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Zeitschrift für Erziehungswissenschaft 29 (2026) 2, S. 627-656



Quellenangabe/ Reference:

Stiewe, Alexander; Ehm, Jan-Henning: Preschool teachers' noticing. A review of conceptualizations, operationalization, and empirical relations - In: Zeitschrift für Erziehungswissenschaft 29 (2026) 2, S. 627-656 - URN: urn:nbn:de:01111-pedocs-355505 - DOI: 10.25656/01:35550; 10.1007/s11618-025-01343-x

<https://nbn-resolving.org/urn:nbn:de:01111-pedocs-355505>

<https://doi.org/10.25656/01:35550>

in Kooperation mit / in cooperation with:



<https://info.oe-deepgreen.de>

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Preschool teachers' noticing: a review of conceptualizations, operationalization, and empirical relations

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Received: 11 April 2023 / Revised: 20 March 2025 / Accepted: 24 May 2025 / Published online: 18 September 2025
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Abstract This paper presents an overview of research on preschool teachers' noticing. A systematic literature search was conducted to find out how noticing has been conceptualized, what methods have been used to investigate it, and whether relationships with other constructs can be demonstrated. The review included 35 studies that met the criteria for inclusion. Three conceptualizations of noticing could be identified: perception, perception and interpretation, and perception, interpretation, and decision-making. The results showed that the majority of the reviewed studies focused on video-based testing and used interviews, questionnaires, thinking-aloud practices, case studies, and journaling to assess noticing. The reviewed studies investigated knowledge, beliefs, experience, and interaction quality, as constructs related to noticing.

Based on the findings, the question of which facets of perception, interpretation, and decision-making should best conceptualize noticing is discussed.

Keywords Preschool teacher · Noticing · Perception · Interpretation · Decision-making

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Beobachtungen von Vorschullehrer*innen: Eine Übersicht über Konzeptualisierungen, Operationalisierungen und empirische Zusammenhänge

Zusammenfassung Dieser Beitrag gibt einen Überblick über die Forschung zum Thema „Wahrnehmung“ bei Vorschullehrer*innen. Es wurde eine systematische Literaturrecherche durchgeführt, um herauszufinden, wie das Thema „Wahrnehmung“ konzeptualisiert wurde, welche Methoden zur Untersuchung verwendet wurden und ob Beziehungen zu anderen Konstrukten nachgewiesen werden können. Die Überprüfung umfasste 35 Studien, die die Einschlusskriterien erfüllten. Es konnten drei Konzeptualisierungen des Themas „Wahrnehmung“ identifiziert werden: Wahrnehmung, Wahrnehmung und Interpretation sowie Wahrnehmung, Interpretation und Entscheidungsfindung. Die Ergebnisse zeigen, dass sich die Mehrheit der untersuchten Studien auf videobasierte Tests konzentrierte und Interviews, Fragebögen, Laut-Denken-Übungen, Fallstudien und Tagebuchaufzeichnungen zur Bewertung der Wahrnehmung verwendete. Die Studien untersuchten Wissen, Überzeugungen, Erfahrungen und Interaktionsqualität als Konstrukte im Zusammenhang mit der Wahrnehmung.

Auf der Grundlage der Ergebnisse wird die Frage diskutiert, welche Facetten der Wahrnehmung, Interpretation und Entscheidungsfindung die Wahrnehmung am besten konzeptualisieren sollten.

Schlüsselwörter Vorschullehrer*innen · Wahrnehmung · Interpretation · Entscheidungsfindung

1 Introduction

This paper will focus on noticing in the preschool sector. In order to explore this topic, however, noticing among teachers will first be discussed, followed by the depiction of noticing in the preschool sector. The ability of a teacher to notice is regarded as a crucial component of teaching competency. Teachers must process a great deal of information during teaching and decide, sometimes instantly, what to pay attention to, what to ignore, how to make sense of students' actions, and how to move the lesson forward (Santagata et al. 2021). What and how teachers notice affect students' learning and classroom experiences (Jacobs et al. 2010; Stahnke et al. 2016). Accordingly, in teacher education, noticing serves as the foundation for knowledge- and evidence-based reflection on one's own practice and can be viewed as a precondition to professional action competence. It is therefore seen as one of the important variables determining a teacher's effectiveness and expertise (Goodwin 1994; Seidel and Stürmer 2014). Several review papers in teacher research have already recognized the significance of noticing and have investigated it in great detail (e.g., Amador et al. 2021; König et al. 2022; Stahnke et al. 2016).

Teacher noticing has been conceptualized as a knowledge-based process involving selective attention and knowledge-based reasoning. It is frequently viewed as a set of situation-specific abilities that operate as in-between processes that transfer teacher

dispositions (including cognition, affect, and motivation) into teaching behaviors (Blömeke et al. 2015; Santagata et al. 2021). In the preschool context, noticing is considered to be of importance for children's learning activities as well. However, in comparison to school, the subject of learning is less predetermined, and the learning activities are less structured by the preschool teachers. Whereas in school a curriculum specifies the learning content and the teacher uses different didactic methods to stimulate learning directly, learning in the preschool context usually takes place in spontaneous everyday scenarios (Samuelsson and Carlsson 2008). For these everyday events to become natural learning situations for children, preschool teachers must first identify the events' potential (Gasteiger and Benz 2016). Moreover, the developmental needs of preschool-aged children are distinct, requiring preschool teachers to notice not just academic progress, but also social-emotional development, physical growth, and the emergence of early learning skills (Shuttlesworth and Shannon 2015). This fundamental difference necessitates a distinct approach to teacher noticing. Despite this importance, preschool teachers' noticing has received insufficient attention in empirical studies compared to school-based contexts (Amador et al. 2021; Süzer and Sönmez 2023). Specifically, an overview of the approaches and methods that have been utilized to investigate noticing as well as which factors are related to preschool teachers' noticing, has not yet been compiled. This review aims to fill these gaps. We will first give an overview of the different conceptualizations of teacher noticing. Following this, various conceptual relationships will be illustrated through the presentation of models, bridging the gap to the construct of noticing in the preschool context. We will then discuss how we selected relevant works on preschool teachers' noticing for inclusion in this paper. These studies will be examined based on our research questions.

This review contributes to the field in several ways. First, it provides a comprehensive overview of how noticing is conceptualized and studied specifically in preschool contexts, which may differ from school-based noticing due to the unique nature of early childhood education. While previous reviews (e.g., Stahnke et al. 2016) have included some research on preschool teachers, a focused review on this context is necessary to fully understand the unique characteristics and challenges of noticing in the preschool setting. By focusing exclusively on this area, our review allows for a more in-depth analysis of the specific attributes of preschool teacher noticing. Second, we identify and examine the methodological approaches used to study preschool teachers' noticing, which can inform and enhance future research methodologies in this field. Finally, by exploring the relationships between noticing and other constructs within the preschool context, this review highlights areas for further investigation and discusses potential implications for preschool teacher education and professional development.

2 Theoretical background

2.1 Conceptualizations of noticing

Many conceptualizations of noticing evolved from early theories of a “professional vision” by Goodwin (1994). He argued that people view their environment always through the lenses of their profession. Due to differences in e.g., knowledge and experiences people will most likely perceive a situation differently. This assumption has been interpreted in relation to the teaching profession to the effect that schema-based classification of classroom situations seems to be guided by the teacher’s knowledge and experiences (Bromme 1997). More specifically, Bromme (1997) coined the term categorical perception to describe teachers’ professional vision. Categorical perception refers to the cognitive process of breaking down events into cognitive units, putting them into context, and thus structuring situations for action. According to this conceptualization, categories stored in a teacher’s memory provide the structure of how this person perceives teaching. Likewise, Mason (2002) focused on cognitive processes and introduced the term intentional noticing. He described noticing as an act of attention, which takes place independently of the professional’s intention, but is rather an automatic process that is influenced by the teacher’s level of experience and preparation (Mason 2011).

In parallel with Mason’s early work on the discipline of noticing, van Es and Sherin (2002) examined teachers’ classroom interactions and proposed a conceptualization of noticing—referred to as “professional vision”—that comprises selective attention and knowledge-based reasoning (Sherin and van Es 2008). The first term describes how teachers direct their attention in complex classroom situations. The second term involves the description, evaluation, and interpretation of observed classroom events based on knowledge of the subject matter, the curriculum, or students’ prior comments. The authors point out that selective attention and knowledge-based reasoning interact dynamically and are therefore not to be understood as separate sub-processes (Sherin 2007; Sherin and van Es 2008). This assumption is called into question by Star and Strickland (2008), who limit their conceptualization to the first component of van Es and Sherin’s conceptualizations. They argue that, if a teacher does not notice or attend to the details of the observed lesson, knowledge-based reasoning is not possible.

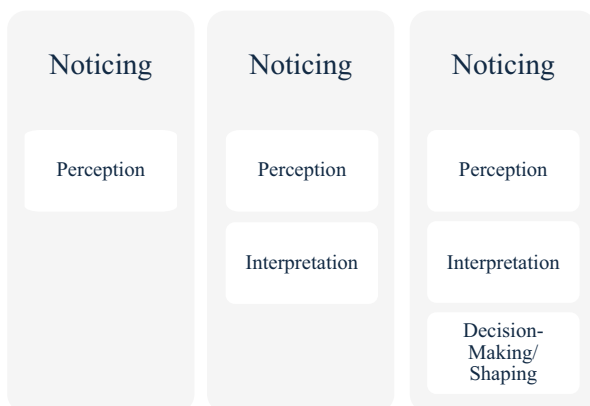
Seidel and Stürmer (2014) rather expand and differentiate the approach of Sherin and van Es (2008), using also professional vision as the umbrella term. The first component, noticing, is referred to as “knowledge-driven identification of situations and events in instruction that are critical to the success of instructional actions from a professional perspective” (Seidel et al. 2010). The second component, knowledge-based reasoning, is referred to as the knowledge-driven processing of teaching. This component is further differentiated into three interrelated sub-processes: (1) describing teaching components that are effective for learning in a differentiated way based on theoretical knowledge, (2) explaining teaching situations based on scientific theories and findings, (3) and predicting the effects of teaching situations on further teaching-learning processes (Seidel et al. 2010). The authors point out that expertise research shows that novices in the teaching profession predominantly describe

teaching situations, with their descriptions oftentimes seeming overgeneralized and undifferentiated, due to a lack of theoretical knowledge. Therefore, it is assumed that the aspects of explaining and predicting necessitate more strongly networked knowledge structures and a higher level of expertise.

While some research groups focused only on the aspect of attending (Star and Strickland 2008; Star et al. 2011), and others conducted their research on attending and interpreting (Goldsmith and Seago 2011; Goodwin 1994; van Es and Sherin 2002), Jacobs et al. (2010) extended Van Es and Sherin's conceptualization by the element of deciding. This element outlines the method for reacting according to the children's ideas and comprehension, which pertains to the degree of knowledge teachers have gained about the children's understanding in the particular context (Jacobs et al. 2010). This leads to the assumption that there is an embedded relationship between the abilities of identifying, interpreting, and deciding, where the ability to interpret depends on the ability to identify and the decision regarding how to respond depends on the interpretation. In the following, the inclusion of the aspect deciding (also: decision-making) was taken up by several research groups (Fernández et al. 2018; Kaiser et al. 2015). Moreover, van Es and Sherin (2021) have recently revisited their earlier conceptualizations of noticing and proposed to include the aspect of "shaping", which they describe as constructing interactions, while noticing, to gain access to additional information that further supports their noticing. This revision emphasizes noticing as a situation-specific practice in which momentary events and interactions are pivotal to the investigative stance and formative actions.

Taken together, as of today, a consensus on the understanding and conceptualization of noticing has not yet been reached (Stahnke et al. 2016). In detail, the numerous works on this field of research set different emphases, refer to only one or two of the processes, summarize them, complement them, or differentiate them further. Jacobs and Spangler (2017) summarized three conceptualizations of teacher noticing, regarding the most common aspects of noticing and how these key activities interact with each other. We have extended the summary of Jacobs and Spangler (2017) to include the aspect of shaping to incorporate the considerations of van Es and Sherin (see Fig. 1).

Fig. 1 Conceptualizations of noticing



2.2 Conceptual relations of noticing

The following section aims to describe models incorporating noticing and to highlight models' assumptions regarding the relationship of noticing to other constructs or the performance of preschool teachers. Since the following modeling approaches originate from different disciplines with different foci, the ability to notice is described in various ways. Accordingly, the construct noticing, as we understand it, is replaced by its respective equivalent from the model (e.g., perception) in order to remain true to the authors' original conception. While several models of teacher noticing have been developed in the context of school education (e.g., Endsley 1995; Schoenfeld 2011), we will focus primarily on those most relevant to the preschool context.

Blömeke et al.'s (2015) model of teacher competence, although developed for school teachers, provides valuable insights for understanding preschool teacher noticing. In this model, teacher competence is viewed as a continuous process that links dispositions—including knowledge and affective-motivational characteristics—with professional actions through situation-specific skills like perception, interpretation, and decision-making. Perception acts as a mediator between teachers' dispositions and classroom practice (Dunekacke et al. 2015; Treisch 2018), emphasizing the integration of cognition and practice rather than viewing them separately. This conceptualization is particularly relevant in preschool contexts, where teachers must quickly perceive and respond to diverse learning opportunities that arise through play and everyday interactions rather than formal lessons.

Santagata and Yeh (2016) proposed a revision to Blömeke et al.'s (2015) teacher competence model. They describe the development of perception as bidirectional rather than linear, suggesting that perception, interpretation, and decision-making are simultaneously influenced by teacher knowledge, beliefs, and classroom practices. The authors argue that improvements in teachers' competence would not be achievable unless teachers pay attention to and interpret practice and, by that, come to conclusions that result in new knowledge and beliefs. As a result, practice allows teachers to improve their perception, interpretation, and decision-making skills while expanding their knowledge and changing their beliefs. This bidirectional conceptualization is particularly relevant in the preschool context, where the dynamic and often unpredictable nature of young children's learning necessitates constant adaptation and reflection on the part of the preschool teachers.

Scheiner (2021) argues that teacher noticing should be viewed as embodied, cultural, and positional, criticizing the tendency to confine it to mental processes alone. He contends that classroom events are not merely mental representations detached from teachers' lived experiences; instead, teachers actively engage with their environment through physical exploration and interactions. This perspective is particularly relevant in the preschool context, where preschool teachers often engage in physical interactions with children and the environment as part of the learning process.

Of particular importance for our review are models specifically developed for the preschool context. Fröhlich-Gildhoff et al. (2014) propose a competence model where perception and interpretation are classified under the dispositional facet of

situation perception and analysis. In addition, different facets of knowledge, motivation as well as specific prerequisites for action like procedural knowledge and social skills are assumed to be dispositional. These components are thought to influence performance. However, their model assumes that the performance of preschool teachers is influenced not only by explicit, scientific-theoretical knowledge but also by implicit (habitual) experiential knowledge. This recognition of both explicit and implicit knowledge reflects the complex nature of noticing in early childhood settings, where teachers often rely on intuitive understanding developed through experience.

Gasteiger and Benz (2016) developed a model of preschool teachers' professional knowledge and skills for early mathematics education. The model—described as a structure-process model—consists of four structural facets: knowledge, situational observing and perceiving, pedagogical-didactical action, and evaluation. In line with Blömeke et al. (2015), noticing acts as a mediator between the required dispositions for competent acting and the actual performance. At the same time, preschool teachers' diagnostic knowledge is assumed to play an essential role in identifying children's mathematical learning dispositions.

This model emphasizes the cyclical nature of noticing in preschool settings. The authors highlight the importance of pedagogical-didactical action (PDA), which manifests in daily preschool scenarios, encompassing the creation of planned learning environments and the spontaneous utilization of appropriate situations for mathematical learning. It is thus strongly influenced by situational observing and perceiving, which the authors regard as a prerequisite for utilizing natural learning contexts for mathematics learning. Their model illustrates the influence of situational observing and perceiving through a cyclical process, incorporating the idea that effective learning circumstances, influenced by implicit knowledge, can subsequently contribute to identifying situations as relevant learning opportunities.

The models presented show similarities and differences with regard to the localization of noticing and the constructs associated with noticing. A central commonality among these models is the assumption that noticing is both influenced by knowledge and serves as a key factor driving teacher action. Differences can be identified in particular with regard to the sub-facet or construct of deciding. In some models, “deciding” is seen as a conceptual component of noticing (e.g., Blömeke et al. 2015), whereas in other models it is seen as an independent construct that is influenced by noticing (e.g., Fröhlich-Gildhoff et al. 2014).

These models collectively enhance our understanding of how preschool teachers notice and respond to learning opportunities, highlighting key aspects such as the importance of explicit and implicit knowledge, the cyclical nature of noticing, its mediating role between dispositions and behaviors, and the necessity for flexibility in less structured environments.

2.3 Present study

Noticing by teachers has been the topic of various previous works, and its value has been emphasized (Amador et al. 2021; König et al. 2022; Stahnke et al. 2016). Although noticing is considered to be of importance for the preschool setting in particular, preschool teachers' varied noticing types have attracted relatively little

attention. Therefore, we review research on preschool teachers' noticing to pursue the following research questions:

1. In preschool research, how is the construct "noticing" conceptualized?
2. Which methods have been used so far to investigate noticing in preschool?
3. Can relationships between noticing and other constructs be demonstrated?

It has already been shown that there is a great variety of definitions and conceptualizations of the term noticing in the field of teacher research. Accordingly, we expect a variety of conceptualizations, in regard to the aforementioned facets of noticing in the preschool sector as well. For this purpose, we will create an overview to show which aspects of the construct noticing (perception, interpretation, decision-making) have been addressed in the revised papers.

Due to the missing consensus on how to conceptualize noticing, we expect to find differences in its operationalization. This lack of clarity will lead us to investigate whether there is a fit between the theoretical and empirical application of each study's conceptualization.

The identification of different modeling approaches also revealed that varied perspectives on which constructs interact with noticing exist. In the case of preschool research, it may be of interest to determine which other constructs have been linked to noticing in the revised studies. For example, in accordance with the model of Blömeke et al. (2015), these could be constructs that are more likely to influence noticing or constructs that are more likely to be influenced by noticing (e.g., interaction quality).

Based on the observation that many models describe an influence of knowledge and motivation on noticing, we assume that this is also taken into account in the reviewed research.

3 Method

3.1 Literature search

A comprehensive literature search was conducted for this purpose. The following databases were used: APA PsycInfo, APA PsycArticles, Education Research Complete, ERIC, and Fachportal Pädagogik. In the complementary Internet search with the search engines Google and Google Scholar, a maximum of the first 100 results were taken into account in each case (see Zimmer et al. 2020). In each database, we utilized a combination of keywords and Boolean operators to refine our search. For instance, perceptive terms like noticing, professional vision, perception, and situational awareness, were combined with educational settings like teacher, kindergarten, preschool, play situations, and early childhood education. We also included the term "sensitivity" in our search strategy, as it represents a specific construct in early childhood education that overlaps with noticing, particularly in the context of Pedagogical Content Knowledge (PCK). In the preschool context, sensitivity refers to teachers' ability to perceive and interpret children's actions and learning processes (Anders and Rossbach 2015; McCray 2008), making it conceptually relevant to our

investigation of noticing, though the terms are not typically used interchangeably in the literature. Following the approach of reviews on teacher noticing (e.g., König et al. 2022), we excluded broader terms such as “observe” that, while related to educational practice, would have yielded an unmanageable number of results and many irrelevant references. This decision allowed us to maintain a focused and thorough analysis of literature specifically addressing noticing in preschool settings. All search terms were adjusted according to the specific indexing language of each database. For example, for databases that allow this function, it was also taken care to include all other possible conjugations of a word in the search (e.g., *notic** for notice, noticing or *perc** for perceive, perception). Additionally, where possible, we used database-specific filters to narrow down the results to research articles, and exclude non-peer-reviewed materials. No restrictions were applied regarding the publication year during the search. The terms were reviewed both in free text and in keyword searches. The search was conducted in November 2024 and produced a total of 13,073 results.

3.2 Inclusion and exclusion criteria

As a first exclusion criterion, results not published in scientific journals were removed, which excluded 5186 manuscripts from further consideration. For the purposes of this review, a scientific journal is defined as a periodical publication intended to further the progress of science, usually by reporting new research. These journals should be peer-reviewed or refereed, meaning that the articles published have been critically assessed by independent experts not involved in the study. Subsequently, all results not written in English or German were removed based on the reviewers' language proficiency, which accounted for the removal of another 86 results. 7819 results were then screened for their title and abstract content in the following screening process. In this step, results that did not focus on the preschool setting or whose focus was not inside an educational environment were deleted (5470 results excluded). Preschools are understood here as educational settings catering to children aged 3 to 5 years, before they enter formal schooling. Following this, it was reviewed whether the article focuses on early childhood education professionals and does not exclusively deal with the children in this institution or their parents (1546 results excluded). The remaining 803 results were examined to see if they related to the construct of noticing. This excluded, for example, findings that used “perception” in the sense of a professional's attitude or opinion, as well as papers that dealt with higher-level decisions (e.g., curriculum decisions) or studies that assessed professionals' knowledge solely from a cognitive perspective. Applying these criteria, as well as cleaning up duplicates, resulted in a final database of 35 research articles used for this review (see Fig. 2).

3.3 Process of study selection

The studies selected for this review were agreed on by the authors based on the aforementioned inclusion and exclusion criteria. Ambiguous selections were identified for articles that were chosen by a single researcher. The respective other then

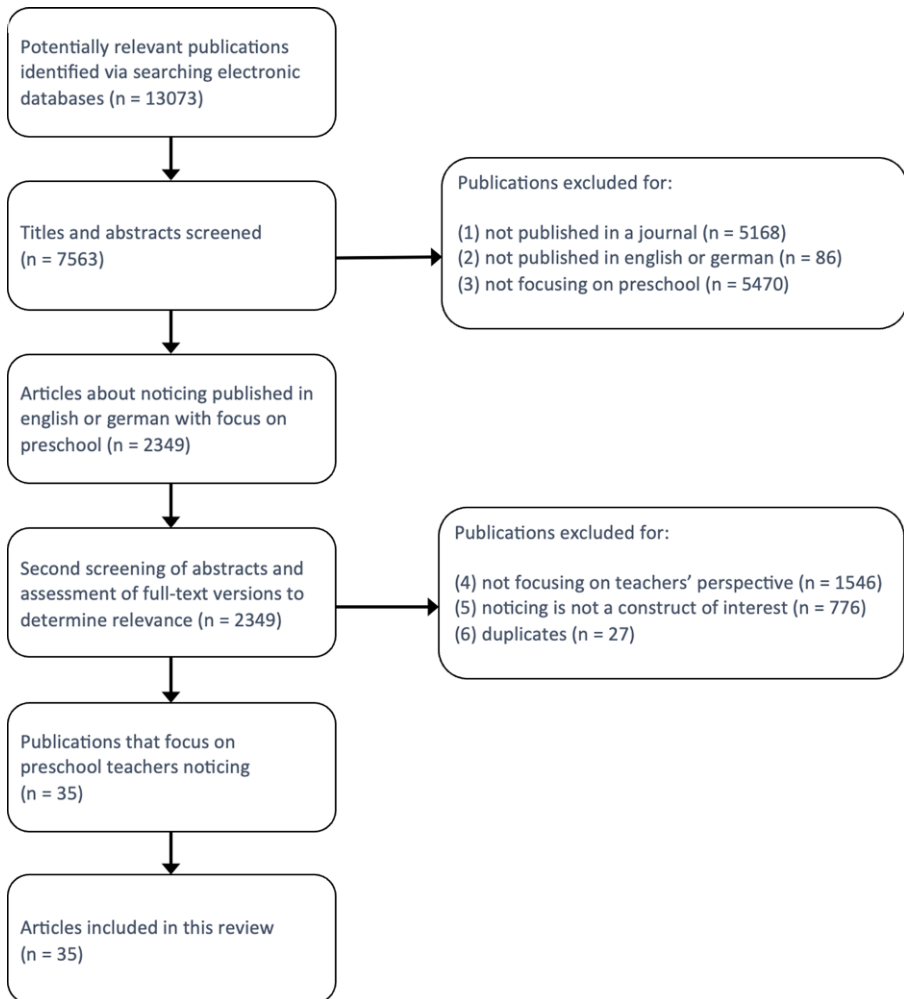


Fig. 2 Systematic literature search and study selection process

went through the full text of the relevant study and screened it. Should there be a disagreement, the writers discussed until they arrived at an agreement.

4 Results

In the following section, we will first provide an overview of how noticing was conceptualized in the available literature (Research Question 1). For this purpose, we refer to the conceptualization possibilities previously described (see 2.1). If possible, we extract the use of perception, interpretation, and decision-making from the paper, according to the authors' specifications. Should the researchers not clearly state which aspects of noticing are used, we assess them according to how appropriate the

respective aspects seem to fit the study. Two coders separately rated the theoretical and empirical conceptualization of noticing presented in the 35 studies. The mean percentage of agreement regarding the theoretical conceptualization was 94.3%. Cohen's Kappa was calculated at 0.86, indicating excellent inter-rater reliability. If scores diverged, the causes were traced and consensus was reached by discussion. The agreement regarding the empirical conceptualization was 100%.

In the next step, we will summarize the studies to address which methods previous preschool research has utilized to investigate noticing (Research Question 2). In doing so, we also investigate whether the respective studies indicate a relationship between noticing and other constructs (Research Question 3).

4.1 Conceptualization of noticing

Of the 35 papers considered in this review, none used the first conceptualization, 14 used the second conceptualization, and 21 used the third conceptualization (see Table 1). Due to the novelty of the term, "shaping" has not yet been examined in any papers.

4.2 Empirical approaches and findings in preschool teacher noticing research

Our analysis of 35 studies reveals diverse methodological approaches to investigating preschool teacher noticing. The research landscape comprises qualitative studies ($N = 10$), quantitative studies ($N = 15$), and mixed-methods approaches ($N = 10$). Data collection methods across these studies show distinct patterns. Video-based assessments emerge as the predominant method, with $N = 27$ studies using video vignettes to investigate noticing. These vignettes typically present standardized situations, allowing researchers to examine how preschool teachers perceive and interpret specific educational scenarios. The majority of the studies ($N = 28$) used external interactions rather than preschool teachers' own everyday interactions, potentially enhancing comparability across participants but raising questions about ecological validity. Regarding data capture, studies employed both oral ($N = 12$) and written ($N = 15$) response formats, with some studies ($N = 8$) utilizing both. The timing of data collection was predominantly retrospective ($N = 28$), with few studies capturing noticing simultaneously with the situation. The analytical approaches employed across studies reflect the diversity of methodological orientations in this field. Quantitative analyses were prominent, with Structural Equation Modeling (SEM) being the most frequently used method ($N = 9$), particularly in studies examining relationships between noticing and other constructs. Other quantitative approaches included statistical analyses employing ANOVA, correlational analyses, and multi-level modeling. Qualitative content analysis ($N = 5$) was the most common approach among qualitative studies, supplemented by various other methods such as thematic analysis, grounded theory, and case study approaches. Several studies employed mixed analytical methods, combining qualitative coding with statistical analyses to provide both depth and breadth in understanding preschool teacher noticing.

The reviewed studies reveal several patterns in the relationships between noticing and other constructs. Knowledge emerges as a frequently examined construct,

Table 1 Theoretical and empirical conceptualizations of noticing and related constructs

References	Theoretical conceptualization of Noticing			Empirical conceptualization of Noticing			Further Constructs
	Perception	Interpreting	Decision-Making	Perception	Interpreting	Decision-Making	
Anantharajan (2020)	x	x	—	x	x	—	Knowledge
Anders and Rossbach (2015)	x	x	—	x	x	—	Knowledge, Beliefs
Aumann et al. (2024)	x	x	x	x	x	x	Knowledge, Beliefs, Professional Development, Experience
Bruns and Gasteiger (2019)	x	x	—	x	x	—	Knowledge
Bruns et al. (2021)	x	—	—	x	—	—	—
Cabral et al. (2021)	x	x	x	x	x	x	Knowledge
Callejo et al. (2021)	x	x	x	x	x	x	Knowledge
Dunekacke et al. (2015)	x	x	x	x	x	x	Knowledge, Professional Competence, ACT
Dunekacke et al. (2016)	x	x	x	x	x	x	Knowledge, Beliefs
Dunekacke et al. (2022)	x	x	x	x	x	x	Professional Competence, Knowledge, Experience
Dunekacke and Wulschleger (2024)	x	x	x	x	x	x	Professional Development, Support, Teaching Quality
Gasteiger and Benz (2018)	x	x	x	x	x	x	Knowledge, Professional Development, Experience
Haubert (2017)	x	x	x	x	x	x	—
Jacobs et al. (2010)	x	x	x	x	x	x	Experience
Jenßen et al. (2020)	x	x	—	x	x	—	Knowledge, Professional Competence, Mathematics Anxiety
Jordan and Sumrall (2023)	x	x	x	x	x	x	Knowledge, Professional Development

Table 1 (Continued)

	Theoretical conceptualization of Noticing			Empirical conceptualization of Noticing			
Lanwehr and Jegodtka (2020)	x	x	x	x	x	x	Knowledge, Beliefs
Lee (2014)	x	x	—	x	x		Knowledge
Lee (2017)	x	x	—	x	x		Knowledge, Experience
Lindmeier et al. (2016)	x	x	x	x	x	x	Knowledge, Experience, Professional Competence
Mänty et al. (2022)	x	x	x	x	x	x	Professional Development, Knowledge
Mathers (2021)	x	x	—	x	x	—	Knowledge, Professional Development, Classroom Quality
McCray and Chen (2012)	x	x	x	x	x	x	Knowledge, Experience, Professional Development, Teaching practices
Mischo et al. (2022)	x	x	x	x	x	x	Knowledge, Interaction Quality, Experience
Mischo et al. (2020b)	x	x	x	x	x	x	Interaction Quality, Experience
Mischo et al. (2020a)	x	x	—	x	x	—	Interaction Quality
Mischo (2023)	x	x	x	x	x	x	Knowledge, Experience, Interaction Quality, Self-Efficacy
Moreno et al. (2021)	x	x	x	x	x	x	Knowledge
Oppermann et al. (2016)	x	x	—	x	x	—	Knowledge, Experience, Professional Development, Self-Efficacy
Peters et al. (2021)	x	x	—	x	x	—	Beliefs, Knowledge
Schmitt et al. (2023)	x	x	x	x	x	x	Knowledge, Beliefs, Professional Development, Experience
Soto (2018)	x	x	—	x	x	—	Professional Development

Table 1 (Continued)

	Theoretical conceptualization of Noticing			Empirical conceptualization of Noticing			
Süzer and Sönmez (2023)	x	x	x	x	x	x	Professional Development, Experience
Torbeyns et al. (2019)	x	x	—	x	x	—	Knowledge, Experience, Professional Development
Wolstein et al. (2021)	x	x	—	x	x	—	Self-efficacy beliefs, Interaction quality, Knowledge

with several studies demonstrating positive correlations between noticing and professional knowledge (e.g., Dunekacke et al. 2015; Oppermann et al. 2016; Wolstein et al. 2021). Experience shows a relatively consistent pattern: Studies found that teachers with more experience demonstrated higher competencies in noticing (e.g., Lee 2017; Mischo et al. 2022). Some studies explored relationships between noticing and interaction quality (e.g., Mischo 2023; Mischo et al. 2022), finding correlations between professional vision and various aspects of classroom organization and emotional support. Studies examining the internal structure of noticing found connections between its different components, such as correlations between perceiving and interpreting facets (Mathers 2021) and between interpreting and enhancing children's mathematical thinking (Lee 2017). Moreover, the educational background appears to play a role, with some studies (e.g., Lindmeier et al. 2016; Mischo 2023; Peters et al. 2021) suggesting that teachers with higher educational qualifications demonstrate better noticing abilities. However, it's important to note that not all studies examined relationships empirically, and the strength and nature of these relationships often varied across studies and contexts.

A significant portion of the research focuses on mathematics education, with many studies examining how preschool teachers notice children's mathematical thinking and learning opportunities (e.g., Anantharajan 2020; Cabral et al. 2021; Lee 2017).

The development of standardized assessment tools represents another trend in the field. Several studies have worked to develop and validate instruments for measuring preschool teachers' noticing abilities (e.g., Bruns and Gasteiger 2019; Mathers 2021). These efforts often involve video-based assessments combined with structured response formats, aiming to create reliable measures of noticing competence (Table 2).

4.3 Theoretical vs. empirical fit

This review aims to show whether there is a fit between the theoretical and empirical conceptualization of Noticing. By fit we mean that the theoretical assumptions about the conceptualization are reflected by the methodological approach. Here we present two studies that show a good fit and present how we reason about it:

The study by Callejo et al. (2021) demonstrates a strong alignment between the theoretical and empirical conceptualization of noticing by employing a Hypotheti-

Table 2 Methodological characteristics and analytical approaches

References	Study Type	Participation	Stimuli Type	Interaction Source	Interaction Mode	Noticing Capture	Answer Format	Capture Mode	Timing	Data Analysis
Anantharajan (2020)	Qualitative	$N = 12$	Classroom activities, student representations	Own interactions	Direct observation, physical representations	Semi-structured interviews	Open-ended	Oral	Retrospective	Qualitative Coding
Anders and Rossbach (2015)	Quantitative	$N = 221$	Written Scenarios, Vignettes	External Source	Written Descriptions	Questionnaire	Closed	Written	Simultaneous	Structural Equation Modeling (SEM)
Aumann et al. (2024)	Mixed-Methods	$N = 162$	Video-vignettes	External Source	Video	Category System	Open-ended/Closed	Oral	Retrospective	Content Analysis, Factor Analysis
Bruns and Gasteiger (2019)	Mixed-Methods	$N = 91$	Video-vignettes	External source	Video	Questionnaire	Open-ended/Closed	Written	Retrospective	Descriptive Analysis, item quality examination
Bruns et al. (2021)	Mixed-Methods	$N = 363$	Video-vignettes	External source	Video	Semi-structured interviews	Open-ended	Written	Retrospective	Integrated Data Analysis (Qualitative and Quantitative)
Cabral et al. (2021)	Qualitative	$N = 4$	Video-vignettes	Own Interactions	Video, Written Description	Written responses, Discussion	Open-ended	Oral/Written	Retrospective/Simultaneous	Task responses, discussion analysis, and interpretation
Callejo et al. (2021)	Qualitative	$N = 64$	Hypothetical teaching scenarios	External source	Written description	Written responses	Open-ended	Written	Retrospective	Grounded Theory

Table 2 (Continued)

References	Study Type	Participation	Stimuli Type	Interaction Source	Interaction Mode	Noticing Capture	Answer Format	Capture Mode	Timing	Data Analysis
Dunekacke et al. (2015)	Quantitative	$N = 354$	Video-vignettes	External source	Video	Written responses	Open-ended/Closed	Oral	Retrospective	Structural Equation Modeling (SEM), Confirmatory Factor Analysis
Dunekacke et al. (2016)	Quantitative	$N = 354$	Video-vignettes	External source	Video	Written responses	Open-ended/Closed	Written	Retrospective	Structural Equation Modeling (SEM)
Dunekacke et al. (2022)	Mixed-Methods	$N = 240$	Video-vignettes	External source	Video	Written responses	Open-ended	Written	Retrospective	Qualitative content analysis
Dunekacke and Wullschleger (2024)	Quantitative	$N = 122$	Video-vignettes	Own interactions/External source	Video, Direct observation	Structured interviews, Rating instrument	Closed	Oral	Retrospective/Simultaneous	Multilevel latent change model
Gasteiger and Benz (2018)	Mixed-Methods	$N = 40-60$	Video-vignettes, Real-life situations	Own interactions/External source	Video, Direct observation	Reflection meetings, Interviews	Open-ended	Oral/Written	Retrospective/Simultaneous	Qualitative content analysis
Haubert (2017)	Qualitative	$N = 2$	Real-life classroom interactions	Own interactions	Direct observation and recollection	Observation notes, semi-structured interviews, participant journaling	Open-ended	Written	Retrospective/Simultaneous	Multiple Case Study

Table 2 (Continued)

References	Study Type	Participation	Stimuli Type	Interaction Source	Interaction Mode	Noticing Capture	Answer Format	Capture Mode	Timing	Data Analysis
Jacobs et al. (2010)	Mixed-Methods	$N = 131$	Classroom practice artifacts (video clip and written student work)	External source	Video, written descriptions	Written responses	Open-ended	Written	Retrospective	Response coding, Statistical analysis, Qualitative interpretation
Jenßen et al. (2020)	Quantitative	$N = 354$	Video-vignettes	External source	Video	Questionnaires, Written responses	Open-ended/Closed	Written	Retrospective	Structural Equation Modeling (SEM)
Jordan and Sumrall (2023)	Qualitative	$N = 8$	Written Scenarios, Vignettes	External source	Written description	Semi-structured interviews	Open-ended	Oral	Retrospective	Qualitative content analysis
Lanwehr and Jegodtka (2020)	Qualitative	$N = 9$	Video-vignettes	External source	Video	Guided group discussions	Open-ended	Oral	Retrospective	Qualitative content analysis
Lee (2014)	Qualitative	$N = 5$	Classroom observations	Own interactions	Direct observation	Post-observation, interviews	Open-ended	Oral	Retrospective	Constant Comparative Method
Lee (2017)	Mixed-Methods	$N = 30$	Hypothetical play scenario	External source	Written description	Semi-structured interview	Open-ended	Oral	Retrospective	Quantitative descriptive statistical analysis
Lindmeier et al. (2016)	Quantitative	$N = 112$	Video-vignettes	External source	Video	Written responses	Open-ended/Closed	Written	Retrospective	Structural Equation Modeling (SEM), Confirmatory Factor Analysis

Table 2 (Continued)

References	Study Type	Participation	Stimuli Type	Interaction Source	Interaction Mode	Noticing Capture	Answer Format	Capture Mode	Timing	Data Analysis
Mänty et al. (2022)	Mixed-Methods	$N = 414$	Video-vignettes, Real-life situations	Own interactions/ External source	Video, Direct observation	Questionnaires	Open-ended/ Closed	Written	Retrospective/ Simultaneous	Thematic analysis, statistical analysis
Mathers (2021)	Quantitative	$N = 104$	Video-vignettes	External source	Video	Written responses	Open-ended	Written	Retrospective	Confirmatory Factor Analysis Structural Equation Modeling
McCray and Chen (2012)	Mixed-Methods	$N = 22$	Hypothetical play scenarios	External source	Written description	Semi-structured interview	Open-ended	Oral	Retrospective	Hierarchical linear modeling, Qualitative coding
Mischo et al. (2022)	Quantitative	$N = 120$	Video-vignettes	External source	Video	Thinking aloud, rating-items	Open-ended/ Closed	Oral/ Written	Retrospective/ Simultaneous	Structural Equation Modeling (SEM)
Mischo et al. (2020b)	Mixed-Methods	$N = 120$	Video-vignettes	External source	Video	Thinking aloud, retrospective interviews	Open-ended	Oral	Retrospective/ Simultaneous	Generalizability study, Correlation analysis
Mischo et al. (2020a)	Mixed-Methods	$N = 120$	Video-vignettes	External source	Video	Thinking aloud, retrospective interviews, rating scales	Open-ended/ Closed	Oral/ Written	Retrospective/ Simultaneous	Structural Equation Modeling
Mischo (2023)	Quantitative	$N = 120$	Video-vignettes	External source	Video	Thinking aloud, retrospective interviews, rating scales	Open-ended/ Closed	Oral/ Written	Retrospective/ Simultaneous	Structural Equation Modeling (SEM), Path analysis

Table 2 (Continued)

References	Study Type	Participation	Stimuli Type	Interaction Source	Interaction Mode	Noticing Capture	Answer Format	Capture Mode	Timing	Data Analysis
Moreno et al. (2021)	Qualitative	$N=47$	Hypothetical scenarios of learning-teaching situations	External source	Written description	Written responses	Open-ended	Written	Retrospective	Two-phase qualitative analysis
Oppermann et al. (2016)	Quantitative	$N=221$	Written play scenarios	External source	Written description	Questionnaire	Open-ended/Closed	Written	Retrospective	Structural Equation Modeling (SEM), regression analysis
Peters et al. (2021)	Quantitative	$N=120$	Video-vignettes	External source	Video	Thinking-aloud retrospective interviews, questionnaire	Open-ended/Closed	Oral/Written	Retrospective/Simultaneous	Exploratory Latent Profile Analysis
Schmitt et al. (2023)	Mixed-Methods	$N=151$ (73)	Video-vignettes	External source	Video	Questionnaire, Rating scale	Open-ended/Closed	Written	Retrospective	Structural Equation Modeling (SEM), Content analysis
Soto (2018)	Mixed-Methods	$N=11$	Video-vignettes	External source	Video	Reflective Journals	Open-ended	Written	Retrospective	Qualitative Thematic Coding, Quantitative Chi-Square Analysis
Süzer and Sönmez (2023)	Qualitative	$N=3$	Video-vignettes	External source	Video	Semi-structured interview	Open-ended	Oral/Written	Retrospective	Content analysis, thematic analysis
Torbeyns et al. (2019)	Quantitative	$N=162$	Written Scenarios	External source	Written description	Scenario-based test	Closed	Written	Retrospective	ANOVA, qualitative error analysis
Wolstein et al. (2021)	Quantitative	$N=120$	Video-vignettes	External source	Video	Thinking-aloud	Open-ended	Oral	Simultaneous	Statistical Analysis

cal Learning Trajectory (HLT) to analyze pre-service kindergarten teachers' (PKTs) noticing of children's mathematical thinking in the domain of length and measurement. The authors define noticing as encompassing three core skills: attending to children's strategies, interpreting their mathematical understanding, and deciding how to respond. These theoretical constructs are systematically operationalized through tasks integrated into the PKTs' training, which involve observing children's interactions with length-based measurement activities and analyzing their understanding. The study assesses perception by requiring PKTs to identify the mathematical elements involved in children's problem-solving during structured tasks. The interpretation of children's understanding is assessed through PKTs' responses to questions requiring them to reason about the mathematical concepts demonstrated in the children's actions. Decision-making is explicitly addressed in the study by prompting PKTs to propose instructional tasks tailored to the children's identified levels of understanding. PKTs are required to design activities that would help children progress in their mathematical reasoning, such as moving from an understanding of conservation to recognizing the universality of measurement units. These tasks provide empirical evidence of how well PKTs translate their interpretations into actionable teaching strategies. The study therefore achieves a strong fit between its theoretical framework and empirical approach by systematically addressing each aspect of noticing.

Jacobs et al. (2010) empirically assess preschool teachers' ability to perceive through specific scenarios. The participants view a video clip or written student work and are asked to describe the children's strategies in detail. This directly measures their perceptual skills in noticing the details of the children's mathematical approaches. The study also empirically evaluates how teachers interpret these strategies by asking them to explain what they learned about the children's mathematical understandings from these strategies. It furthermore assesses the participants' abilities to decide how to respond based on their interpretation, by asking them to suggest future problems or teaching strategies based on their understanding of the children's mathematical thinking. This demonstrates a fit of the study's empirical approach and its theoretical framework, as it systematically evaluates each aspect of teacher noticing.

For the complete summary of all studies' theoretical and empirical fit, refer to Table 1.

5 Discussion

The purpose of this paper was to provide an overview of research on preschool teachers' noticing to understand how this construct has been conceptualized in previous studies, what methods have been used to investigate it, and whether relationships with other constructs have been demonstrated. To do so, we conducted a systematic literature search to gather relevant information on preschool teacher noticing and identified 35 studies that met the criteria for inclusion in this paper after an extensive screening process. This process was guided by the following research questions: In preschool research, how is the construct "noticing" conceptualized? Which meth-

ods have been used so far to investigate noticing in preschool? Can relationships between noticing and other constructs be demonstrated?

The overview of different conceptualization approaches to noticing revealed that some authors describe it as comprising only perception, others as comprising perception and interpretation, and still others as comprising perception, interpretation, and decision-making. Our objective was to then align the studies on preschool teacher noticing that were identified through our systematic literature search with one of these conceptualizations. This approach allowed us to clarify and organize the existing literature on preschool teacher noticing and to better understand the different ways in which this construct has been studied. It could be shown that the existing research on preschool teacher noticing mainly includes perception and interpretation ($N=14$), or perception, interpretation, and decision-making ($N=21$), but not solely perception. This can be explained by the fact that the available studies mostly refer to more recent theoretical frameworks, in which perception and interpretation are considered to be closely connected (Blömeke et al. 2015; Jacobs et al. 2010; van Es and Sherin 2008).

In this paper, we also aim to take a stance on the conceptualization of noticing ourselves. Since the first conceptualization, which describes noticing as comprising only perception, does not align with current theoretical frameworks and is not supported by any of the studies reviewed in this paper, we excluded this conceptualization from our further consideration. It is therefore to be determined whether noticing should be conceptualized as comprising perception and interpretation or as comprising all three facets of perception, interpretation, and decision-making. One of the challenges we face in conceptualizing noticing is that it is not always clear where decision-making fits into the process. As described in Sect. 2.2., some theories see decision-making as part of noticing, while others see decision-making as being influenced by noticing. This is because perception, interpretation, and decision-making can occur simultaneously or in a sequence, depending on the situation and the individual's cognitive processes.

The dual process theory of thinking, proposed by Kahneman (2011), holds that there are two different and distinct systems of thinking: the automatic and the controlled. The automatic system is quick and intuitive and is responsible for perception, interpretation, and simple decision-making processes. More complex tasks, however, do seem to require the slower and more deliberate controlled system. Kahneman's findings can therefore be interpreted as an argument that perception and interpretation happen quickly and automatically through the automatic system, while decision-making requires the slower and more deliberate controlled thinking system, which indicates a sequence rather than a simultaneous occurrence. This highlights the importance of considering the context in which noticing is occurring and the cognitive processes involved in the decision-making process.

In general, decision-making has been found to be influenced by a range of individual factors beyond perception and interpretation, including goals, motivation, and cognitive flexibility (Tversky and Kahneman 1981). The decision-making process of a preschool teacher might be influenced by factors, such as their respective education (Smith 1997), their ideology and epistemological beliefs (Lynch 2009), regulations, and policies (Corrie 2000), or the setting of their workplace (Woodrow

and Press 2007). Beauchamp and Thomas (2009) found that teachers' decision-making is influenced by their professional identity, which is dynamic in that it is constantly constructed and shaped by the educational context. In addition, factors such as workload, time constraints, and competing demands might also play a role in shaping the decision-making process of preschool teachers (Shafir 2003). Based on these findings it seems plausible to assume that preschool teacher noticing depends on the complexity of the situation and the cognitive processes involved. For example, in a situation where a preschool teacher is faced with a complex or unfamiliar problem, they might need to go through a series of steps to arrive at a solution or judgment (Stahnke et al. 2016). This might involve perceiving relevant information, interpreting its significance, and making decisions about how to proceed based on that information and preexisting knowledge. In this case, perception, interpretation, and decision-making might not happen at the same time, but rather in a sequence as the teacher works through the problem-solving process (cf. Sherin and van Es 2008). However, this process is assumed to be highly dependent on the professional experience of the preschool teachers. From the perspective of the expertise approach proposed by Berliner (2001, 2004), for example, it can be considered that processes are increasingly automated as the level of expertise rises. Nevertheless, the complexity of decision-making processes leads the authors of this study to advocate in favor of the second conceptualization and suggests that decision-making should not be seen as a part of noticing, but rather as a sequential step after perception and interpretation already occurred.

The second aim of this review was to give an overview of the methods which have been used to investigate preschool teachers noticing. It was shown that both qualitative and quantitative research designs could be found in the reviewed studies. Due to the lack of established instruments, a variety of methods could be described, such as interviews, questionnaires, thinking-aloud practices, or case studies. This is not surprising given that a scoping review by Weyers et al. (2023) revealed that studies on teacher noticing varied greatly in terms of measurement strategy and test specifications as well. This is echoed by the systematic review of prospective teachers noticing by Amador et al. (2021), which showed that, despite the narrow focus of the study of prospective math teachers' noticing, there are significant differences in the approaches taken to data collection and analysis. One difference was, however, that Amador and colleagues found that the construct of noticing was mostly captured in written form, whereas our review of preschool teachers' noticing saw a rather balanced use of oral and written noticing captures. The comparison of research instruments used to operationalize noticing turned out to be challenging due to a lack of clear reporting of quality criteria in some studies. Specifically, some studies did not report any information on validity or reliability measures, making it difficult to assess the robustness of the findings. Additionally, in other studies, the numbers reported for validity and reliability measures were not clearly depicted, further complicating the comparison of the methods used. Given the significant importance of the concept of noticing for early education, these results highlight the need for further research on how preschool teachers engage in noticing. Our review reveals an increasing use of video-based assessments in studying preschool teacher noticing (e.g., Bruns and Gasteiger 2019; Mathers 2021). This trend reflects the field's recog-

inition of the importance of context in understanding noticing. Video-based methods allow researchers to capture the complexity of preschool environments and provide teachers with concrete situations for reflection. However, this methodological trend also raises questions about the ecological validity of such assessments and how well they capture the spontaneous nature of noticing in real-world preschool settings. The preference for retrospective data collection over simultaneous capture may also influence our understanding of noticing as an immediate, situation-specific process. These methodological choices have important implications for how we understand and measure noticing in preschool contexts.

In our review, we also aimed to analyze the relationship between noticing and other constructs, as assumed by many theoretical models (e.g., Blömeke et al. 2015; Fröhlich-Gildhoff et al. 2014; Gasteiger and Benz 2016; Santagata and Yeh 2016). For example, some studies investigated the relationship between noticing and beliefs (e.g., Peters et al. 2021; Wolstein et al. 2021), or interaction quality (e.g., Mischo et al. 2020a, 2022). The majority of the reviewed studies assumed that knowledge is related to noticing, which is in line with the theoretical assumption assuming noticing to be a knowledge-based process (van Es and Sherin 2008; Gasteiger and Benz 2016). However, this close connection leads to cases where knowledge and noticing are intertwined and a clear distinction between knowledge and noticing is not always accomplished (e.g., Lee 2017).

Research has focused on how teachers perceive, interpret, seek evidence for, and attribute meaning to the various types of knowledge that influence their practice, including knowledge of student thinking (Sherin et al. 2011). Commonly studied facets of knowledge include content knowledge (CK), pedagogical content knowledge (PCK), and general pedagogical knowledge (GPK). Empirical studies suggest that these different facets of knowledge can have differential effects on teaching practice and student outcomes. However, there is still ongoing debate about how best to define and measure knowledge and its impact on teaching and learning (Cochran-Smith and Zeichner 2005; Faas 2013; Park and Oliver 2008; Shulman 1986). This is also evident in the studies reviewed in this work. Although noticing is theoretically considered a knowledge-based process by most, few scientific measures are reported (e.g., Mischo et al. 2022; Peters et al. 2021). Due to the qualitative approach of some studies a close interaction between knowledge and noticing is rather implied and based on the authors' interpretation of the individual study design (e.g., Moreno et al. 2021). According to Parks and Wager (2015), the knowledge required to facilitate play-based mathematical learning among children differs from that required by elementary teachers who explicitly structure mathematical tasks. Specifically, prekindergarten teachers need a distinct set of knowledge and skills to effectively integrate mathematical concepts into children's free play without disrupting their play experiences (Haubert 2017). This highlights the need for further research on preschool teachers noticing and the part knowledge plays in it. In general, it remains unclear which of the facets that are understood as dispositions are particularly significant for noticing. SSherin

In the introduction to this review, it was already emphasized that noticing plays a central role in the development of action competence. This assumption was also empirically investigated in the studies examined. Based on the work of Faas (2013),

a clearer distinction can be proposed. Observable action is understood as the direct manifestation of professional action, whereas facets such as knowledge and beliefs represent the underlying cognitive and affective structures that inform and guide this action. A clear distinction between these two levels makes it possible to consider the interplay between noticing and the subsequent action in a more differentiated way. It also allows a closer look at the way professionals take in and interpret information from their environment before acting. This approach might open the way for further research that focuses specifically on the effects of noticing on the quality of observable action and the resulting pedagogical outcomes.

The relationships revealed between noticing and other constructs suggest a complex interplay of factors influencing preschool teachers' noticing abilities. While knowledge consistently shows positive associations with noticing, the relationship with experience appears more nuanced, suggesting that mere accumulation of teaching experience may not automatically enhance noticing skills. The connections found between noticing and interaction quality indicate that noticing might be crucial for effective teacher-child interactions in preschool settings.

In summary, our review highlights the multifaceted nature of preschool teacher noticing and its critical role in supporting children's learning. While significant progress has been made in understanding and measuring noticing, several gaps remain. The field appears to be moving towards a more nuanced, context-sensitive understanding of noticing, recognizing its interconnections with other aspects of teacher competence. However, there is a need for more research on noticing in domains other than mathematics, such as language development, social-emotional learning, and physical development. Additionally, longitudinal studies examining how noticing skills develop over time and their long-term impact on teaching practices and child outcomes are scarce.

5.1 Limitations

Several limitations should be kept in mind when interpreting the results of the present review. Some studies might have not been included in this review due to a possible mismatch between the search strings and the wording used in the studies. In our search, we focused on the most commonly used terms in the literature, "noticing" and "professional vision", and expanded it by including the construct of "sensitivity". However, despite this inclusion, it is possible that certain research groups used different terms to describe a concept, which would have been of relevance for our literature search, but remains to be unfound.

We also acknowledge that some works may have not been included in this review because they have not been published in scientific journals, or have been written in a language other than English or German. We chose to focus on these two languages based on the language proficiency of our research team. While this approach allowed us to encompass a significant body of research, particularly from German-speaking scholars who have notably contributed to the field, it also introduces a potential bias towards German research. We acknowledge this as a limitation, and future studies might consider including a broader range of languages, subject to available resources and linguistic expertise. The limitation to peer-reviewed journal articles

ensured a focus on rigorously evaluated research. However, this approach may have excluded valuable insights from other works, such as book chapters or conference papers. Future studies may benefit from incorporating these sources to capture a more comprehensive scope of the literature.

5.2 Conclusion

Preschool teachers' noticing is considered to be crucial, since learning in early childhood education and care setting takes place in spontaneous everyday situations. Accordingly, it is of importance to gain an overview of the approaches and methods that have been utilized to investigate noticing as well as which factors are related to preschool teachers' noticing.

Our review found that most studies conceptualized noticing as comprising perception and interpretation or perception, interpretation, and decision-making. However, we saw a lack of consistency between the theoretical conceptualization of the construct of noticing and its empirical measurement across the studies. While some studies demonstrated a clear alignment between theory and practice, this was not the case for all studies. Different methodological approaches could be observed, but the lack of a standardized measurement instrument became apparent. Knowledge was seen as a construct influencing noticing while individual studies also examined other relationships. Not only a demand for further elaboration on what constructs influence noticing could be identified but also, how noticing influences other constructs. For instance, very few studies have investigated how noticing affects action planning (e.g., Mischo et al. 2020b; Soto 2018). Our results show that the empirical investigation of the relationship between noticing and subsequent professional behavior in the preschool context is still barely recognized in current research. There are few studies that specifically outline the relation between preschool teachers' tangible behaviors and facets of noticing (see Table 1). This disparity emphasizes how crucial it is to conduct additional empirical research on the relationship between noticing and action, as this can be considered as the key to determining the effectiveness and applicability of noticing in educational settings. In order to explore these connections, different methodological frameworks may be employed in subsequent research projects. The direction and strength of relationships between particular instructional behaviors and the quality of noticing could be clarified by correlational designs. Interventions, especially those focused on improving noticing skills, may offer causal insights into the ways that practices in the classroom are impacted by improvements in noticing. Furthermore, a temporal dissection of the relationship between noticing and behavior would be possible with cross-lagged panel designs, allowing for the separation of leading and lagging indicators.

The systematic review on teacher noticing by König et al. (2022) stated that qualitative studies with small sample sizes are common, enabling fine-grained analysis but limiting the generalizability of findings. This conclusion is echoed by our review of research on preschool teachers' noticing. Overall, this review demonstrates the potential that future research in the area of preschool noticing can provide. Taken together, the results of this review highlight the need for further research to clarify

the conceptualization of noticing and its relationship to other constructs, as well as the methods that can be used to investigate this.

Funding This research was funded by the Leibniz Institute for Research and Information in Education (DIPF) as part of the project “PERLE—Professional Vision of Early Mathematics in Daily Learning Situations.”

Funding Open Access funding enabled and organized by Projekt DEAL.

Conflict of interest A. Stiewe and J. Ehm declare that they have no competing interests.

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