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Exploring cognitive processes of professional vision: The role of student-oriented goals and visual attention in preservice teachers' reasoning about classroom interactions☆

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ABSTRACT

Background: Teacher professional vision (PV)—teachers' ability to notice and interpret classroom events in instructionally meaningful ways—has been studied primarily in terms of professional knowledge and teacher expertise, while motivational factors remain underexplored. Moreover, prior research has typically examined noticing- and reasoning-related processes separately, despite their theoretical interdependence.
Aims: This study examined how student-oriented goals affect the depth of preservice teachers' reasoning, and how, together with visual attention, they shape the interplay between PV-related processes.
Sample: The sample consisted of 51 preservice teachers.
Methods: In this multimethod study, participants watched three classroom video stimuli while their eye movements were tracked. Visual attention was assessed by fixation count and fixation duration on individual students. Before watching each video, participants were interviewed about their goals for individual students; after each video, they were interviewed about their reasoning regarding noticed student interactions.
Results: Linear mixed-effects models showed that fixation duration, but not fixation count, positively predicted reasoning quality across all videos. The presence of student-specific goals did not generally enhance reasoning, but effects varied by goal type: mastery goals were associated with more elaborated reasoning, whereas classroom management goals predicted more superficial interpretations.
Conclusions: Findings extend prior PV research by demonstrating that goal setting and sustained visual attention both contribute to the cognitive mechanisms underlying PV, shaping the depth of preservice teachers' reasoning and sense-making. The study points to the value of integrating motivation and PV research, paving the way for future studies exploring noticing- and reasoning-related PV processes that underpin effective teaching.

Teacher professional vision (PV)—the ability to notice and interpret classroom events in ways that are instructionally relevant—is widely regarded as a cornerstone of teaching expertise (Gegenfurtner & Stahnke, 2024; Seidel et al., 2024; Sherin & van Es, 2009). Methodological advances in eye-tracking research provide new opportunities to examine the cognitive underpinnings of PV processes. In particular, it allows us to investigate how teachers' visual processing of observed student behavior relates to the cognitive processes involved in

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☆ The analysis codes used in this study are available from the corresponding author via email. The data used in this study are not publicly available as the study participants did not provide consent for this. This study was preregistered.

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interpreting and making sense of this behavior. By capturing where and how teachers allocate their visual attention, eye-tracking offers objective indicators of teacher noticing processes (Keskin et al., 2024; Seidel et al., 2021). However, recent calls in the eye-tracking literature emphasize the need for more multi-method research that allows visual data to be linked with underlying cognitive processes reflected in qualitative data (Witt et al., 2024). The present study contributes to this growing body of multi-method research (e.g., Muhonen et al., 2023) by linking visual attention and knowledge-based reasoning in the context of teacher professional vision.

Many PV studies are situated within expertise research, focusing on knowledge and experience-related differences, while motivational factors have received far less attention, despite theoretical claims that goals, beliefs, and values are assumed to shape teachers' attentional and reasoning processes (Daumiller et al., 2025; Seidel et al., 2024). Building upon the fundamental role of goal-related processes in directing and sustaining attention (e.g., Dijksterhuis & Aarts, 2010), within the broader range of teacher motivation facets, teachers' goals represent a promising, but understudied, factor that may explain variation in how teachers allocate visual attention and construct meaning from observed classroom interactions. From a cognitive psychology perspective, goals serve as top-down regulators of attention, guiding selective information processing and shaping the relevance criteria that guide interpretation (Corbetta & Shulman, 2002; Dijksterhuis & Aarts, 2010). Recent work suggests that student-oriented goals are especially relevant for such processes, as they are directly tied to teachers' intentions for student learning and classroom functioning (Daumiller et al., 2022). However, despite strong theoretical assumptions, empirical evidence linking teachers' goals to PV processes remains scarce.

Against this background, the present study examines how teachers' student-oriented goals function as proximal motivational mechanisms that guide the cognitive processing underlying teachers' interpretation and sense-making of observed classroom interactions, and how, together with visual attention, they shape how noticing- and reasoning-related processes interfold in professional vision.

1. Cognitive processes of noticing and interpreting classroom interactions

Teacher PV is the capacity to perceive and make sense of classroom events that are instructionally relevant (Seidel et al., 2024; Seidel & Stürmer, 2014; Sherin & van Es, 2009). PV processes unfold in-the-moment and enable teachers to apply their professional knowledge to specific classroom situations, supporting effective instructional decision-making. In the present study, we conceptualize professional vision from a cognitive-psychological perspective (König et al., 2022; Santagata & Guarino, 2011; Seidel & Stürmer, 2014; Sherin & van Es, 2009; van Es & Sherin, 2002), which is well established in video-based research in teacher education (for an overview of different theoretical perspectives on professional vision, see König et al., 2022; Louie, 2018). Based on the cognitive-psychological perspective, PV refers to teachers' perceptual and interpretative processes involved in making sense of classroom situations (Seidel & Stürmer, 2014; Sherin, 2007). Research separates noticing (selective attention) and knowledge-based reasoning as two distinct components of PV (Seidel et al., 2024; Sherin, 2007; Sherin & van Es, 2009). Noticing refers to the perceptual–cognitive process by which teachers direct their attention towards relevant classroom events while filtering out less relevant information (Santagata et al., 2021; Seidel et al., 2024; Sherin, 2007). Due to the high complexity of teaching, effective noticing requires an active, conscious direction of attention to identify relevant events during instruction at any given moment. For example, a teacher's attention may be drawn to a student who is reluctant to engage in classroom interactions. Knowledge-based reasoning builds on what has been noticed, describing the process by which teachers interpret noticed events using their professional knowledge and experience (Seidel et al., 2024; Sherin, 2007). It involves interpreting the noticed events by connecting them to pedagogical knowledge, goals, and beliefs. For example, a teacher might use their knowledge about effective teaching and learning to make sense of students' low engagement in class discussions. High-quality reasoning is characterized by analytical, knowledge-based explanations and predictions about the consequences of classroom events for student learning (Farrell et al., 2022; Seidel et al., 2024; Wolff et al., 2017). Noticing and knowledge-based reasoning are assumed to interact dynamically: what teachers notice shapes how they reason about a situation, while their prior knowledge and professional experience simultaneously guide what they notice in the first place (Sherin & van Es, 2009). Although previous eye-tracking research has focused predominantly on the noticing process (Keskin et al., 2024; Witt et al., 2024), PV extends beyond recognizing relevant classroom events to understanding why they are pedagogically significant and how they connect to broader principles of effective teaching and learning.

Recent conceptualizations (Gegenfurtner, 2024; Seidel et al., 2024, 2026) have linked PV processes to their underlying cognitive system. The cognitive processing model of teacher PV provides a framework for understanding how perception, attention, reasoning, and cognition interact through four core processes (Seidel et al., 2026). Information selection and breadth of the visual field are noticing-related processes. Information selection involves the encoding and processing of visual and auditory information, guided by prior knowledge and existing schemas that direct attention toward pedagogically relevant events. Breadth of the visual field reflects the ability to distribute attention across both central and peripheral classroom areas, allowing multiple classroom events to be monitored and processed simultaneously. Both noticing processes feed into reasoning processes that rely on knowledge resources stored in long-term memory. These reasoning-related processes include cognitive organizing and cognitive integrating processes that enable teachers to reason and make sense of the observed student behavior. Through cognitive organizing, noticed events get structured into coherent mental models by categorizing them and relating them to existing schemas, while integrating connects these mental models with broader professional knowledge. Evidence for the importance of well-developed cognitive schemas in supporting reasoning processes comes from studies on teacher expertise, which indicate that novices often face difficulties in applying their knowledge flexibly (Seidel et al., 2021; Stahnke & Blömeke, 2021; Wolff et al., 2017). As a result, their reasoning tends to be superficial and less accurate, relying on intuitive judgments rather than adaptively connecting observed classroom events to well-established professional knowledge grounded in principles of effective teaching and learning (Farrell et al., 2022; Wolff et al., 2021).

Recent research has extended the focus beyond professional knowledge by highlighting teacher motivation—particularly teachers' goals—as a relevant determinant of PV processes (Daumiller et al., 2025; Seidel et al., 2024). Goals provide a proximal motivational mechanism that connects broader, dispositional orientations (e.g., goal orientations, self-efficacy beliefs) to situated teaching processes, thereby acting as an in-situ filter for what teachers notice and how they reason (Daumiller et al., 2025; Lazarides et al., 2025). While dispositional motivational beliefs capture more stable individual differences, student-oriented goals represent the actualization of some of these beliefs into classroom practice, directed at individual students. As such, they define criteria for relevance, attention towards, and interpretations of student behavior. In this sense, they can form a motivational pathway through which teachers' broader orientations can affect student outcomes (Lazarides et al., 2025). Eye-tracking research has already shown that such goals shape preservice teachers' allocation of visual attention (Daumiller et al., 2025), and recent models illustrate that they should likewise regulate reasoning by activating meaning systems and professional knowledge required for integrating classroom information (Blömeke, 2024; Eβling et al., 2023; Seidel et al., 2024).

2. The role of teacher goals in guiding attention and regulating knowledge-based reasoning

Building on this cognitive view of professional vision, motivational perspectives highlight that teachers' goals provide a top-down mechanism shaping both noticing and reasoning. Goals are cognitive representations of desired end states (Locke & Latham, 1990) and function as organizers of attention, effort, and persistence (Elliot & Fryer, 2008). Unlike knowledge, which provides the resources for making sense of classroom events, goals determine which of these resources are activated, where cognitive energy is directed, and how interpretations are structured.

Classic models of attentional control emphasize that goals guide selective information processing toward goal-relevant information (Corbetta & Shulman, 2002). In classrooms, this implies that teachers' goals influence whether cues are noticed at all, or whether attention is instead captured by salient but less instructionally relevant events such as disruptions (Schütz et al., 2011). Eye-tracking evidence supports a fundamental link between goals and noticing to begin with: Daumiller et al. (2025) asked preservice teachers to articulate their goals for individual students while observing video-based classroom interactions, and, simultaneously tracked their gaze behavior. The study distinguished between several types of student-oriented goals. Following achievement goal approaches, it included mastery goals (focused on supporting students' competence development) and performance goals (focused on students‘ demonstration of ability), as well as relational goals (focused on fostering positive teacher–student relationships). In addition, two further categories were considered: classroom management goals (maintaining order and discipline) and learning climate goals (promoting a supportive, inclusive atmosphere). The main finding was that goals for individual students were associated with visual attention on those students. At the same time, differences between goal types also emerged, with mastery goals showing stronger links to focused attention than classroom-management ones.

Besides guiding the allocation and intensity of attention, goals are also assumed to shape how noticed information is interpreted. Reasoning in classroom contexts is inherently goal-dependent: teachers explain, predict, and evaluate events in light of what they aim to accomplish (Seidel & Stürmer, 2014). Goals establish the criteria by which interpretations are made. They function as cognitive filters that define what counts as relevant evidence (Dijksterhuis & Aarts, 2010). For example, following a mastery goal for a student who does not respond to a teacher question may lead a teacher to interpret this silence as a lack of engagement requiring support, whereas a classroom management goal may lead to interpreting the same behavior as inattentiveness needing correction.

Goals also structure the knowledge resources that teachers draw upon in reasoning. They are tied to specific schemas and expectations in memory (Mayer, 2014; Schneider & Shiffrin, 1977), which are activated selectively when interpreting student behavior. This also explains why goal-directed reasoning tends to be more strongly anchored in professional knowledge. Studies on teachers' diagnostic competence attest that clear, learning-related goals foster deeper analyses of student learning and behavior, enabling teachers to generate and test hypotheses more systematically (Vogt et al., 2014). By contrast, reasoning without explicit goals risks being superficial.

3. Using eye-tracking research to explore teacher professional vision processes

Eye-tracking has become an important tool for studying professional vision, as it provides objective indicators of how teachers allocate their visual attention during classroom observation (Keskin et al., 2024; Witt et al., 2024). Fixation count and fixation duration are two primary measures of visual attention that are commonly assumed to reflect different aspects of cognitive processing. Whereas the number of fixations reflects processing breadth (e.g., how broadly and frequently attention is distributed across students), fixation duration has been linked to more effortful cognitive processing, which may indicate the extent of sustained cognitive engagement with the observed event (Holmqvist et al., 2011; Negi & Mitra, 2020). In this way, these two metrics provide complementary insights into whether teachers monitor classroom events or engage in deeper cognitive processing—making them especially suitable for examining noticing- and reasoning-related processes in PV research.

Research on teacher noticing and reasoning has received considerable attention in recent years (Gegenfurtner & Stahnke, 2024; Grub et al., 2020; Santagata et al., 2021), with a substantial body of work examining expertise-related differences in each process. However, surprisingly little is known about how these processes relate to and interact with each other, despite their definitionally interrelated nature. For studying visual processes associated with noticing, eye-tracking has become a prominent method (Jarodzka et al., 2021; Keskin et al., 2024), whereas reasoning processes are typically examined through interviews, think-aloud protocols, open responses, or tests that approximate the depth and sophistication of cognitive processing (König et al., 2022; Witt et al., 2024; Wolff et al., 2017). Investigating a sample of primary school teachers, Muhonen et al. (2023) found that teachers' knowledge-based reasoning relates to their visual attention in the classroom, showing that the kinds of content teachers address in their reasoning are linked to how they distribute their gaze across the class and individual students. From the few eye-tracking studies that have investigated the relationship between visual attention and knowledge-based reasoning, important insights emerge on how noticing connects to subsequent cognitive processing and interpretation. For example, analyses of participants' eye movements during reading tasks revealed that reasoning performance improved when learners allocated longer fixation durations to critical sections of the text (Wang et al., 2020; Yang, 2017). This finding supports the theoretically assumed link that increased time spent on specific areas can foster the organization of information and deeper processing, reflecting learners' efforts to build coherent mental structures (Coskun & Cagiltay, 2022). Similarly, Negi and Mitra (2020) investigated fixation durations during a video-based learning task and found that students who spent more time fixating on the video content exhibited deeper cognitive processing, which was beneficial for reasoning and comprehension. Other studies indicate that prolonged visual attention to relevant areas is not only linked to improved reasoning but also strongly associated with higher diagnostic accuracy, underscoring the importance of effective cognitive processing for subsequent decision-making (Balslev et al., 2012; Seidel et al., 2021). However, with a few exceptions, such as Seidel et al. (2021) and Muhonen et al. (2023), these studies are not situated in teacher professional vision research, which limits the insights on how noticing-related indicators of visual attention (such as fixation count and fixation duration) are linked to subsequent processes of knowledge-based reasoning about observed classroom interactions.

4. The present study

The present research investigates teachers' student-oriented goals as proximal motivational mechanisms of noticing- and reasoning-related PV processes: they are assumed to shape both what teachers attend to and how they interpret it. While prior findings indicate that student-oriented goals guide visual attention (Daumiller et al., 2025), their impact on reasoning remains largely untested. The present study seeks to address this gap by examining whether the presence and type of student-oriented goals explain variation in reasoning depth beyond visual attention. In this way, we aim to provide empirical evidence on the role of teacher motivation in shaping professional vision—mechanisms that have thus far been assumed in theory but not systematically examined. A second aim of this study is to extend prior professional vision research by investigating how noticing- and reasoning-related processes are interconnected. Previous research has considered these processes separately, but little is known about how visual attention supports the depth of teachers' reasoning. By combining eye-tracking measures of noticing with interviews assessing teachers' reasoning about observed student behavior, we test whether attention allocation explains variation in reasoning alongside knowledge and motivation. Against this background, the present study addresses the following research questions:

1. To what extent do patterns of visual attention (i.e., number and duration of fixations) and motivational factors (i.e., situation-specific, student-oriented goals) predict the depth of preservice teachers' reasoning and sense-making about observed classroom events?
2. Does the presence of goals explain differences in the depth of reasoning beyond the effects of visual attention? Do different types of teacher goals differentially predict the depth of reasoning?

We expected that both the number and duration of fixations will enhance the quality of reasoning about classroom events, as they facilitate the organization and integration of classroom information into coherent mental models (Coskun & Cagiltay, 2022; Wang et al., 2020). In addition, we expected that the presence and type of student-oriented goals will influence reasoning depth. Goals are expected to guide attention and activate relevant knowledge structures, making reasoning more analytical and targeted (Daumiller et al., 2025; Seidel et al., 2024). In addition, we expected that the association between student-oriented goals and reasoning depth would depend on goal content. In particular, goals emphasizing student mastery and learning were assumed to be more strongly linked to deeper reasoning than goals emphasizing classroom management. For other goal types, such as relational or learning-climate goals, we did not formulate directional hypotheses but were explored without directional hypotheses.

5. Method

In this study, preservice teachers observed video-based classroom interactions while their gaze behavior was recorded using eye-tracking and subsequently participated in interviews assessing their reasoning about the observed students. The data stem from the same project as reported in Daumiller et al. (2025). While the previous publication focused on the exploration of preservice teachers' goals and their gaze behavior during one video, the present analyses extend the dataset by including all three videos and the reasoning data from interviews conducted after each round of video observation, which have not been analyzed previously. The study and its hypotheses were preregistered (https://aspredicted.org/jf9eu3.pdf).

5.1. Sample

The sample consisted of 51 preservice teachers from two universities in southern Germany. On average, they were in the fifth semester of their teacher education program ($SD = 3.09$). Their mean age was 22.78 years ($SD = 4.35$), and 70.6% identified as female. Participants already had some prior teaching experience, having taught, on average, 40.25 classroom lessons ($SD = 117.83$). About one-third of the sample was preparing to teach at the primary level, while two-thirds were enrolled in secondary education tracks. Of those in secondary education, 3.9% prepared to teach at the lower secondary level (Hauptschule), 1.9% at the intermediate level (Realschule), and 60.8% at the upper secondary level (Gymnasium).

5.2. Procedure

Preservice teachers were recruited via flyers to take part in a video-based simulation study during which their eye movements were recorded. Participants received €20 for their voluntary participation and provided informed consent prior to the study. Data were treated confidentially in accordance with university data protection regulations, and the study complied with the Ethical Principles of Psychologists and the Code of Conduct established by the American Psychological Association (APA, 2017) and the German Psychological Association (DGPs, n.d.). The study did not undergo a formal ethics committee review, as the procedures involved minimal risk, consisted solely of non-invasive eye-tracking during video observation, and included informed consent, voluntary participation, and strict data anonymization. No sensitive personal or health-related data were collected.

The study was conducted in the university's eye-tracking laboratory. Participants were first informed that they would watch classroom video recordings while their eye movements were tracked and that, for each video clip, they would take part in two interviews—the first addressing their student-oriented goals and the second focusing on their perceptions of the observed classroom interactions for each video. They viewed a total of three video clips, each approximately 3 min in length, portraying standardized secondary school classrooms engaged in teacher-centered instruction (Lewalter et al., 2020). All videos were filmed from a frontal, teacher-perspective (ego perspective) and depicted realistic classroom settings. The first video stimulus showed 12 ninth-grade student actors during a geometry lesson. The second featured 14 student actors in an 11th-grade trigonometry lesson, and the third displayed 20 student actors participating in an 11th-grade lesson on algorithms and data structures. The videos were intentionally selected and designed to focus on student interactions and observable classroom behaviors (e.g., engagement, verbal participation, peer interaction), rather than on subject-specific or didactic aspects of mathematics instruction.

For each video, participants first watched the beginning of the video stimulus to obtain an overview of the teaching context and classroom environment. In a first interview, they were then asked to imagine themselves as the class teacher and were interviewed about the student-oriented goals they would set in that particular teaching context. Following this, participants watched the remainder of the video while their eye movements were recorded. Based on this video, participants were interviewed a second time and were asked about their perceptions of the teaching situation, specifically, which events they noticed and how they interpreted these in relation to effective teaching and learning. The interview about student-oriented goals lasted about three to 7 min and the interview on their reasoning about observed classroom events lasted between three and 12 min.

5.3. Measures

5.3.1. Eye-tracking

Preservice teachers' visual attention was assessed via eye tracking using a stationary Tobii Pro Fusion device operating at 120 Hz, mounted on a 24-inch monitor displaying the video stimuli. For each participant, a five-point calibration and validation were conducted before each video to ensure data quality. To capture attention to student behavior, each student was defined as a dynamic area of interest (AOI), adjusted frame by frame to account for movement. From these AOIs, two standard eye-tracking metrics were derived: fixation count and fixation duration. Fixation count refers to the number of discrete fixations on a student AOI, indicating how frequently attention is allocated across students. Fixation duration reflects the total time spent fixating on a student AOI, which is typically associated with more sustained engagement and deeper cognitive processing (Holmqvist et al., 2011).

5.3.2. Interviews

For each video stimulus, we conducted two semi-structured interviews with the participants. Therein, they were asked to position themselves in the role of the classroom teacher. The first interview was conducted after participants watched a preview of the video clip and were familiar with the students and the teaching context. The interview was designed to assess any goals for individual students that participants would set for themselves as their classroom teacher ("What student-related goals would you pursue as a teacher in this situation?"). The second interview was designed to assess the depth of reasoning and sense-making of observed student interactions. Participants were first asked to recall any relevant observations from the video and then to explain why they consider this situation as relevant for the further instructional process, what impact this situation may have on the students or the further course of the lesson and what they, as a classroom teacher, might have done differently in this situation. These questions were designed to capture the different aspects commonly related to reasoning, including the explanation of the situation, making a prediction about learning consequences and providing alternative strategy suggestions for improved teaching behavior (Farrell, 2024; Seidel & Stürmer, 2014). Pedagogically relevant events were not predefined in the video stimuli; instead, participants themselves decided which situations they considered instructionally relevant while watching the video stimuli.

For both interviews, follow-up prompts were employed to help participants elaborate on their responses (e.g., "Why do you think that?", "Can you say more about that?"). One lead author and two research assistants conducted the interviews. To ensure consistency, all interviewers completed several practice sessions, observing and discussing each other's techniques to standardize the approach.

5.3.3. *Quantitative self-reports*

To assess the perceived authenticity of the video scenes, participants rated the extent to which they were able to immerse themselves in the classroom situation and gain insight into both the setting and the students, each with one item, on an 8-point Likert scale ranging from 1 (*not at all*) to 8 (*to the fullest extent*). Across all three videos, participants reported high levels of perceived authenticity (Video 1: $M_{\mathrm{Item}1/2} = 6.52/6.32$, Video 2: $M_{Item1/2} = 6.53/6.36$, Video 3: $M_{Item1/2} = 6.53/6.38$). After completing the procedure for all three video stimuli, participants completed a demographic questionnaire. Practice-based teaching experience was assessed by asking participants to report the number of school lessons they had taught independently ("How many school lessons have you taught by yourself?").

5.4. *Interview coding procedure*

All interviews were transcribed and imported into MAXQDA 2024 (VERBI Software, 2021) for coding. The coding of goals articulated in the first interview followed a two-step procedure. First, coders linked each student-oriented goal to the corresponding student shown in the video clip. Next, the goals were categorized by content into different goal types. Following Daumiller et al. (2025), we conceptualize student-oriented goals as situation-specific instantiations of teachers' motivational orientations that guide attention and reasoning in concrete instructional contexts. For this purpose, we developed a coding scheme adapted from an existing instrument on goal orientations (Daumiller & Dresel, 2020). This instrument distinguishes between achievement goals such as mastery goals (task- and learning-focused), performance goals (appearance- and norm-focused), as well as relational goals, and work avoidance goals. In addition, we inductively added two further categories focused on aspects of instructional quality: classroom management goals (addressing student discipline and behavior) and learning climate goals (addressing students' sense of belonging and the overall learning atmosphere). The coding of student-oriented goals followed a hybrid deductive–inductive approach, as outlined in Daumiller et al. (2025). Initial goal categories were deductively derived from achievement goal research, including mastery-oriented and relational goals. However, because the present study focuses on situation-specific goals articulated for a concrete classroom video, we did not aim to reproduce the full differentiation of dispositional achievement goal orientations (specifically, performance and work avoidance goals were deemed unlikely). Therefore, inductive refinement was applied during coding to capture goal contents that emerged frequently but were not fully represented in classic achievement goal frameworks. This process led to the identification of the two additional goal types (classroom management goals and learning climate goals). Ten of the 382 student-oriented goals could not be assigned to any category and did not align with a common overarching theme. The classification of these goals was carried out by four research assistants. All coders participated in multiple training workshops during which they reviewed the definitions of each goal and clarified any uncertainties or disputes. In the first step, the research assistants coded the transcripts independently, with each interview coded by two independent raters. The interrater reliability of the independent coding indicated substantial agreement ($\kappa = .78$). Afterwards, they met for a consensus meeting to compare their coding and resolve discrepancies. Four different types of goals were articulated in the interviews: mastery goals, relational goals, learning climate goals, and classroom management goals (for details, see Table S1 in the supplemental material).

Transcripts from the second interview, which focused on participants' reasoning about observed student interactions, were coded in a two-step process. First, each reasoning segment was linked to the respective student in the video clip. Next, we developed a rating scale to assess the quality and depth of participants' reasoning and sense-making of each noticed student interaction. The rating scale was adapted from a qualitative coding measure on the quality of professional vision developed by Farrell (2024). Each noticed student interaction was scored on one of five levels of reasoning quality.

(1) Unclear: No interpretation of the interaction; opinions, assumptions, or judgments remain unjustified; provided interpretations lack a logical connection to the noticed interaction or are contradictory/factually incorrect.
(2) Undifferentiated: A loose connection to the noticed interaction is recognizable; claims are partly based on information from the video but mixed with uninformed assumptions or opinions.
(3) Standard: A clear and logical connection to the noticed interaction; interpretations are grounded in relevant information from the video with little to no reliance on uninformed assumptions.
(4) Differentiated: A clear and logical connection to the noticed interaction; interpretations include multiple, evidence-based arguments from the video and exclude unjustified opinions or assumptions.
(5) Highly differentiated: In addition to the previous indicators, interpretations draw on theoretical models and/or empirical evidence about effective teaching and learning.

A team of three student assistants (one of whom served as the master rater) was trained on the rating scale to assess participants' reasoning quality. After training, 30% of all reasoning segments were independently rated by all three coders. Interrater reliability indicated satisfactory agreement (ICC = .83). The remaining data were subsequently coded by the master rater. For each participant, we calculated their average reasoning quality across all scored reasoning segments.

5.5. *Data analysis*

5.5.1. *Matching goals and reasoning*

To examine how preservice teachers' student-oriented goals were taken up in their subsequent reasoning, the two datasets were systematically matched. Each articulated goal from the first interview was linked to reasoning data from the second interview when the segment referred to the same student.

5.5.2. *Statistical analysis*

To investigate how preservice teachers' goals and their visual attention relate to the depth of reasoning and sense-making of noticed student interactions, we specified linear mixed-effects models. All analyses were performed in R 4.3.3 (R Core Team, 2025) using the lme4 package (Bates et al., 2015). Model parameters were estimated with restricted maximum likelihood (REML) to obtain unbiased estimates of variance components. P-values for fixed effects were calculated using the lmerTest package (Kuznetsova et al., 2017). The MuMIn package (Barton, 2024) was used to compute R^2, and the multilevel package (Bliese, 2022) was employed to calculate intraclass correlation coefficients (ICCs). Predictors included eye-tracking metrics (number and duration of fixations per student AOI), participants' practice-based teaching experience, a dichotomous goal variable (indicating if the reasoning segment was matched with a respective student-oriented goal or not), with reasoning quality as the outcome. Perceived authenticity of the video clips was included as a covariate. Analyses were conducted stepwise, with successive models including (1) a dichotomous goal variable, (2) eye-tracking metrics only, (3) eye-tracking metrics plus the dichotomous goal variable, and (4) all predictors, including differentiated goal types (see Table 3). To account for the nested structure of repeated observations, we specified a three-level hierarchical model, with repeated observations (reasoning segments) nested within participants, and participants nested within the three video stimuli. All predictors were measured at the individual level and examined accordingly, while the modeling approach explicitly accounted for the resulting non-independence of observations. Statistically, we addressed this dependency by specifying linear mixed-effects models with random intercepts. All focal predictors (teacher goals and eye-tracking metrics) were entered as fixed effects, alongside person-level covariates. Thus, the primary units of analysis were reasoning segments derived from repeated observations across video stimuli. Additional robustness checks revealed that simplified model specifications (reduced models and person-level aggregation for subgroup comparisons) showed consistent findings. Q–Q plots and histograms were plotted to analyze the distributions of residuals. Residuals were checked for outliers, and all independent variables were checked for multicollinearity. As an additional robustness check, we controlled for the saliency of each student's behavior—determined from video ratings of how often the student spoke to the teacher, chatted with classmates, or raised their hand—to ensure that the quality of reasoning was not simply an artefact of how noticeable the student's behavior was in the clip. One-way ANOVAs were run to test group differences between primary- and secondary-track preservice teachers. There were no statistically significant differences in reasoning quality, fixation count, fixation duration, or the proportion of student-oriented goal formulations. Moreover, they did not differ in practice-based teaching experience or perceived authenticity of the videos.

6. Results

6.1. Descriptive results on teachers' reasoning quality

We first analyzed the distribution of reasoning quality levels across all scored segments. On average, each preservice teacher reasoned about approximately five distinct student behaviors ($M = 5.27$, $SD = 2.74$), which were observed in the classroom videos. The mean reasoning score across all preservice teachers was $M = 1.58$ ($SD = .78$), indicating generally low levels of reasoning quality in the sample. As shown in Table 1, the majority of reasoning segments were rated as either standard (45.34%) or undifferentiated (36.4%), indicating that most preservice teachers' reasoning showed a clear connection to specific student interactions, though the level of justification varied across responses. Fewer segments were rated as differentiated (10.47%), reflecting more elaborate and evidence-based reasoning, while none were rated as highly differentiated, a level requiring integration of theoretical and empirical evidence related to effective teaching and learning. Only 7.75% of segments were rated as unclear, indicating a lack of logical justification or connection to the observed student behavior.

Of note, only for approximately one-third of the student-related reasoning segments did we identify a corresponding student-oriented goal articulated by the same participant. Correlations with reasoning quality were generally modest (see Table 2): reasoning quality was positively related to fixation duration and practice-based teaching experience, and negatively to the presence of goals.

6.2. Associations between visual attention, goals and reasoning quality

To investigate our first research question, we tested how the depth of teachers' reasoning was associated with their visual attention to individual students and the presence of situation-specific goals (see models 1–3 in Table 3). Controlling for video authenticity, salience of student behaviors, and practice-based teaching experience, we observed that duration of fixations, but not number of fixations, was positively linked to reasoning depth (mirroring the descriptive correlations). Surprisingly, and contrary to our expectations, we found that the reasoning depth for the student observations was not higher if participants had formulated a goal for these students before watching the video. On the contrary, the effect was descriptively even in the wrong direction, albeit weak.

To answer our second research question, we further investigated the associations between the type of student-specific goals and reasoning quality (see model 4 in Table 3). For these analyses, we found that reasoning quality correlated positively with mastery-oriented goals ($r = .28$, $p < .01$), whereas classroom management goals were negatively

Table 1
Frequencies and percentages of reasoning quality levels.

	n (%)	Example statements
(0) Unclear	20 (7.75)	"With the blonde girl, it was like she had this sense of relief when the teacher handed her the sheet. Unlike the boy, she thinks: "Oh yes, I'm the super popular student. I'll probably get everything right." I think at the beginning of the video, she just repeated the same thing, and the teacher didn't really respond. Kind of like: "Well, isn't that the same as before?"
(1) Undifferentiated	94 (36.43)	"I might approach him after class and say, "Hey, did you actually understand it? How are you doing in math? Are you keeping up?" If he's having difficulties, of course I'd help him, and I'd also ask how he's doing. It could be that he's just having a bad day and is a bit stressed or something."
(2) Standard	117 (45.35)	"He didn't speak up. He didn't seem very engaged, but it also wasn't like he appeared distracted. He was taking notes. The handout process went fairly quickly too. It wasn't like he was a major obstacle. […] Maybe, if it happens more often that students look at the clock or something, I'd address it and ask if they find the lesson boring. That way, it becomes clear to them that it's not something they should do and that they should pay attention. But in this case, since it only happened once, I don't think I would've done anything."
(3) Differentiated	27 (10.47)	"Now that I know Fabian doesn't really have any social connections in the class, I would organize group work in math. I'd intentionally put Hannah and Lara in a group together. One of them—Hannah—is the top student in the class, and Lara still needs a bit of support with the cosine rule. […] Yes, well, it was clear that he doesn't really have any connections. And I don't want anyone to be excluded or bullied. School should be a good time for students, since it's a very important time in their lives. So that it doesn't end up having negative consequences for him."
(4) Highly differentiated	–	–

Table 2
Descriptive statistics and bivariate correlations.

	M	*SD*	Bivariate correlations 1	2	3	4	5	6
[1] Reasoning quality	1.59	0.78						
[2] Number of fixations per student	33.46	24.87	.08					
[3] Duration of fixations per student	11102.47	9034.41	**.23**	**.74**				
[4] Goal for student: yes or no	0.36	0.48	**−.16**	.02	−.07			
[5] Teaching experience	40.25	117.83	**.16**	−.10	−.04	.02		
[6] Authenticity of video material	3.86	0.50	.06	−.05	.10	−.12	.01	
[7] Salience of student behaviors	1.63	1.64	.07	−.05	−.03	−.04	.05	−.03

Note. $N = 252$ student observations within $N = 51$ preservice teachers. Goal for student is coded as 1 = student-specific goal present and 0 = no student-specific goal present. Presented are Pearson correlations. Statistically significant ($p < .05$) correlations are boldfaced.

Table 3
Associations between visual attention on individual students and student-specific goals on reasoning quality.

Predictors	Model 1			Model 2			Model 3			Model 4		
	β	*SE*	*p*	*β*	*SE*	*p*	*β*	*SE*	*p*	*β*	*SE*	*p*
(Intercept)	.08	.09	.368	−.06	.09	.484	−.02	.09	.858	.01	.10	.938
Number of fixations (Attention)				−.09	.11	.404	−.07	.11	.528	−.07	.11	.496
Duration of fixations (Processing Depth)				**.22**	**.08**	**.005**	**.20**	**.08**	**.009**	**.20**	**.08**	**.007**
Student-specific goals	−.09	.04	.051				−.08	.04	.052	**−.54**	**.20**	**.008**
Mastery[a]										**.50**	**.23**	**.030**
Relational and additional goals[a]										.01	.35	.980
Teaching experience	**.16**	**.08**	**.041**	**.16**	**.08**	**.041**	**.17**	**.08**	**.036**	**.16**	**.08**	**.038**
Control Variables												
Authenticity of video	.08	.09	.386	.07	.09	.407	.06	.08	.470	.05	.08	.555
Saliency of student behaviour	.07	.06	.245	.09	.06	.169	.08	.06	.207	.08	.06	.185
Random effects												
σ^2	.70			.67			.68			.65		
$\tau_{00\ ID:d.Video}$	.04			.05			.02			.05		
$\tau_{00\ ID}$	.20			.19			.18			.17		
ICC	.25			.26			.23			.25		
Marginal R^2/Conditional R^2	.06/.30			.09/.33			.11/.31			.13/.35		

Note. $N = 252$ student observations within $N = 51$ preservice teachers. Presented are standardized regression coefficients. Random intercepts are included for participants and videos. Predictors are modeled on the within level. Statistically significant ($p < .05$) values are boldfaced.
[a] Reference category: classroom management goals.

associated ($r = -.22$, $p < .05$). Relational goals showed no significant relation, and learning climate goals occurred too infrequently to be analyzed. As overall only few goals were mentioned (see Table S1 in the supplementary materials), two dummy variables were created for mastery goals and relational goals, with classroom management goals as the reference category. Thirteen participants, despite expressing one or more goals, did not provide a reasoning segment that could be clearly linked to any of their goals. Therefore, the underlying sample size for this model is smaller, and the respective results need to be interpreted with caution. Still, the results from this final multilevel model (model 4 in Table 3), confirmed the prior bivariate patterns. In contrast to classroom management goals, mastery goals emerged as a statistically significant positive predictor of reasoning quality ($\beta = .50$, $p = .030$), suggesting that when preservice teachers focused on fostering student mastery instead of classroom management, their subsequent sense-making was more elaborated. The negative effect that we observed regarding the presence of goals may thus partly reflect the strong prevalence of classroom management goals.

7. Discussion

In everyday classrooms, teachers constantly have to decide which student behaviors deserve attention and cognitive resources to make pedagogically appropriate decisions, yet key factors beyond knowledge and the underlying mechanisms of this sense-making remain unexplored. In this multimethod study, we found that sustained visual attention (fixation duration, but not fixation count) was positively associated with reasoning quality. We also found that student-oriented goals did not exhibit a uniform benefit for reasoning: having articulated a goal for a student was not associated with higher reasoning quality overall, but goal content mattered. Because these results rely on aggregated eye-movement indicators, they should not be interpreted as behavior-specific causal effects; rather, they suggest that who is looked at for longer and what the teacher aims to achieve for that student are meaningfully related to the depth of subsequent sense-making. By measuring goals, attention, and reasoning at three different time points via distinct assessment methods, the methodologically innovative study provides initial empirical support for motivational pathways in professional vision models and highlights sustained attention as a plausible mechanism connecting noticing-related processes to knowledge-based reasoning beyond teaching experience.

7.1. Relations between visual attention, student-oriented goals and reasoning quality

Consistent with prior research, the overall reasoning quality of preservice teachers in our study was relatively modest. This aligns with evidence that novices often struggle to move beyond surface-level observations and generate more elaborated, knowledge-based analyses of classroom interactions (Farrell et al., 2022; Wolff et al., 2017). Importantly, reasoning could be meaningfully captured through interviews, and we observed substantial variability both between pre-service teachers and across observations, indicating that this method was effective in identifying individual differences in sense-making. With regard to goals, we found that mastery goals were most frequently articulated, while performance and avoidance goals occurred rarely, likely because student achievement comparisons were neither salient nor feasible within the short video segments.

Extending a previous study on the relation between goals and teacher noticing (Daumiller et al., 2025), the present research investigated how student-specific goals and visual attention (measured via the number and duration of fixations) affect the depth of preservice teachers' reasoning about observed classroom events across three classroom videos. To this end, our analyses revealed no general positive effect of having articulated a student-specific goal on reasoning quality. Instead, the type of goal emerged as relevant: mastery goals were associated with more elaborated reasoning, while classroom management goals predicted more superficial interpretations. This pattern highlights that although goals can direct teachers' attention toward individual students (Daumiller et al., 2025), only certain types of goals appear to activate the deeper cognitive processes required for knowledge-based reasoning. One explanation that we suggest is that mastery goals inherently involve student learning and competence development, which are dimensions that are not directly observable and thus in demand of abstraction, diagnostic inference, and the actualization of professional knowledge (Seidel et al., 2024). This may further stimulate hypothesis generation and reflective sense-making. In contrast, preservice teachers' classroom management goals tend to focus on overt behaviors such as compliance or disruption, which are easier to perceive and interpret and therefore require less analytical depth (Chaudhuri et al., 2022). Interpreting this absence of a main effect of goals, we should also bear the reduced salience of goals across the study in mind: while participants articulated goals during the preview, these may have lost relevance once the classroom interaction unfolded, particularly given that our sample consisted mostly of novices whose attention is easily drawn to salient but less instructionally relevant events (McIntyre et al., 2019; Wolff et al., 2016). Overall, these findings do not support the assumption that goals uniformly enhance reasoning. Instead, their impact may depend on their content and the cognitive demands they entail. On a larger scale, this underscores the importance of considering motivational mechanisms alongside knowledge and attention in models of professional vision, while also pointing to the need for nuanced analyses of teacher motivation in PV

With regard to attention, our results show that fixation duration is associated with better reasoning performance, while fixation count was not related. This finding may reflect the qualitative differences in cognitive processing associated with these eye-tracking metrics (Holmqvist et al., 2011). High reasoning quality requires comprehensive mental models about the noticed student behavior, promoting a well-grounded explanation, a logically derived prediction of its learning consequences, and/or a suggestion for more effective teaching behavior (Farrell et al., 2022; Seidel & Stürmer, 2014; Sherin & van Es, 2009). For elaborate reasoning, it may not be sufficient to simply register a behavior—more closely linked to fixation count—but rather to show deep cognitive engagement with the observed behavior, which seems to be better captured by the fixation time (Holmqvist et al., 2011; Negi & Mitra, 2020). The cognitive processing model of teacher PV (Seidel et al., 2026) emphasizes that organizing and integrating information are key reasoning-related processes. Our findings suggest that it is sustained attention that facilitates these reasoning-related PV processes, enabling preservice teachers to engage in high-quality reasoning. This is consistent with prior research outside the field of teacher education, which has linked sustained attention and improved reasoning and diagnostic performance (Balslev et al., 2012; Wang et al., 2020; Yang, 2017). The cognitive process model of teacher professional vision (Seidel et al., 2026) assumes that visual attention and cognitive processing are closely related, as commonly proposed by the eye–mind assumption (Just & Carpenter, 1980; van Gog & Jarodzka, 2013). However, this assumption is debated because eye-tracking data alone cannot provide direct insights into the underlying cognitive processes (see Orquin & Holmqvist, 2018). Our mixed-method design, therefore, combines eye-tracking measures with interview data to obtain an indicator of the depth of cognitive processing. The observed association between preservice teachers' gaze data and their reasoning quality found in this study supports the assumed relation between attentional and cognitive processes, which is widely referenced but not always empirically demonstrated in eye-tracking research (Holmqvist et al., 2011).

While earlier eye-tracking studies have often focused on teachers' gaze behavior associated with noticing-related processes (Keskin et al., 2024; Witt et al., 2024), the present study adds to more recent multi-method approaches by linking quantitative noticing- and qualitative reasoning-related PV processes and offering empirical insights into their interrelations (e.g., Muhonen et al., 2023). Finally, with regard to practice-based teacher experience, our study replicates prior research indicating that professional knowledge and experience gained through deliberate practice promote teacher reasoning (Huang et al., 2023; McIntyre et al., 2017; Stahnke & Blömeke, 2021).

7.2. Limitations and suggestions for future research

Several limitations need to be acknowledged. First, the sample consisted of a relatively small group of preservice teachers. While with regard to eye tracking research this sample size is strong and provided a controlled context (i.e., all participants viewed the same standardized classroom video stimuli under standardized eye-tracking conditions, received identical instructions, and completed structured interviews to report their reasoning), generalizability is still limited, particularly to in-service teachers, who draw on richer professional knowledge and more practical experience that influence top-down processes such as goal setting and attention allocation (Keskin et al., 2024; Seidel et al., 2024). In addition, experts possess more sophisticated mental models of classroom dynamics, and prior research has shown that experienced teachers engage in deeper and more elaborate reasoning about classroom events (Stahnke & Blömeke, 2021; Wolff et al., 2016). Future research should therefore include more diverse samples and explicitly compare novice and expert teachers to capture how expertise shapes the role of goals in attention and reasoning. A further limitation related to generalizability concerns the instructional context of the video material. Although the video material was selected to emphasize student interactions and observable classroom behaviors that are common across educational contexts, the videos depict secondary mathematics instruction. We therefore recommend that future studies examine additional instructional contexts by including more diverse subject areas and school tracks.

Second, we relied on participants watching videos in a laboratory setting. Although participants rated the videos as highly authentic and effects were consistent across three scenarios, the absence of real interaction and background knowledge constrains ecological validity. Certain goal types, such as performance or relational goals, were rarely articulated, which may partly reflect the simulated nature of the task (see Daumiller et al., 2025). Studies in real classrooms or high-fidelity simulations could address this limitation and examine whether similar links emerge under more complex and especially interactive conditions.

While our interview approach provided rich qualitative data, a third limitation is that interviews are susceptible to memory limitations, selective recall, or social desirability – especially for reasoning, which was assessed retrospectively. The high frequency of mastery goals, for example, could reflect such biases. Moreover, participants' articulated goals did not always align with their subsequent reasoning, suggesting a disconnect between original intentions and actual processing. Future research could combine interview data with concurrent measures such as think-aloud protocols, stimulated recall, or gaze-based prompts to even more closely capture the underlying in-the-moment cognitive processes giving rise to goal change or take-up.

Finally, our analyses focused on the presence of goals rather than their strength or salience and modeled them as linear predictors. This approach may overlook the complexity of teachers' motivational profiles and the possibility that multiple goals interact in shaping attention and reasoning. In addition, some goal categories occurred too infrequently to allow robust testing, rendering the analyses on goal type largely exploratory. Future work should consider capturing goal strength, investigating goal combinations, and pondering designs that could facilitate testing less common goals with sufficient power.

7.3. Practical implications

By linking teacher goals and PV, the present study provides an important starting point for future PV theory development and highlights the need for more holistic PV training that includes teacher motivation. This involves reflecting on the role of goals in PV processes and recognizing that attention allocation is crucial for what and how teachers perceive and process classroom events. Eye movement modeling examples, and gaze-feedback could help preservice teachers become more aware of these attentional patterns, while guided reflection can foster understanding of how motivational mechanisms shape visual attention and cognitive sense-making (Emhardt et al., 2023; van Gog et al., 2025).

8. Conclusions

In the present study, we employed an innovative mixed-method design that allowed us to link eye-tracking data on visual attention with qualitative interview data capturing reasoning processes. This approach responds to recent calls in the literature for eye-tracking studies that examine both noticing- and reasoning-related professional vision processes by combining quantitative and qualitative methods (Witt et al., 2024). Moreover, our findings highlight the often underrepresented role of teacher motivation, suggesting that the field should more systematically incorporate motivational factors in both PV research and theory. By demonstrating how student-oriented goals shape reasoning processes, this study advances our understanding of how teacher motivation contributes to the cognitive mechanisms underlying PV, extending the focus beyond knowledge and experience emphasized in prior expertise research.

CRediT authorship contribution statement

Ricardo Böheim: Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Martin Daumiller:** Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Aldin Alijagic:** Writing – review & editing, Validation, Methodology. **Doris Lewalter:** Writing – review & editing, Resources. **Andreas Gegenfurtner:** Writing – review & editing, Conceptualization. **Markus Dresel:** Writing – review & editing, Project administration, Methodology, Conceptualization. **Tina Seidel:** Writing – review & editing, Project administration, Methodology, Conceptualization.

Declaration of generative AI and AI-assisted technologies in the manuscript preparation process

During the preparation of this work, the authors used MS Copilot for language editing purposes, including improving clarity, grammar, and wording. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the published article.

Declaration of competing interest

We have no known conflict of interest to disclose.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.learninstruc.2026.102404.

Data availability

Data will be made available on request.

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