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Title: Professional vision of Grade 1 teachers experiencing different levels of work-related stress

Year: 2022

Version: Published version

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Please cite the original version:

Muhonen, H., Pakarinen, E., & Lerkkanen, M.-K. (2022). Professional vision of Grade 1 teachers experiencing different levels of work-related stress. Teaching and Teacher Education, 110, Article 103585. https://doi.org/10.1016/j.tate.2021.103585

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Teaching and Teacher Education 110 (2022) 103585

Contents lists available at ScienceDirect

Teaching and Teacher Education

journal homepage: www.elsevier.com/locate/tate

Research paper

Professional vision of Grade 1 teachers experiencing different levels of work-related stress

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HIGHLIGHTS

- Professional vision of teachers with low, moderate and high stress was explored.
- Grade 1 teachers reasoned their eye-tracking recordings of classroom interaction.
- Domains of knowledge-based reasoning (description, explanation and prediction) were considered in the analysis.
- All three stress groups utilised description predominantly in their reasoning.
- The three stress groups differed in their use of self-reflection.

ARTICLE INFO

Article history:
Received 10 September 2020
Received in revised form
29 September 2021
Accepted 16 November 2021
Available online xxx

Keywords:
teacher Professional vision
Knowledge-based reasoning
Teacher work-related stress
Retrospective think-aloud interview
eye tracking

ABSTRACT

This study explored teachers' professional vision by examining how teachers experiencing low, moderate and high work-related stress reason their eye-tracking recordings in terms of description, explanation and prediction. A qualitative analysis of retrospective think-aloud interviews with 24 Grade 1 teachers showed that teachers predominantly used description in their reasoning, while explanation and prediction were less frequent. The description mainly focused on teacher information/elaboration and classroom management/behaviour. Teachers with moderate stress utilised self-reflection most frequently, whereas teachers with high stress utilised it the least. The results suggest that the level of teacher work-related stress may be reflected in their self-reflection.

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1. Introduction

Teachers must cope with many challenges and demands in the classroom that may affect their well-being and work performance in diverse ways (Steinhardt et al., 2011). They must be attentive to all situations and factors in the classroom, which foster or constrain students' learning, to be able to react to and reflect on those situations and factors (Hammerness et al., 2002). Not surprisingly, recent studies have reported that teachers on diverse school levels experience high work-related stress when compared with many other professions (e.g., Aloe et al., 2014; Herman et al., 2020; Kyriacou, 2001; Länsikallio et al., 2018). Teaching young students, who are still in the process of learning school rules and effective ways to study, can be especially demanding and stressful for early education and yearly primary school teachers (see e.g., Li Grining et al., 2010; Penttinen et al., 2020; Zhai et al., 2011). Since stress has been found to reduce a person's attentional and cognitive resources (Chajut & Algom, 2003), it may also be reflected in teachers' professional vision, which is one of the key factors of teacher professional competence.

Teachers' professional vision describes their use of professional knowledge in two steps: first, by *noticing* meaningful features of classroom situations and second, by engaging in *knowledge-based reasoning* to interpret and reason about the noticed classroom information (Berliner, 2001; Goodwin, 1994; Seidel & Stürmer, 2014). Prior studies on teachers' professional vision have framed it, and especially its domain of knowledge-based reasoning, as a vital pedagogical competence in achieving high levels of teaching quality (Gegenfurtner et al., 2020). In order to support the high quality of teaching and to enhance students' learning, there is a

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https://doi.org/10.1016/j.tate.2021.103585
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need to investigate if teachers' ability to apply knowledge-based reasoning may be linked with the level of their work-related stress, a factor that is typically present in teachers' everyday work. However, there is scant empirical evidence to support this link.

In addition, since the concept of professional vision relies on teachers' ability to observe what is happening in their classroom (Seidel et al., 2011), video-based analysis has become an important tool for exploring teacher expertise and learning (Putnam & Borko, 2000; Seidel et al., 2011; Sherin, 2004). Previous studies exploring teachers' professional vision have utilised video recordings of teacher's own teaching or the teaching of others (e.g., Blomberg et al., 2011; Seidel et al., 2011; Sherin and Van Es, 2009) recorded from an objective perspective (e.g. video camera at the back of the classroom). However, there are hardly any studies that have utilised the methodology of eye tracking along with interviews to investigate teachers' professional vision in terms of knowledge-based reasoning (as an exception, see Muhonen et al., 2021). Consequently, the present study aimed to explore if and how the level of teacher work-related stress may be reflected in Grade 1 teachers' professional vision through retrospective think-aloud (RTA) interviews conducted while teachers watched their own eye-tracking video recordings.

1.1. Teacher work-related stress

Depending on the branch of science, the definition of stress can vary significantly. Stress comprises both psychological and physiological changes that can be observed and measured, for instance, on the levels of brain activation, cellular mechanisms and person's subjective experience (Von Dawans et al., 2021). In the field of early years education, teacher work-related stress has been predominantly investigated through self-reports measuring their subjective experience of stress (see e.g., Curbow et al., 2000; Friedman-Krauss et al., 2014; Zhai et al., 2011). Consequently, teachers' work-related stress has been defined as the experience of negative emotions in their work, including tension, anxiety and frustration (Klassen & Chiu, 2010; Kyriacou, 2001). Though most teachers in Finland find their work satisfying and rewarding, recent reports have shown that teachers' job satisfaction is decreasing (Länsikallio et al., 2018; Taajamo & Puhakka, 2020), and internationally, many teachers, especially those working with younger students, experience moderate to high levels of stress (Herman et al., 2018). If lasting for a longer period, stress can lead to burnout, which is defined as a type of prolonged occupational stress that results particularly from interpersonal demands at work (Schaufeli & Enzmann, 1998) and is characterised by domains of emotional exhaustion, cynicism and feeling of inadequacy (Maslach et al., 2001; Pyhältö et al., 2011).

Stress (especially prolonged stress) affects a person's cognition and behaviour in diverse ways (Lupien et al., 2009). For instance, a high level of stress has been shown to diminish a person's social attention, empathy, memory and sleep (Lo Martire et al., 2020; Schwabe et al., 2012, Von Dawans et al., 2021). It has been suggested that stress reduces one's attentional resources and favours more selective attention (Chajut & Algom, 2003). In the 1950s, Callaway and colleagues (see e.g. Callaway & Dembo, 1958; Callaway & Thompson, 1953) introduced the concept of *narrowing of attention* to characterise the selectivity of a person's cognition under stress. Especially in situations with social overload (a situation in which the person has to respond to too many requests and demands from other people), the cognitive system often leads to narrowing down the focus of attention (Baron, 1986). Among teachers, who may often experience social overload in their work, increased stress has been shown to relate to lower distribution of their focus of attention among students and stronger focus on certain individual students (Chaudhuri et al., 2021).

Further, research has shown other links between teachers' work-related stress and their teaching practises in early school years' classrooms. Prior studies have reported a negative association between early education teachers' stress and performance, and high stress has been linked to teachers' lower professional commitment (Buettner et al., 2016). For instance, a high level of stress may harm teachers' executive functioning abilities, which are necessary for staying focused on learning goals and executing lessons (Downer et al., 2012; Leskin & White, 2007). Highly stressed preschool teachers have been found to be less supportive of students (Zinsser et al., 2013) and to be more likely to suffer from lower quality behaviour management and classroom organisation (Li Grining et al., 2010; Penttinen et al., 2020). In addition, in the context of secondary school, high stress has been associated with teachers' lower self-efficacy, whereas lower stress and higher coping are typically associated with teachers' higher self-efficacy (Herman et al., 2020). However, it should not be generalised that high stress equals poorer teacher performance and classroom outcomes, as some amount of stress might actually be needed to support teacher performance. For instance, Friedman-Krauss et al. (2014) identified a link between a moderate level of preschool teachers' stress and more positive classroom interaction and climate. They also found that teachers' teaching performance tended to be lower in less stressful situations. In addition, Muhonen et al. (2021) showed that moderately stressed preschool teachers utilised educational dialogue (reciprocal, cumulative and extended classroom talk) the most in their classrooms, whereas teachers experiencing low stress utilised dialogue the least.

These earlier somewhat divergent findings support the assumption that stress links with a person's cognition and attention and that teachers' stress is connected to their teaching practises. Since attention, cognition and teaching practises are all factors that also align with the concept of teacher professional vision, there is a need to further examine if and how the early primary school teachers' work-related stress may be reflected in their professional vision.

1.2. Teacher professional vision

Teacher professional vision refers to teachers' ability to focus their attention on relevant classroom events and elements (Berliner, 2001; Sherin and Van Es, 2009; Star & Strickland, 2008) and perceive and make sense of the situations at hand (Sherin, 2001). Previous literature has suggested that the concept of professional vision includes two components: the teacher's ability to *notice* and *reason about* the relevant features of classroom situations (Van Es and Sherin, 2002). *Noticing* describes paying attention to events that are meaningful for teaching and learning in the classroom (Seidel & Stürmer, 2014). However, the focus of the present study was on the second part of professional vision – *reasoning* – where teachers use their existing knowledge to interpret the situations they notice. Previous research has predominantly conceptualised teachers' knowledge-based reasoning through the three qualitatively different domains of description,

explanation and prediction (Berliner, 2001; Borko & Livingston, 1989; Seidel et al., 2011; Sherin and Van Es, 2009). Through *description*, teachers talk about their observations and share classroom-related information without further evaluations or judgements (Seidel et al., 2017). *Explanation* relies on teachers' use of their acquired knowledge to reason about or justify situations and phenomena (Shäfer & Seidel, 2015). Lastly, *prediction* entails teachers drawing conclusions about what might happen in the future, for instance, with students' learning, thus linking the situations they have noticed with their broader views on learning and teaching (Seidel & Stürmer, 2014). Previous studies have shown that teachers are capable of describing classroom situations and information but struggle with explaining and predicting, especially during the very early stages of their career (Oser et al., 2010; Seidel & Prenzel, 2007). It has been suggested that, in terms of the underlying knowledge structures of knowledge-based reasoning, teachers in the early stages of their career are missing the more elaborated and integrated knowledge structures (explanation and prediction) that enable them to link the noticed classroom situations with the professional knowledge about teaching and learning (Putnam & Borko, 2000). However, since all three domains of knowledge-based reasoning have been found to be used by experienced in-service teachers, this indicates that teachers' professional knowledge structures most likely develop over time and experience (Seidel & Prenzel, 2007). Therefore, Seidel and Stürmer (2014) have suggested that explanation and prediction are more demanding aspects of knowledge-based reasoning, with prediction being even more challenging than explanation.

Researchers have investigated teacher professional vision primarily through video-based studies, since video enables an authentic representation of complex classroom settings (Schwan & Riempp, 2004). In most of these studies, teachers from different school levels watched selected video clips of others' teaching (e.g. Meschede et al., 2017; Seidel & Stürmer, 2014; Shäfer & Seidel, 2015). This enabled researchers to map the parts on which the teachers commented and elaborate on the aspects that attracted their attention (Seidel et al., 2011). However, significantly fewer studies have utilised video recordings of teachers' own teaching. One of these exceptions is the work of Seidel et al. (2011), who found that teachers who watched a video clip of their own teaching noticed more relevant components of teaching and learning but were also less self-reflective in articulating critical incidents. In another study, Cherrington and Loveridge (2014) had early childhood education teachers watch videos of their own teaching collectively, which allowed them to engage in a broader philosophical dialogue about their classroom practices. However, the development of software and digital equipment may allow us to investigate teachers' professional vision more thoroughly. The present study relied on mobile eye tracking to enable Grade 1 teachers to watch their own eye-tracking videos and comment on their focus of attention in the classroom.

Despite the acknowledged importance of teachers' professional vision, there is relatively little research evidence available regarding the links between professional vision and diverse teacher- or student-related factors, especially in the early primary school context. The majority of previous studies on teacher professional vision have investigated its relation to teacher experience and professional development (e.g. Gegenfurtner et al., 2020; Muhonen et al., 2021; Sherin, 2007; Sherin and Van Es, 2009). Also, professional vision is generally seen as a skill that develops as expertise grows (Gegenfurtner et al., 2020; Lehtinen et al., 2020). In the majority of prior studies, expert teachers have been found to show greater professional vision and ability to process classroom information compared with novice teachers (Berliner, 2001; Gegenfurtner et al., 2020; Meschede et al., 2017; Seidel & Prenzel, 2007). In addition, limited prior research has shown that teachers' professional knowledge and related reasoning link positively with both instructional quality and students' learning (Kersting et al., 2012). It has also been shown that teachers' professional vision can be trained through video-based programmes in order to further train teachers' teaching practises (Roth et al., 2011; Sherin and Van Es, 2009). However, further research in terms of teachers' professional vision and its related factors is needed to support high-quality teaching practises and thereby students' learning in the classroom. It is important to investigate what other teacher-related factors, in addition to teacher expertise, are linked with teachers' professional vision. Thus, the present study explored teacher work-related stress in relation to teachers' professional vision.

1.3. Aims of the study

The profession of teacher has been acknowledged as very stressful at diverse school levels (e.g. Herman et al., 2020; Länsikallio et al., 2018; Li Grining et al., 2010; Zhai et al., 2011). In particular, teachers working in hectic early education and early primary school classrooms face constant demands that require their continuous attention for them to be able to create a supportive learning environment for their students (Chaudhuri et al., 2021). However, no studies have investigated how the level of early primary school teachers' occupational stress may be reflected in their professional vision. In addition, only a few studies have provided insight into teachers' professional vision by having teachers watch video recordings of their own teaching. The present study aimed to identify Grade 1 teachers experiencing different levels of stress and explore their professional vision while they reflect on their own eye-tracking video recordings. The research question was as follows: *How do Grade 1 teachers with low, moderate and high work-related stress reason about their eye-tracking recordings in terms of description, explanation and prediction?*

2. Methodology and methods

2.1. Participants

This study was part of a larger longitudinal research project studying Finnish primary school teachers, students and their parents (Lehtinen & Pakarinen, 2016-2022). The research project was reviewed and approved by the university's Ethics Committee in 2017. Signed consent forms were collected from all participants (teachers and parents of the students) prior to data collection. The data were anonymised following the guidelines of the Finnish Social Science Data Archive. For instance, data relating to individuals and schools were made anonymous through the allocation of code numbers. In addition, in the transcriptions of the teachers' RTA interviews, teachers and students' names and other identifying information were changed. Children whose guardians did not provide written consent to allow their children to appear on video-recorded footage were offered seats in the room where they could participate in the activities without being on camera. Data

restoration was undertaken according to the guidelines of the university's Ethics Committee.

The present study examined Finnish Grade 1 teachers and students in their classrooms during the fall semester of 2017 (from September to December 2017). The initial sample consisted of 54 teachers (50 female, 4 male) who were, on average, 44.6 years old and had, on average, 16 years of teaching experience (minimum 0.5 years, maximum 39 years). All teachers had a master's degree in education, which is a requirement for primary school teachers in Finland. On average, there were 17.8 students (minimum 6, maximum 23) present in the classroom during the data collection (eye-tracking video recording). This number reflects the typical size of a Grade 1 class in Finland. Students ($N = 780$, 49% girls and 51% boys) had entered primary school a couple of months prior to data collection and were approximately seven years old. All the classrooms were Finnish speaking, and the participating teachers were native Finnish speakers who had received their teacher education in Finland. In addition, the clear majority of the students were native Finnish speakers, but there were a few students with immigrant backgrounds. Therefore, although Finnish was used as the common communication language, cultural and linguistic variation was present in the classrooms to some extent. The education level of the participating parents ($N = 577$) varied from no vocational education to a licentiate or doctorate (*Mode* = vocational school degree).

2.2. Measures and procedure

2.2.1. Eye-tracking video recordings

The participating teachers wore eye-tracking glasses for about 20 min during one lesson on a normal school day. The recording was done with a Tobii Pro Glasses 2 mobile eye-tracking device that collects both visual and audio data. Two research assistants set and calibrated the eye-tracking glasses just before the recording and removed the equipment from the teacher after 20 min. Calibration of the device was conducted using one point. Then, to verify the quality of the calibration and data analysis, the research assistants asked the teacher to look at three set points on the wall at the beginning of the video recording to verify that their gaze met the three points. The research assistants also confirmed with each teacher that they felt natural and comfortable while wearing the glasses during the lesson. The sampling rate of the Tobii Pro Glasses 2 eye tracker was 50 Hz (25 frames per second). The eye tracker yielded a 1920 × 1080 pixel video capturing 82° horizontally and 52° vertically.

2.2.2. Retrospective think-aloud interviews

During the same day of the eye-tracking recording, each teacher was asked to watch their eye-tracking video recording with a trained research assistant who was also responsible for the eye-tracking recording. While watching the video recording, the teachers were encouraged to recall what they were thinking during the recording and explain why they acted the way they did. Each teacher was given exactly the same instruction, and no additional clarifying or expanding questions were asked during the video watching. On average, the interviews lasted approximately 20 min, which was the duration of the eye-tracking recording the teachers watched. However, the teacher had an opportunity to pause the eye-tracking video at any stage of watching, elaborate on the situation on the video further and then continue watching the video. Prior eye-tracking studies employed a similar RTA protocol and confirmed its validity (see e.g. Guan et al., 2006; Hyrskykari et al., 2008) for gathering qualitative information on a participant's thought process, especially their intentions and reasoning. Recordings (audio and visual) of the RTA interviews were made using Screencase-O-Matic software.

2.2.3. Teacher stress questionnaire

All the participating teachers also filled in a questionnaire regarding their work-related stress and well-being. The teachers filled in the questionnaire during their own time and returned it to the research assistants when it was complete. In most cases, the teachers returned their questionnaires after the day during which the eye-tracking recording and RTA interview were conducted. Teachers' self-reported work stress was measured utilising the 9-item Bergen Burnout Inventory (BBI-9; Salmela-Aro et al., 2010), which includes nine items measuring three domains of stress: (1) exhaustion (three items; e.g. *I am snowed down under work*), (2) cynicism (three items; e.g. *I feel dispirited at work and I think about leaving my job*) and (3) inadequacy (three items; e.g. *I frequently question the value of my work*). Items measuring exhaustion examined fatigue due to increased workload. Items measuring cynicism assessed teachers' feelings of indifference towards work and people at work, including loss of interest. Items measuring teachers' inadequacy focused on teachers' reduced efficacy in professional competence and accomplishments at work. Teachers rated all nine items on a scale ranging from 1 (completely disagree) to 6 (completely agree). The reliability and validity of the BBI-9 has been confirmed in prior research, and the factorial structure has been found to remain the same regardless of sample differences and measurement times (see Feldt et al., 2014; Salmela-Aro et al., 2010). In addition, the teachers were provided with the following description of stress: *Stress refers to a situation in which a person feels strained, anxious, nervous or restless, or has trouble sleeping when things start to bother* (Elo et al., 2003). After carefully reading this description, the teacher rated their experience of stress from 1 (not at all) to 6 (very much). The content, criterion and construct validity of the measure have been confirmed in prior research (see Elo et al., 2003).

After the data collection, the stress measures were standardised and merged into one composite stress score (Cronbach's alpha = 0.82). This was done to identify each teacher's work-related stress level. The average stress score for the whole sample was .00, with the total range varying from −1.52 to 2.10 ($SD = 1.00$). As a cut-off criterion, ±1 *SD* (e.g. Pelletier, 2006) was used to identify different three work-related stress levels: below the sample average, within the sample average and above the sample average. Teachers whose stress score ranged from −1.52 to −1.00 (more than −1 *SD* from the sample average of 0.00) were considered to experience the lowest level of work-related stress in the sample ($n = 8$, $M = -1.31$). Teachers with a stress score ranging from −1.00 to 1.00 (±1 *SD* from the sample average of 0.00) were considered to experience a moderate level of work-related stress in the sample ($n = 33$, $M = -0.22$). Furthermore, teachers whose stress level ratings ranged from 1.00 to 2.10 (more than +1 *SD* from sample average of 0.00) were considered to experience the highest level of work-related stress in the sample ($n = 12$, $M = 1.49$). Finally, simple random sampling (random number table) was used to select eight teachers from each stress subgroup: teachers with low, moderate and high work-related stress. The eight teachers in each stress subgroup were numbered from one to eight. Consequently, 24 teachers and their RTA interviews based on their eye-tracking video recordings were selected for further analysis.

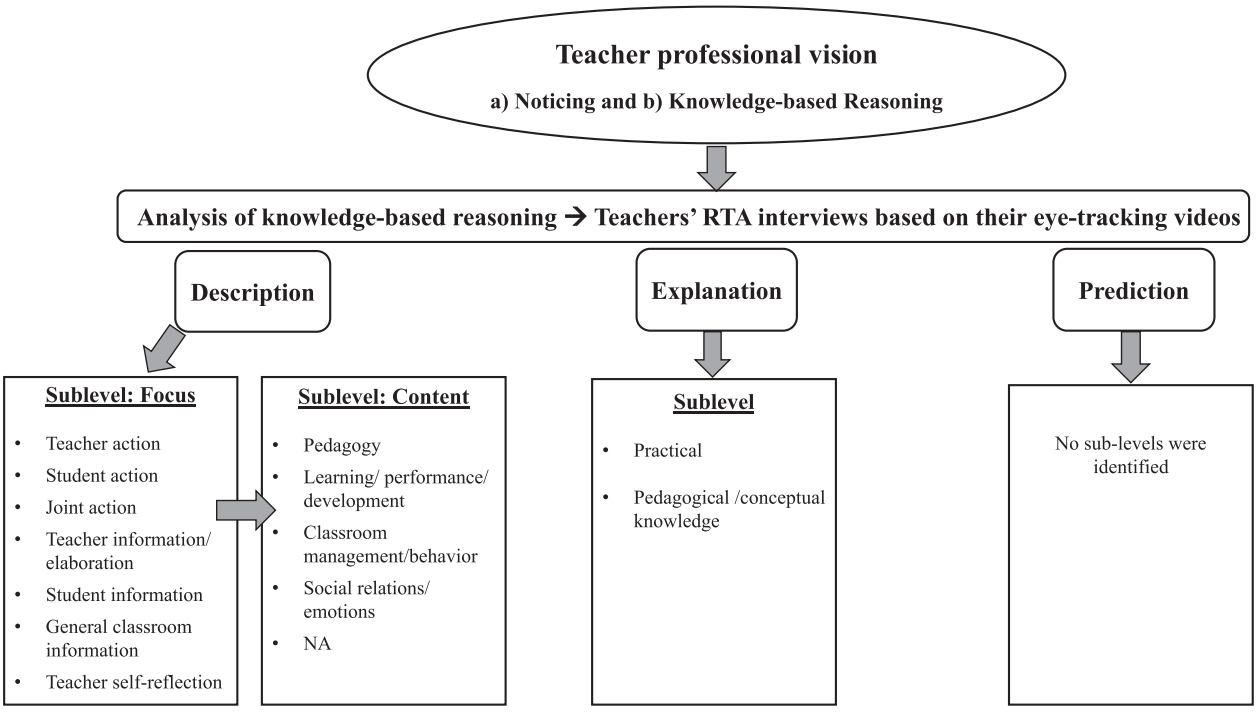


Fig. 1. Structure of the analysis framework of teachers' knowledge-based reasoning.

2.3. Analysis

First, the 24 teachers' RTA interview recordings were transcribed by trained research assistants. Then, the transcripts were read through by the first author to get an overview of the data. The theoretical framework for the analysis was drawn from the concept of teacher professional vision comprising the two domains of noticing and knowledge-based reasoning. The analysis focused on knowledge-based reasoning, which could be examined in the RTA interviews through the teachers' reflections on their intentions and reasoning related to their focus of attention in the classroom. The analysis was based on three domains of knowledge-based reasoning suggested in previous research (e.g. Seidel & Stürmer, 2014; Sherin & van Es, 2009): (1) description, meaning the ability to identify, differentiate and classify teaching and learning components; (2) explanation, meaning the ability to link the observed classroom situation to professional knowledge; and (3) prediction, meaning the ability to use professional knowledge to forecast learning-related consequences. In addition to the three main domains, sublevels emerged from the data content. Fig. 1 presents the analysis framework, and Appendix 1 provides examples of each analysis unit. The analysis units were identified as separate statements or thoughts from the teacher and were coded individually. The statements could include teachers' thoughts, for instance, about themselves, the students, the school in general etc.

After identifying the unit, it was determined whether the unit statement represented description, explanation or prediction. Analysis units representing description were coded into two sublevels. The first sublevel examined the *focus* of the teacher's description: teacher action, student action, joint action, teacher-related information/elaboration, student information, general classroom information or teacher self-reflection. The second sublevel examined the *content* of the teacher's description: pedagogy, learning/performance/development, classroom management/behaviour, social relations/emotions or not applicable (NA) content. Analysis units representing explanation were coded within one sublevel: whether teachers provided explanations with *practical knowledge* or *pedagogical/conceptual knowledge*. Analysis units representing prediction were scarce in the sample and, therefore, no sublevel could be identified for them. The first author of the paper predominantly conducted the analysis. Prior to the data analysis, the coding framework was tested and validated with an 80% inter-rater agreement score between the first author and trained research assistants utilising different but similar types of RTA interview data. For the present study, the findings were agreed upon and corroborated using researcher triangulation among the research team in the form of discussions on interpretations (Cohen et al., 2007; Miles & Huberman, 1994). In addition, 20% of the teachers' RTA interview transcripts were double-coded by a second rater to ensure the reliability of the analysis. The inter-rater reliabilities for each code type were calculated as intraclass correlation coefficients (ICCs). The ICCs ranged from 0.72 to 0.98, therefore indicating a substantial level of agreement.

Finally, Friedman's test was utilised to compare frequency differences among the knowledge-based reasoning domains of description, explanation and prediction.

The Kruskal–Wallis H-test was used to determine if there were statistically significant differences among the teacher stress groups in terms of description, explanation and prediction.

3. Results

The aim of this study was to investigate how teachers with low, moderate and high work-related stress reason about their own eye-

Table 1
Analysis units of description among teachers with low, moderate and high stress.

	Teachers with low stress	Teachers with moderate stress	Teachers with high stress	Kruskal-Wallis test x^2 (p-value)
Description focus				
Teacher action	37	76	90	1.952 (.377)
Student action	65	79	72	0.035 (.982)
Joint action	19	38	36	1.140 (.566)
Teacher information/elaboration	281	170	234	2.945 (.229)
Student information	250	163	216	1.430 (.489)
General classroom information	30	23	31	0.710 (.701)
Teacher self-reflection	47	66	18	6.503 (.039)
Total	729	615	697	
Description content				
Pedagogy	199	133	162	0.955 (.620)
Learning/performance/development	222	142	158	1.189 (.552)
Classroom management/behaviour	274	291	307	0.658 (.720)
Social relations/emotions	25	34	54	1.605 (.448)
NA	9	15	16	0.779 (.678)
Total	729	615	697	

tracking recordings in terms of description, explanation and prediction. In total, 791 analysis units of teachers with low stress, 678 analysis units of teachers with moderate stress, and 775 analysis units of teachers with high stress were found. Considering the whole sample, Friedman's test showed a statistically significant frequency of differences among the three domains of knowledge-based reasoning, $\chi^2(2) = 46.083$, $p = 0.000$. The teachers reflected on their eye-tracking recordings predominantly through description (2041 units) and utilised explanation (198 units) and prediction (5 units) significantly less frequently. The following three sections, devoted to description, explanation and prediction, present the findings for teachers in the three stress groups.

3.1. Description

Description was the predominant knowledge-based reasoning domain of the sample. Regarding the number of analysis units, 729 units were found among teachers with low stress, 615 units among teachers with moderate stress and 697 units among teachers with high stress. All description analysis units were given two codes – one indicating the description focus and the other the description content. Table 1 presents the frequencies of analysis units per type of description focus and content. Regarding the description focus, teacher information/elaboration occurred the most frequently among the three stress groups. Thus, the teachers shared their beliefs, strategies, goals and feelings related to the classroom interaction on the video recording (see example extracts below).

> And here I was thinking that I try to make this calculation example as concrete as possible by utilising those toys and money. (*Teacher 5 with moderate stress*)

> In this situation, I aimed that as many children as possible would have the time to actually process and raise their hand. (*Teacher 3 with low stress*)

> In this situation, I am panicking a bit because we should move on to the actual content of the lesson, but I feel like I should listen to what the children have to say. (*Teacher 7 with high stress*)

The second most dominant description focus type was student information (see example extracts below). In sharing student information, the teachers talked about students' skills, characters, behaviour or social relations. This type of information was often shared as background information extending beyond the students' performance during the video.

> And then there, in the back row, are the students that I know can handle this task. The task is easy for them. (*Teacher 1 with low stress*)

> This child usually always wants confirmation from the teacher that she knows she is doing the right thing. (*Teacher 6 with high stress*)

> It is usually difficult for him to understand at which stage we are. He always needs help in keeping up with the lesson. (*Teacher 1 with moderate stress*)

The other types of description focus (teacher action, student action, joint action and general classroom information) occurred less often among all three stress groups. However, the Kruskal–Wallis H-test showed that there was a statistically significant difference in teacher self-reflection among the three stress groups, $\chi2(2) = 6.503$, $p = 0.039$, with a mean rank score of 13.44 for teachers with low stress, 16.44 for teachers with moderate stress and 7.63 for teachers with high stress (see Table 1). The teachers with moderate stress reflected on their own performance and work the most (66 units), whereas the teachers with high stress utilised self-reflections the least (18 units). During self-reflection, the teachers noticed, realised or elaborated on things related to their work and classrooms (see example extracts below).

> Nice to see that my eyes meet those students – the quiet ones – because I always wonder if I notice and pay attention to them enough. (*Teacher 6 with moderate stress*)

> In my opinion, I have always thought that I let the children move around very freely, but apparently I don't. (*Teacher 2 with moderate stress*)

> I realise I am constantly watching and observing the children like a hawk. My gaze does not calm down at all; it is constantly registering something. (*Teacher 3 with high stress)*

Regarding the description content (see Table 1), the teachers in all three stress groups predominantly shared comments related to classroom management and behaviour. The content of this type of reflection included comments about the teachers' classroom management or how the children or the teacher behaved in the classroom (see example extracts below).

> And then I ask the children to put their pencils in the middle of the book. (*Teacher 3 with moderate stress*)

Table 2
Analysis units of description among teachers with low, moderate and high stress.

	Teachers with low stress	Teachers with moderate stress	Teachers with high stress
Practical explanation	31	33	45
Pedagogical/ conceptual explanation	30	27	32
Total	61	60	77

We have this thing where I count from one to five, and at five, they should calm down and start to work on their assignments. (*Teacher 1 with high stress*)

As you can see, it is very difficult for them to sit down for the entire lesson. (*Teacher 7 with high stress*)

In addition, reasoning related to pedagogy or learning/performance/development occurred relatively evenly among the teachers with low, moderate and high stress (see example extracts below). Description content related to pedagogy included teachers' thoughts about their educational and pedagogical actions, goals and strategies for reaching the goals. Also, description content related to learning/performance/development included teachers' thoughts about (mostly students') academic performance, physical development and age and learning of social or behavioural skills.

I see that we still need to practise finding the right page. I need to pay more attention to that and give more time. (*Teacher 8 with low stress*)

And I always like to go through the instructions for the work sheets together before they start to work on them, even though they could not remember them after that. (*Teacher 2 with high stress*)

Giving homework to them is so hard because they are all at different skill levels. (*Teacher 1 with low stress*)

He is very talented in writing. (*Teacher 3 with moderate stress*)

Description content related to social relations and emotions occurred more seldom among all three stress groups compared with the other types of description content. There were also 40 analysis units in total in which the coding of description content was not applicable (NA). The Kruskal–Wallis H-test showed no statistically significant differences among the three stress groups in terms of types of description content (see Table 1).

3.2. Explanation

Teachers in all three stress groups utilised some explanatory comments to reason about their eye-tracking recordings, though the explanatory comments occurred relatively seldom. Regarding the number of analysis units representing explanation, 61 units were found among teachers with low stress, 60 units among teachers with moderate stress and 77 units among teachers with high stress. Analysis units of explanation were identified either as practical explanations or pedagogical/conceptual explanations (see Table 2). The Kruskal–Wallis H-test showed no statistically significant differences among the three stress groups in terms of practical explanations ($\chi 2(2) = 1.014$, $p = 0.602$) or pedagogical/conceptual explanations ($\chi 2(2) = 0.240$, $p = 0.887$).

The teachers used practical explanations to reason about their actions, thinking or other classroom actions by relying on practical knowledge or concrete reasons (see example extracts below). The practical explanations were often related to classroom organisation and, therefore, they also often followed description units of which content was coded as classroom organisation/behaviour.

Apparently, it was quiet in the classroom, because I could concentrate on my writing and I didn't have to go around the classroom to check them.[1] (*Teacher 4 with moderate stress*)

So, then I went to get a new notebook for him, because the backpack was already checked and nothing was found there, and there was only his biology book and personal notebook in the desk. [1] (*Teacher 5 with moderate stress*)

The teachers utilised pedagogical/conceptual explanations to reason about their pedagogical actions, thinking or other actions in the classroom by relying on educational concepts or pedagogical knowledge (see example extracts below). The pedagogical/conceptual explanations usually followed description units of which content was coded to focus on pedagogy or learning/performance/development.

And here I am looking at how the children read, and I am trying to look at the movements of their mouth and lips. That is because I am trying to see how courageously they articulate and use the muscles of their mouths, since that is associated with the phase when they start to write syllables and correct letters.[1] (*Teacher 3 with high stress*)

I gave this observation task so that as many children as possible could engage with it. (*Teacher 4 with high stress*)

3.3. Prediction

The knowledge-based reasoning domain of prediction occurred the least frequently in the sample (see example extracts below). Among the teachers with low stress, only one out of the 791 analysis units (0.001%) represented prediction. Among the teachers with moderate stress, three out of the 678 analysis units (0.44%) represented prediction. Among the teachers with high stress, only one out of the 775 analysis units (0.001%) represented prediction. The identified predictions followed the first appearing descriptions and explanations by drawing conclusions about the future. The predictive comments were related to either classroom behaviour or student learning.

So, it takes a long time and you wonder how to group them because some of the chemistries simply do not match, and I can already see that some of those groups won't work.[2] (*Teacher 5 with moderate stress*)

So, we usually solve these calculations together to deepen their understanding … I think that if we keep repeating now, it will help them understand more difficult calculations and divisions in the future.[2] (*Teacher 1 with low stress*)

4. Discussion

The present study aimed to contribute to the literature on teacher professional vision by exploring how teachers with low, moderate and high work-related stress reason about their eye-

[1] Text in lighter colour included as the context for the explanative comment.
[2] Text in lighter colour included as the context for the predictive comment.

tracking recordings. The analysis of the Grade 1 teachers' RTA interviews showed that teachers with low, moderate and high work-related stress reflected on their eye-tracking recordings predominantly through description and utilised explanation and prediction less frequently. The description focus showed that the teachers predominantly shared teacher information/elaboration and that the description content was mostly related to classroom management/behaviour. Moreover, there was a statistically significant difference in teachers' self-reflection, which showed that teachers with moderate stress utilised self-reflection most frequently and teachers with high stress utilised it the least frequently.

The study investigated how teachers with low, moderate, and high stress reason their eye-tracking recordings in terms of description, explanation and prediction. Previous research has conceptualised teachers' knowledge-based reasoning through the three domains of description, explanation and prediction (Berliner, 2001; Borko & Livingston, 1989; Seidel et al., 2011; Sherin and Van Es, 2009). All three domains (and their content-driven subtypes) were identified in the present data, but there was significant variation in their occurrence. The teachers reasoned about their eye-tracking videos predominantly through description and made explanatory and predictive comments significantly less often. This finding appears to be in line with previous research, which has suggested that although teachers are capable of describing classroom situations and information, they may have difficulty in explaining and predicting these situations (Oser et al., 2010; Seidel & Prenzel, 2007). This may be because explanation and prediction can be considered to be more demanding phases of knowledge-based reasoning (Seidel & Stürmer, 2014). However, the present study showed that there was variation in the types of description according to the focus and content, and some of these subtypes may seem more complex to reason about than others.

Among the teachers with low, moderate and high stress, the teachers' description focus of teacher information/elaboration and student information occurred the most. This indicates that the teachers largely shared broader background information and were able to reason beyond just describing the actions occurring in the present moment. Regarding the description content, the described information was predominantly about classroom management and behaviour. It may be that teachers value effective classroom management, as shown in observational studies of classroom quality: the quality of classroom organisation is usually higher compared with instructional support provided by the teacher (see e.g. Pakarinen et al., 2010; Penttinen et al., 2020; Pöysä et al., 2019).

In terms of the knowledge-based reasoning domain of explanation, teachers in all three stress groups utilised explanation relatively infrequently. This finding was somewhat surprising because the teachers were specifically asked to explain their actions during the recording. On the other hand, explanation, as one of the domains of teachers' knowledge-based reasoning, is considered to be a more elaborate and integrated knowledge structure compared with description (Putnam & Borko, 2000; Seidel & Stürmer, 2014). Therefore, providing explanatory comments for their eye-tracking video may require more professional knowledge, and therefore, more effort from the teachers compared with providing descriptive comments. In addition, explanation has been defined as an ability that enables teachers to link their noticed classroom situations with their professional knowledge about teaching and learning (Putnam and Borko, 2000). However, in the present study, explanatory comments were not only related to teaching and learning, but were also categorised as practical and pedagogical/conceptual explanations. There were no differences in their occurrence, but the findings showed that the practical explanations often followed management- and behaviour-related descriptions, whereas pedagogical/conceptual explanations followed pedagogy- and learning-related descriptions. These particular findings suggest that the nature of explanation in knowledge-based reasoning may vary, and more research, especially regarding the practical type of explanations, is needed in the future.

Prediction occurred very infrequently in the sample, and no clear categorisation of its content could be made. Although the teachers in this sample were not specifically asked to use prediction in their reasoning, its scarcity is nonetheless notable. Despite the very rare occurrence of prediction, its relevance should not be undervalued. Seidel and Stürmer (2014) showed that the three-dimensional model of knowledge-based reasoning (including description, explanation and prediction) best describes the concept of professional vision the and that all three domains are highly interrelated. In previous research, in-service teachers and school principals were found to utilise predictions of teacher actions more frequently than pre-service teachers did (Gegenfurtner et al., 2020). Therefore, the domain of prediction should be considered a rare but important domain indicating perhaps the most developed reasoning stage of teacher professional vision and its knowledge-based reasoning.

Regarding the levels of teacher stress, relatively little variation was found in teachers' knowledge-based reasoning in the sample. All three groups of teachers utilised description the most and predominantly shared comments reasoning about teacher information/elaboration and student information, and the content was mostly related to classroom management/behaviour. However, an interesting finding showed a significant difference in the teachers' self-reflection. Teachers with moderate stress reflected on their teaching and behaviour the most, and teachers with high stress utilised self-reflection the least. High stress has been linked to teachers' lower professional commitment (Buettner et al., 2016) and lower attentional resources (Chajut & Algom, 2003), which may also be reflected in their self-reflection ability. The teachers with high stress struggled the most in paying attention to the relevant learning points, which is in line with prior research suggesting an association between stress and more selective attention (Callaway & Dembo, 1958; Chajut & Algom, 2003). The findings of the present study indicate that the high level of stress may link with teachers' lower resources to pay attention to the relevant learning points related to their teaching. Some previous studies also identified a link between moderate stress and early education teachers' higher performance in terms of classroom interaction, climate and dialogue (Friedman-Krauss et al., 2014; Muhonen et al., 2021; Penttinen et al., 2020). In the present study, teachers with moderate stress utilised self-reflection the most, meaning that they realised and noticed new aspects related to their performance in terms of pedagogy or classroom management. This finding may indicate that the teachers with moderate stress benefited from watching their eye-tracking videos the most and that they were sensitive to developing their teaching.

4.1. Implications, limitations and future directions

The present study has both theoretical and practical implications. To the best of our knowledge, no previous studies have explored the link between stress and teachers' professional vision. Research has shown that teachers' work is demanding and stressful

(Herman et al., 2020) and that the level of stress can affect the teachers' work performance (Steinhardt et al., 2011). However, in terms of professional vision, the present study showed that the level of stress seems to be reflected predominantly in the teachers' self-reflection ability. Adding to the limited existing literature (e.g. Friedman-Krauss et al., 2014; Muhonen et al., 2021), the present study suggests that a moderate level of work-related stress may link with teachers' consciousness of what is happening in the classroom as well as their own performance. Based on the study results, we would argue that it is important that teachers become aware of their level of stress and how too high a level of it may harmfully link with their professional vision. Supporting teachers' well-being can support the quality of teacher performance and thereby improve student learning. Attention to supporting teachers' well-being and their ability to cope with stress should be paid from the start of teacher education and continued with in-service training.

Irrespective of the level of stress they experienced, the teachers in this study seemed to utilise explanations and predictions rarely when reflecting on what was happening in the classroom. It is important that teachers are aware of the reasons for, and goals of, their actions in the classroom even in the routine of everyday teaching. The findings suggest that the teachers need practice in explaining and predicting their classroom actions, and this practice should begin as early as the teaching practice period of pre-service training.

Concerning the methodology for studying teacher professional vision and its knowledge-based reasoning, most previous studies used video recordings filmed from an objective perspective (e.g. Blomberg et al., 2011; Seidel et al., 2011;). The present study adds to the previous research by investigating teachers' knowledge-based reasoning through RTA interviews that were conducted while the teachers watched their own eye-tracking video recordings. Using teachers' own eye-tracking videos adds a more personal perspective to the research field of teachers' professional vision. In particular, it allows teachers to focus more on their own performance and focus of attention and, consequently, practice more self-reflection. This methodology of eye-tracking and RTA interviews could also be utilised in the training of professional vision and knowledge-based reasoning for both in- and pre-service teachers.

Considering the analysis strategy, the analysis framework utilised in the study was based on previous literature on knowledge-based reasoning (domains of description, explanation and prediction). However, in addition to the three main domains, the data content evinced sub-levels of each domain. The data-driven sub-levels add to the existing literature on knowledge-based reasoning and suggest an additional approach to study teachers' professional vision.

The present study also had limitations, and caution is needed before using the findings to draw direct causal conclusions. First, the sample (24 teachers) was small, which may have decreased the power of the statistical testing, but it can be considered sufficient for a qualitative study. Second, eight teachers from each of the low, moderate and high stress groups were randomly selected to represent their stress group. However, the initial group sizes varied. Eight teachers had low stress, 33 had moderate stress and 12 had high stress. Therefore, there could be variation in how well the eight randomly selected teachers represented the stress levels. Third, the lesson subjects of the eye-tracking recordings were not controlled for. This means that the subjects varied within the recordings that the teachers watched and commented on. Fourth, teacher work-related stress was measured with the BBI-9 (Salmela-Aro et al., 2010) and a single-item stress measure (Elo et al., 2003). Though the measures aimed to assess work-related stress and burnout, it is important to acknowledge that the experience of stress may be attributed to teachers' wider life circumstances as well. In the future, real-time measures (e.g. physiological ones, such as cortisol) could provide more accurate information regarding the teachers' level of stress. Finally, each teacher was given exactly the same instruction for the RTA interview: they were asked to recall what they were thinking during the recording and explain why they acted the way they did during the recorded classroom activities. No additional clarifying or expanding questions were asked during the video watching. However, some teachers might have found it challenging to recall and reason about their recordings, which is why some of their interviews remained scarce. In the future, more clarifying and expanding questions could be used to encourage the teachers to express their reflections.

5. Conclusions

The findings are of great importance because they provide a new approach to investigate teacher professional vision by exploring how Grade 1 teachers with low, moderate and high work-related stress reason about their eye-tracking recordings in terms of the three domains of knowledge-based reasoning (description, explanation and prediction). Based on the findings, it may be concluded that irrespective of their level of stress, Grade 1 teachers' ability to use knowledge-based reasoning is predominantly characterised by the use of description. The domains of explanation and prediction seem more challenging for the teachers to utilise when reasoning their classroom actions. We suggest that teachers need conscious practice and training in becoming more aware of the reasons for, and goals of, their actions in the classroom and in being better able to reflect on these more deeply.

The findings also suggest that teachers' level of stress may be reflected in their self-reflection ability. High stress levels may link with teachers' lower resources to acknowledge the relevant learning points related to their teaching, whereas moderate stress may associate with teachers' consciousness of their own performance and what is happening in the classroom. Therefore, it is important that teachers' occupational well-being should be supported in order to enhance their professional performance.

Acknowledgements

The study was funded by the Academy of Finland (No. 317610), the Finnish Work Environment Fund, and Ella and Georg Ehrnrooth Foundation. We would like to thank Professor Antje von Suchodoletz for supporting the design of the analysis framework. The design of the analysis framework was funded by the New York University Abu Dhabi Research Enhancement Fund (No. RE059).

Appendix 1. Examples of analysis units

Description	
Focus	
Teacher action	'I actually did physically step on her hand'.
Student action	'He is just running around and not concentrating'.
Joint action	'Here we are just working and enjoying'.
Teacher information/elaboration (beliefs, strategies, goals, feelings)	'I believe it is good for them to do these tasks independently and take responsibility'.
Student information (skills, character, behaviour, social relations)	'So, he can appear to be distracted, but when I can ask him to call something, he can do it exactly'.
General classroom information (classroom/school activities, tasks, routines, equipment)	'This is my teaching assistant. She works with me three days per week'.
Teacher self-reflection (noticing/realising things/elaborating)	'You don't realize how busy it is till you see this'.
Content	
Pedagogy (educational/pedagogical actions, goals and strategies for how to reach the goals)	'So, I use examples of other children's good posture, good behaviour on the carpet and hope the others will copy'.
Learning/performance/development (academic performance, physical development [age], learning social or behavioural skills etc.)	'This boy here just learned to read about a week ago. It happened very quickly'.
Classroom management/behaviour	'Okay, so I'm checking … by just looking, I was making sure that this girl over here is in her seat'.
Social relations/emotions	'I do feel quite bad I didn't focus more on them'.
NA (not applicable comments)	'I should call him tomorrow'.
Explanation	
Pedagogical/conceptual knowledge (explanations of actions, thinking or other classroom actions relying on educational concepts or pedagogical knowledge)	'I am staying in the background because they are supposed to learn independence but also co-operation'.
Practical (explanations of actions, thinking or other classroom actions relying on practical explanations and reasons)	'Looked at the girls because they are taking a large amount of time, and we're clearly trying to move on'.
Prediction	
Expectations, plans, goals and hopes for student learning, performance but also more in general for classroom actions and teaching	'Today, we have been reading lots of stories because I want them to get ideas so that by next week, they would be inspired to plan their own stories and would know the story structure'.

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