Variables	Mental effort	42	4.21	1.26	43	4.33	1.13	0.43	83	0.33
	Pedagogical-psychological knowledge	42	0.65	0.05	43	0.66	0.03	0.16	83	0.44
Dependent variables	Number of identified situations	42	4.57	5.42	43	5.44	1.48	−0.59	83	0.55
	Velocity of identified situations	42	3.73	3.55	42	4.39	6.58	−0.58	82	0.57
	Relevance of identified situations	42	0.57	0.19	43	0.57	0.19	0.06	83	0.95

5.2 Qualitative results

The interview data of the pre-service teachers was analyzed qualitatively to explore how they perceived the teachers' verbal and nonverbal classroom management strategies in two disruptive situations. For each situation, we clustered the participant responses in three categories: (a) noticing a general disturbance but failing to notice the students' specific disruptive behavior, (b) noticing the students' disruptive behavior but failing to notice the teacher's reactive classroom management strategy, and (c) noticing both the students' disruptive behavior and the teacher's reactive classroom management strategy.

In the first situation, several students talk to each other while the teacher explains a subsequent task. By raising his voice and changing his bodily position towards two talking students in the front row, but without addressing the two students directly, the teacher intervenes nonverbally to the disruptive situation. The two talking students end their talking immediately and follow the task instructions. In the qualitative interviews, a total of $n = 13$ participants mentioned this situation as relevant to classroom management. More specifically, among the four pre-service teachers who failed to notice the disruptive student behavior, PST01 said: "I think [I have clicked] because there was a bit of whispering everywhere." In contrast, among the seven pre-service teachers who did notice the disruptive student behavior but failed to notice how the teacher intervened nonverbally, PST02 articulated: "I stopped there because there are quite a few interim conversations with the students, um... which he didn't address at all and I had the feeling that especially in the back row, but also in the front, they weren't paying attention ... and later they also ask questions and ... I had the feeling that he wasn't interested at all that they didn't listen." Finally, two pre-service teachers noticed both the disruptive student behavior and the teacher's nonverbal strategy. For example, PST03 said: "Here [I have clicked] simply because he now goes back to the two girls in sitting the front row and then he also keeps walking back and forth through the room, just to clarify his presence."

In the second situation, the teacher intervenes verbally: she interrupts her explanation because a student is making noise while she speaks. Qualitative analysis shows that $n = 6$ pre-service teachers mentioned this situation as relevant to classroom management. One of them, PST04, noticed a general disturbance but failed to notice the student's specific disruptive behavior and said: "(...) you can hear these comments in the background, that's just loud and somehow nobody really listens..." Another pre-service teacher, PST05, tended to notice the specific disruption but not the teacher's verbal classroom strategy: "(...) and also there was a comment from a student... and she simply ignored it and acted as if nothing had happened." The remaining four pre-service teachers noticed both the student behavior and the teacher's verbal intervention. For example, PST06 articulated: "There was the comment from the student and then the teacher took a short break so that everyone could pay attention again... And maybe she waited a moment to see if there might be more noise from this student before she continued, so that everyone in class could really be attentive again." These analyses tend to indicate that pre-service teachers notice verbal intervention strategies more frequently than non-verbal strategies. These analyses also show that qualitative interviews are useful because they help contextualize why

pre-service teachers click and how differently they interpret the identified classroom management events.

6 Discussion

This mixed-methods study compared the effects of two different instructional conditions—a specific task instruction and prompts—on pre-service teachers' number, velocity, and relevance of identified classroom management events. A second aim was to explore how pre-service teachers perceive verbal and nonverbal teaching strategies in response to student disruptive behavior.

6.1 Main findings

The study has a number of key findings. First, the quantitative findings suggest that specific task instructions and prompts result in a comparable number, velocity, and relevance of identified classroom management events. Furthermore, mental effort was similar across conditions, suggesting that specific tasks induce similar levels of mental effort in pre-service teachers' working memory. Overall, these results support hypotheses 1 to 3: specific tasks have a similar attention-guiding effect as prompts, contributing to discussions on the resource economy of instructions when using classroom videos in teacher education (Gaudin and Chaliès 2015; König et al. 2022; van Es and Sherin 2002). This finding is in line with previous research of Grub et al. (2022a, b) and Martin et al. (2023) who also reported specific tasks to support teacher noticing.

Second, the qualitative findings indicate that pre-service teachers differ in their explanations why they clicked while watching the classroom videos. Although the number of clicks suggest that classroom management events had been noticed, we do see qualitative differences in the reasons behind clicks. Along these lines, verbal reactive strategies of teachers seem to be visually and acoustically more salient than nonverbal strategies and are, consequently, noticed more often than nonverbal reactive strategies. Contextualizing the click data with qualitative verbal explanations of the pre-service teachers served as a triangulation of the data and provided a more detailed insight into how the relevance of identified classroom management events was perceived.

6.2 Implications for theory and practice

This study has a number of implications for theory development and the practice of teacher education. First, in terms of theoretical implications, the study findings highlight that a specific task instruction seems to be equally effective as prompts to scaffold teacher noticing. Thus, specific task instructions tend to support pre-service teachers in their retrieval of knowledge structures and activation of schemata stored in long-term memory (Bannert 2009; Grub et al. 2022b). The knowledge-based processing assumption in the cognitive theory of visual expertise holds that experts use their massive declarative knowledge for knowledge-based noticing (Gegenfurtner

2024; Gegenfurtner et al. 2023) to decide which information is further attended to and which information can be ignored. The present findings seem to indicate that pre-service teachers with low prior knowledge can be scaffolded in their knowledge-based noticing through a specific task instruction.

Second, in terms of educational implications, the study findings contribute to explorations on the resource economy of instructional conditions to promote noticing in teacher education. If it is true that a specific task instruction can be implemented with fewer temporal and technical resources than prompting because specific task instructions can be set before watching the video and not—as it is the case when presenting prompts—during watching the video, then teacher educators might perceive specific task instructions as the simpler and more economic option, without compromising the benefits of promoting pre-service teacher noticing because both conditions showed a similar effect on the number, velocity, and relevance of identified classroom management events. The fact that mental effort was similar across conditions further supports this implication.

Furthermore, our qualitative analyses suggested that pre-service teachers had noticed teachers' nonverbal strategies less frequently than verbal strategies to stop student disruptive behavior. A reason for this difference could be the salience of verbal strategies, both visually and acoustically. Still, if we assume that both strategies can be useful for classroom management, then teacher education can prepare pre-service teachers by directing their attention more on nonverbal classroom management interventions of experienced teachers. For future research, it is desirable to test this exploratory hypothesis in more detail and to compare salient situations between pre-service and in-service teachers: Can the hypothesis, derived from the qualitative results that non-verbal classroom management situations are more difficult to notice for pre-service teachers, be confirmed? Are experienced teachers more likely to perceive nonverbal classroom management interventions than beginning teachers due to their expertise and practical experience?

6.3 Limitations and directions for future research

This study has some limitations that should be noted. First, the study used click data as an indicator for noticing. It is possible that some pre-service teachers did not click while watching the video although they may have noticed classroom management events. We can speculate that participants did not click because they were unsure or because they simply forgot to click the mouse button while watching the videos. Based on our survey data on mental effort, we would assume that pre-service teachers had not experienced excessive levels of cognitive load during the videos, but we cannot rule out the possibility that pre-service teachers did not click every time they noticed a classroom management event. As a remedy, we sought to triangulate the quantitative click data with qualitative interviews in which all participants had the chance to add comments and observations if needed.

Another possibility to collect more objective data on pre-service teacher noticing beyond clicks is the use of eye-tracking (Gabel et al. 2023; Grub et al. 2020; Keskin et al. 2024; Kosel et al. 2024). By recording the eye movements of the participants, we would be able to see if pre-service teachers looked at disruptive student behavior

or at bodily movements of the teachers even if pre-service teachers did not click a button nor mentioned the interventional strategies of the teacher. In future studies, eye-tracking could thus be an option for triangulating the click data used in this study with more objective measures of noticing—for example, when triangulating our velocity measures with the eye-tracker provided time to first fixation or the gaze relational index.

A second limitation of the study is associated with the disciplinary fields of the classroom videos. Since the videos were limited to lessons in the areas of mathematics and nature and technology, we should be cautious when generalizing the findings to other disciplinary fields not covered in the present study as past research suggested professional vision to be discipline-specific (Stahnke and Friesen 2023). We did check for the subject specificity and for any differences between the two videos, which proved to be minimal. Still, in the future, further research can aim to determine how subject-specific the instructions were and how they can be adapted for other disciplinary fields beyond STEM education.

Furthermore, it cannot yet be assumed that the training of noticing competences leads to better teaching. Even if the empirically tested model by Blömeke (2024; Blömeke et al. 2022) acknowledges that professional vision, and thus, noticing comptence has an important mediator effect, we cannot automatically assume that pre-service teachers will demonstrate better teaching quality by training these competences. Further effects of pre-service teachers' noticing competence (and its long-term effects through training) on teaching quality and teacher expertise should be investigated in more detail in the future (Seidel et al. 2024).

A final direction for future research emerged from the qualitative analyses of the pre-service teachers' interview data which offered further insights into how pre-service teachers assessed the teachers' verbal and nonverbal reactive strategies to disruptive student behavior. The analyses tend to signal that verbal strategies are noticed more frequently than nonverbal strategies, possibly because of the salience of verbal strategies. What remains a question for future research is which impact the salience of a situation has on pre-service teachers' noticing (Grub et al. 2022b). In a complex teaching sequence, there might be situations that are more salient to notice for pre-service teachers than other situations. In addition to the reactive strategies explored here, future research can also address the salience of preventive strategies of classroom management.

7 Conclusion

Guiding pre-service teachers' attention when watching classroom videos is essential to reduce complexity and foster top-down processing. In our study, we explored a specific task instruction as an economic alternative to prompts for enhancing pre-service teachers' noticing of classroom management situations. We invite future researchers to further investigate how to best implement classroom videos in teacher education.

8 Appendix

Table 2 Classroom management situations in the videos

Video	Situation	Description
Video 1	A1	The teacher is slowing down his voice during his introduction and is changing his position towards two talking students at the first row on the left side
	A2	The teacher is asking a randomly selected student to answer a question to introduce the topic
	A3	The student does not know the answer and needs time to think. The teacher is reacting with the words: "Come on, this is mathematics for elementary schools!"
	A4	The teacher is asking another student to give an answer. The previous student does not have a chance to answer anymore
	A5	The teacher is turning to the blackboard and students start talking. After a short moment, he is turning back and asks whether the students now can remember the topic
	A6	The teacher is writing down the numbers on the blackboard while students are waiting and talking to each other
	A7	Due to uncertainties about the topic the students start talking to each other. While explaining the following task, the teacher raises his voice and changes his position toward two talking students at the left side
	A8	The teacher is walking through the classroom and is monitoring whether the students need help
	A9	Two students ask for help, the teacher is giving an explanation
	A10	Due to too much time spending with these two students, other students start talking to each other and are not involved with the task anymore
	A11	The teacher is walking through the classroom and asking whether the students need help
Video 2	B1	The teacher is ringing a bell to start the lesson
	B2	The teacher is standing in front of the class and waiting for the students to be quiet and attentive
	B3	While the teacher is giving and introduction to the lesson, a student is shouting. The teacher is stopping her introduction for a little moment to re-gain the attention of all students
	B4	The teacher needs about 10s to organize her material
	B5	The teacher is giving a visual signal (shaking her head and touching her mouth with her finger) when a student wants to interrupt the explanation
	B6	The teacher is voicing what she can see when the students raise their hands to answer a question with three options
	B7	The teacher is touching her mouth and raising her voice to gain attention after a short partner activity

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