Eye tracking in a teaching context: Comparative study of the professional vision of university supervisor trainers and pre-service teachers in initial training for secondary education in French-speaking Belgium.

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Abstract : This study explores the visual strategies of University Supervisor Trainers (UST) for teachers (Upper Secondary Education Teaching Certification - Agrégation de l'Enseignement Secondaire Supérieur (AESS)) in French-speaking Belgium and the pre-service teachers (PT) they train. It aims to understand how these two groups observe a teaching situation, on video, using an eye-tracking device. The video shows the start of a geography lesson given by a trainee in a primary school class. Three research questions were formulated, examining a) the actor observed (the trainee, the pupil working groups and 4 pupil profiles present in the scene), b) the visual strategies used to access these actors and c) the visual itineraries when a planning error by the trainee is presented on the screen. To answer, we chose to carry out an analysis based on oculometric indicators (fixing, visit and first view). The results show that UST and PT focus their attention on the same groups of students. However, they do not do so in the same way. UST adopt visual strategies that are distinct from those of PT, thus aligning their approaches with those of expert teachers in other studies using eye tracking. Within these strategies, we highlight two important points: a) the emergence of dynamic and floating visual strategies in the UST, characterised by more frequent revisits (significantly validated) and fixations of shorter duration than in PT; and b) less fixation of UST in observing students who are very active in class compared to PT. Finally, the specific analysis of the UST gaze itineraries at the time of the trainee's planning error reflected both common elements (e.g. teaching tools) and divergent elements (e.g. checking pupils).

1. Contextualised introduction

In French-speaking Belgium, the initial training of pre-service upper secondary teachers (PT)[1] is provided by the universities as part of the AESS programme (Agrégation de l'Enseignement Secondaire Supérieur - Upper Secondary Education Teaching Certification). This 30-credit course includes theoretical courses and practical placements, but its limited duration poses a challenge for University Supervisor Trainers (UST), particularly in terms of developing their practical teaching skills, which takes place over a period of 40 hours at university and 60 hours on placement in schools. (Bocquillon, 2020). The act of teaching is complex and demanding (Wyss et al., 2021). It generates inherent tensions, as it requires mastery of a variety of teaching practices, some of which have proved more effective than others (Bocquillon, 2020), and adaptation to classroom environments which are often characterised by a density of competing and transient information (Jarodzka et al., 2021; Lanéelle & Perez-Roux, 2014).

[1] Future upper secondary teachers are considered to be pre-service teachers and are therefore referred to in this article by the acronym 'PT' (for 'Pre-service Teacher').

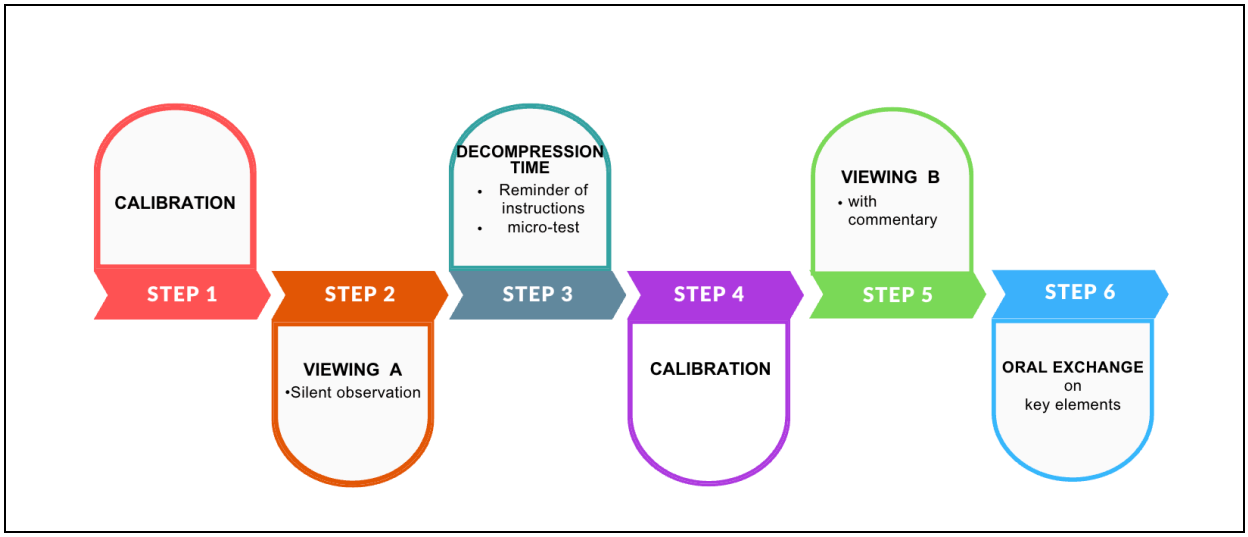
In response to this challenge, a training methodology based on micro-teaching (in the sense of Wagner, 1988) was designed and implemented by Derobertmasure (2012), then Bocquillon (2020) for three faculties at the University of Mons (Belgium). Using their dual role as trainer and researcher (see Bocquillon et al., 2018 for a summary), these authors have developed a system in which each PT gives a 30-minute lesson in front of other PT. The entire lesson is filmed. The PT then discuss a 5-minute sequence, which they have selected beforehand, during individual video debriefing sessions with a UST (Duvivier & Demeuse, 2023). During the debriefing, the UST and PT are thus involved in the same process: that of observing and commenting on the lesson extract chosen by the PT. In the sense of van Es & Sherin (2008) this process of observing and then reflecting about it is based on the concept of the professional vision (PV).

The PV of PT is attracting increasing interest from researchers (Jarodzka et al., 2021), whereas the PV of UST remains largely understudied. Yet the observation and analysis of teaching scenes is one of the main activities of UST (Cohen et al., 2013; Wyss et al., 2021). Moreover, understanding what a UST perceives visually can give an idea of what teachers should perceive (Wyss et al., 2021) or, at least, serve to identify 'points of interest'. Moreover, the UST' practices involve specific features which are sometimes considered opaque (Awaya et al., 2003; Paris & Gespass, 2001) or often taken for granted, often without any attempt being made to describe and analyse them (Zeichner, 2005).

In this context, we aim at deepening understanding of the PV of the UST and PT they train through the micro-teaching methodology. To do this, we set up an experiment in which the UST and PT watched a 7-minute extract of a teaching situation, given by a trainee in a real context. This video had the particularity of simultaneously presenting several aspects linked to classroom management (e.g. pupil[2]'s conduct) and learning management (e.g. a lesson planning error). The gaze of the UST and PT was recorded throughout their viewing of the recorded performance and broadcast on a monitor using eye-tracking (ET) equipment (GazePoint GP3HD). In accordance with the simultaneous verbal protocol described by Roussel (2017) each participant was subjected to a double viewing session of the video extract. During the first session (viewing A), viewing took place in silence (figure 1). During the second session (viewing B), the participants were specifically encouraged to verbalise their thoughts, minimising periods of silence, while watching the video. After watching the extract, each participant verbalised the salient elements, exploring the aspects that had captured their attention. All verbalisations were recorded and later transcribed for analysis.

Figure 1: Sequences of the experiment

[2] In this article, the term 'student' refers to those who receive instruction and includes learners at all levels of education. The term therefore includes pupils, students or any individual in a learning context.



In this study, we focus on the oculometric data collected during the second viewing. We report on these data in four sections. The first deals with the theoretical framework, discussing the PV in a teaching context and the use of ET as a method of analysis. The second describes the methodology, the experimental method and the sample. The results are presented by research question in the third section. Finally, the conclusion and discussion summarise the study and address its limitations and prospects.

2. Review of the literature and theoretical framework

2.1. Professional vision in a teaching context

Alonso-Vilches et al. (2021) point out that training in areas requiring human interaction, such as teaching *"cannot do without taking into account the characteristics of the complex work situations associated with the daily lives of these professionals*" (p.15). Indeed, teaching is considered to be a complex activity (e.g. Jarodzka et al., 2021; Lachner et al., 2016; Seidel & Stürmer, 2014) which is characterised by the multidimensionality, simultaneity and immediacy of its environment (e.g. Sabers et al., 1991; Doyle, 2006; Doyle & Carter, 2003; Jarodzka et al., 2021; Keller-Schneider et al., 2021). Classroom environments are dense with competing and transient information (Doyle, 2006), which forces teachers to make rapid choices. In every lesson, teachers are faced with dynamic and semantically open-ended situations, where they often do not have all the information they need to make informed and considered decisions (Wyss et al., 2021). Thus, teaching acts under the pressure of time (Wahl, 1991) and forces teachers to reconcile various and sometimes contradictory objectives at the same time. This conflict is illustrated by the questions of whether it is better at a given moment to focus on individual needs or group dynamics, and whether it is advisable in a specific situation to pursue didactic or educational issues (see Helsper, 2002 cited by Wyss et al., 2021).

A teacher's expertise then lies in knowing what to be sensitive to in the classroom and how to interpret the information in order to make pedagogical decisions (e.g. van Es & Sherin, 2002 cited by Viau-Guay & Hamel, 2017; Keller-Schneider et al., 2021; Lachner et al., 2016; van Es & Sherin, 2008). This "competence" refers to the PV (Lachner et al., 2016; Keller et al., 2021).

Developed by Goodwin (1994) and applied to Teaching by van Es and Sherin (2008), teachers' PV is a complex process that encompasses two distinct but complementary sub-processes: selective attention or noticing, and knowledge-based reasoning (e.g. Seidel & Stürmer, 2014; van Es & Sherin, 2008; Vifquin & Frenay, 2018). Keller et al. (2021) define attention as the

ability of teachers to focus their attention on significant events in the classroom. They consider this skill to be essential for acting adaptively in teaching contexts. This noticing process is closely linked to reasoning, which in turn is influenced by other perceptual processes (Bromme, 1992; ~~Endsley, 1995~~; van Es & Sherin, 2002). The reasoning process, for its part, refers to teachers' ability to interpret visual information gathered when observing a teaching situation and to formulate informed judgements to guide their teaching action (Keller et al., 2021; Seidel & Stürmer, 2014). It therefore goes beyond simply noticing relevant events and involves reflection and analysis of visual information in relation to teachers' prior professional knowledge. Observation and reasoning are thus two complementary processes: the process of noticing is closely linked to reasoning, which in turn is influenced by other perceptual processes (Bromme, 1992; van Es & Sherin, 2002). Thus, the two aspects interact closely, influencing the way teachers perceive their classroom environment and make informed and flexible pedagogical decisions (Lachner et al., 2016; Putnam, 1987).

Thus, teachers' PV cannot be considered innate (Stürmer et al., 2017). Rather, it emerges in a way that is closely linked to teaching experience and the way in which this experience is organised and reorganised over time (Lachner et al., 2016). According to Lachner et al. (2016), experienced teachers have a larger and better organised store of knowledge than novices, who rely mainly on explicit and isolated knowledge. This accumulation of knowledge forms a 'higher-order knowledge structure' and gives rise to the emergence of 'curriculum scripts' that enable teachers to quickly recognize important patterns in the classroom and make informed and flexible pedagogical decisions (Putnam, 1987; Lachner et al., 2016). 'Curriculum scripts' comprise a three-step process, as summarised by Seidel & Stürmer (2014): 'noticing', 'reasoning' and 'acting'. For this reason, the PV is considered a particularly interesting indicator for describing the knowledge representations that underpin effective pedagogical action in the classroom (Sherin, 2007), which is attracting increasing interest from educational researchers (e.g. Stürmer et al., 2017; Jarodzka et al., 2021).

Finally, the PV is recognised not only as an individual process, but also as a social activity that values certain practices of perception and interpretation (Lefstein & Snell, 2011). This dynamic is a feature of the professional community of teachers, brought about particularly through training (Wyss et al., 2021). Belonging to this community would therefore influence the way in which certain phenomena are viewed and hence the PV of teachers (Vifquin & Frenay, 2018).

2.2. Eye tracking: a method for recording the professional vision

2.2.1. Benefits of eye tracking for capturing the professional vision

According to Laurent et al. (2022) the traditional means of monitoring teacher activity are limited to direct or filmed observation in the classroom, surveys based on questionnaires and participant observation, which is often used in action research projects. These methods have their limitations when it comes to characterising school events and teachers' practices in a detailed and ecological way.

At present, it is possible to use tools that record these situations in detail, annotate them automatically (Laurent et al., 2022) and define the way in which teachers see and interpret the complex interactions occurring in the classroom (Jarodzka et al., 2021). One of these means is ET, also known as oculometry (Holmqvist et al., 2011). With this technology, it is possible to determine the focus of a person's attention through the tracking of their eye movements (Wang, 2022).

Eye-tracking (ET) technologies are playing an increasing role in educational science to analyse teachers' PV (Jarodzka et al., 2017, 2021; Lai et al., 2013). They allow the automatic recording and annotation of gaze behaviour, revealing where individuals focus their attention (Laurent et al., 2022; Wang, 2022). These technologies provide a window into teachers' cognitive and decision-making processes, including how they observe and make decisions in the classroom (Burch et al., 2022; Stürmer et al., 2017). A final advantage of ET is the objective quality of the data collected (Laurent et al., 2023). By eliminating certain subjective biases that can result from traditional observation methods, this technology provides highly reliable data for studying PT interactions and teacher behaviour in the classroom (Beach & McConnel, 2019). This improvement strengthens the evidence-based education movement and enables educational stakeholders to make more informed decisions about their practice (Laurent et al., 2022; Saussez & Lessard, 2009).

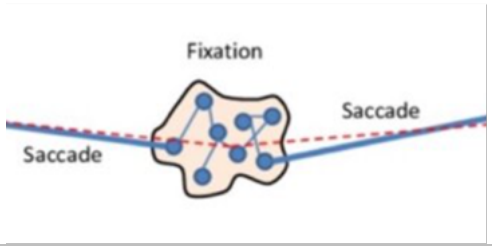
2.2.2.How does eye tracking work?

ET is a method of continuously measuring and recording eye movements as a person interacts with a stimulus in real time, with the aim of knowing what a person has seen (Wang, 2022; Halszka et al., 2017; Becker et al., 2021; Jarodzka et al., 2021) based on detecting the pupil and tracking the corneal reflection (Huang, 2018; Vincent et al., 2018). Two distinct methods are used to measure and analyse people's eye movements. On the one hand, fixed ET is based on stationary devices placed in front of the participant. On the other hand, goggle-based ET involves the use of goggles specially fitted with eye sensors that record data while the subject moves or performs tasks in an ecological environment. For the purposes of this article, we will focus on the fixed ET method.

These elements will be used to establish several indicators (Cilia et al., 2021; Ju, 2018; Loignon, 2021; Vincent et al., 2018; Guerdelli et al., 2010) the main ones of which are detailed below. Before listing them, it is worth clarifying the concept of Area of Interest (AOI)[1]. The AOI designates a specific region or a particular element, called a stimulus, in the image that arouses an individual's attention or interest. The stimulus can be a face, a group of pupils, a bench, a painting, or any other identifiable visual element in the image. The AOI are generally defined by the researcher prior to the analysis, enabling a) a structured approach to the participant's exploration of the visual presentation and b) an understanding of how the different areas of interest contribute to the overall understanding of the stimulus presented. When the stimulus determined by the researcher remains motionless on the screen, such as a fixed object like a bench, we use a fixed area of interest, or fixed AOI, which remains static. On the other hand, when a stimulus is in motion, such as a teacher moving around a classroom, we use a moving area of interest, or moving AOI. In this case, the defined area follows the stimulus as it moves, allowing more accurate analysis of visual attention as a function of stimulus movement.

A number of oculometric indicators are regularly used to assess the PV in teaching. Firstly, fixations (figure 2) are characterised by the state in which the eye is relatively still and fixed on an object of interest (Ju, 2019). During fixations, the brain focusing on areas considered subjectively informative (Huang, 2018). Fixations between 0.2 and 0.9 seconds have proved good indicators of attention (Meteier et al., 2023). Secondly, saccades (figure 2) are rapid and brief jumps between fixation points (Ju, 2019), which redirect the gaze towards a new visual target (Loignon, 2021). They are recognised as good indicators of attention, as they testify to the way in which the individual explores and processes visual information, thus providing information on the perceptual and cognitive processes involved in visual perception.

Figure 2: Example of ocular fixations and saccades

a	b
	
Caption: Ocular trajectory made up of fixations and saccades. When an individual focuses on an area of interest, the eye makes micro-movements around this region. These micro-movements are assimilated to fixations. Saccades, on the other hand, occur when attention is directed towards another area of interest. Adapted from Krueger et al. (2016) and reprinted by Rocca et al. (2023).	*Caption: Example of a sequence on an image: the numbered circles represent fixations, and the lines illustrate saccades. Adapted from iMotions (2018) and reprinted by Rocca et al. (2023).*

Thirdly, visits are indicators that combine fixations and saccades during a gaze visit to an Area of Interest (AOI) (Kim et al., 2012). Visit duration includes all fixations that occurred during a single visit to the AOI, as well as saccades that occurred between these fixations in the same AOI, until the gaze moved outside the AOI. When the participant's gaze returns to a region, particularly an area of interest, that has already been consulted, this is known as revisiting. This suggests that the individual is paying sustained and prolonged attention to this region of the visual stimulus. Fourthly, the 'first view' designates the moment when a person's gaze first lands on a specific element in a visual scene. Fifthly, a blink is considered to be a "measurement error" (Carette, 2020, p.9) which can occur as a result of the participant blinking, head movement or eye-tracker failure. When a blink occurs, the individual's gaze drifts temporarily downward, resulting in "a temporary absence of *gaze* data." (Ju, 2019, p.27). These blinking episodes can disrupt the continuity of the eye-tracker recording and limit the accuracy of the data collected.

2.1.Analysis of eye-tracking indicators

Two main analytical methods are traditionally used to explore visual behaviour. These methods apply both to still scenes, such as photographs, and to animated sequences, as in our study. The two approaches are global analysis and "chain editing" analysis (Huang, 2018, ~~p.31-32~~).

Global analysis aggregates the visual fixations of multiple participants to reveal the areas of greatest interest to the participant. According to the total duration of fixations or the number of fixations recorded (Huang, 2018), AOI can be identified in two different ways in an eye-tracking study. Firstly, they can be identified during the preparatory work. In this approach, the researcher determines in advance what the AOI will be on the basis of their research hypotheses, the literature and the aim of the study. They define the specific regions or elements of the visual environment they wish to analyse. Then, during the experiment, the researcher records eye-tracking data specifically for these predefined AOI. Secondly, AOI can be identified a posteriori. In this approach, the researcher analyses the data to identify a posteriori the areas that aroused particular visual interest in the participants. This approach allows a more open

exploration of ocular behaviour and may reveal elements that the researcher would not necessarily have thought about a priori.

On the other hand, chain editing analysis focuses on visual scanpaths relative to the AOI, based on the order of appearance of fixations and saccades relative to an AOI (Huang, 2022). This makes it possible to identify not only where people look, but also how they visually navigate a scene (Kosel et al., 2021). By analysing gaze trajectories, it is possible not only to identify the specific points at which individuals fix their gaze, but also, and more importantly, to understand the way in which they visually scan a scene, thus revealing the order and path of their observation. This can provide information about how an individual integrates and prioritises visual information, which can be particularly informative in educational or training contexts.

Although the first approach is more common (Le Meur & Baccino, 2013) there appears to be no clear consensus as to the preference of one approach over the other. Some studies (Huang, 2022) consider these approaches to be complementary, based on the following reasoning: the global method provides an initial overview of the relative arrangement of the results, while the chain editing analysis enables the specific aspects raised by the global analysis to be examined in greater depth.

2.2.3. Verbal protocols

Eye activity cannot capture teachers' internal activity and what they are reasoning about (Wyss et al., 2021). This is why a relatively common approach (e.g. Ericsson, 2018; Jarodzka et al., 2021) involves combining the analysis of eye movements with verbalisations, as only the combination of these two methods offers complementary and synergistic information, inaccessible with just one of them (Wyss et al., 2021). By combining these two methods, it is thus possible to gain a better understanding of the cognitive processes underlying educational decision-making, the points of attention favoured by teachers, and the way in which they integrate their knowledge and experience into their PV (Feldon, 2007).

In practice, verbalisations can be collected in two different ways: simultaneously or a posteriori (Roussel, 2017). In the first case, verbalisations are produced in real time while the teaching video is being viewed. This allows for immediate reactions from the teacher regarding what they observe and the thoughts that come to mind as they view the teaching scene (Roussel, 2017). This approach is dynamic and captures the teacher's instantaneous impressions of the teaching situation. In the second case, verbalisations are collected after viewing the video (Roussel, 2017). The teacher is invited to express his or her reflections and retrospective analyses of what he or she observed while viewing the video. This approach offers deeper reflection and allows the teacher to step back and retrospectively analyse the events and pedagogical decisions they may have noticed. This method can also enable teachers to highlight aspects that they would not have noticed spontaneously in real time (Roussel, 2017).

2.3.The use of fixed eye tracking in the study of the professional vision in the classroom

Exploring teachers' PV through the use of eye tracking is a rapidly expanding area of research. Indeed, while the review by Beach and McConnel (2019) identifies six studies in 2019, for our part, we count at least 28 to date from the Springer, Taylor & Francis, Open Edition, Google Scholar, CAIRN and ERIC databases and *Connected Papers* software. Of these 28 works, 13 of them make use of a fixed eye-tracker. For the purposes of this article, we will mainly focus our attention on the 13 studies that make use of fixed eye tracking (table 1)[3].

[3] This choice is based on the observation that mobile ET devices are generally used for self-confrontation of participants with their practices, in contrast to fixed ET, which is mainly oriented towards alloconfrontation. In

Table 1: Studies under review in this article

No.	Reference authors	Research object
1	Yamamoto & Imai-Matsumura (2013)	Spotting pupil misbehaviour
2	van den Bogert et al. (2014)	Distribution of visual attention of classroom events
3	Wolff et al. (2016)	Critical incident
4	van Leeuwen et al. (2017)	Measuring teachers' learning analysis strategies in computer-assisted collaborative learning
5	Goldberg et al. (2021)	Visible commitment from pupils
6	Kosel et al. (2021)	Identification of the visual scanpath patterns and relationship to the assessment of pupil characteristics relevant to learning
7	Minarikova et al. (2021)	Classroom monitoring
8	Schnitzler et al. (2020)	Pupil characteristics in terms of motivational and cognitive engagement
9	Seidel et al. (2021)	Teachers' diagnostic skills when observing pupil commitment
10	Shinoda et al. (2021)	Off-task behaviour in the classroom
11	Stahnke & Blömeke, (2021)	Event perception in classroom management
12	Wyss et al. (2021)	Critical incident
13	Kosel et al. (2023)	Pupil involvement

2.3.1. Aims of the studies in relation to classroom management and learning

The object of the work (table 1) can be distinguished in terms of the two types of interventions used by teachers to support pupil learning: learning management and classroom management (Doyle, 1980). Like two sides of the same coin (Bocquillon, 2020), these two elements make up “the teacher's double agenda” (Shulman,1986 cited by Bocquillon, 2020).

2.3.2. Learning management: meaning and examples

The teacher's management of learning involves the actions by which teachers take charge of pedagogical content (McKee & Witt, 1990) and ensure that pupils master it (Bocquillon, 2020). This includes implementing appropriate teaching strategies, assessing learner progress and adapting to learner needs and responses. Learning management also includes the teacher's strategies for compensating for a possible planning error - in this sense, a gap or oversight in relation to the original lesson plan.

According to the *Teaching and Learning International Survey* (TALIS) (Quittre et al., 2018), to which the Fédération Wallonie-Bruxelles (FW-B) contributed, teachers in the OECD area devote on average 78% of their time to managing learning, while those in the FW-B devote

addition, existing literature (e.g., Duchowski, 2017; Jardozka et al., 2021) highlights the unique challenges associated with mobile ET, particularly with respect to data processing.

70% of their time to it. This significant time allocation highlights the priority given to the active involvement of pupils in the learning process. Among FW-B teachers, more than half (54%) admit that they have difficulty motivating pupils who are not very interested in schoolwork, a rate well above the OECD average of 32%. This problem is particularly pronounced among novice teachers, 61% of whom report experiencing this difficulty.

While the notion of pupil engagement seems to be a major concern among the teachers interviewed in the TALIS survey, it appears to be of lesser concern in the research on the PV. Indeed, only two studies focus on learning management: one by van Leeuwen et al. (2016) which analyses teachers' strategies for assessing pupil learning, and one by Kosel et al. (2023) which examines visual pathways and their links to the assessment of pupil learning characteristics.

2.3.3. Classroom management, meaning and examples

Classroom management encompasses all the actions a teacher takes to manage his or her classroom, create a climate conducive to learning and set standards of behaviour (Bocquillon, 2020), including creating a safe and stimulating environment, monitoring interactions between pupils and setting expectations in terms of discipline and engagement. Most research is based on the analysis of video clips selected to focus on classroom incidents or the behaviour of target pupils. Target pupils are those who behave differently from their peers or from what is expected of them (Schnitzler et al., 2020). This may include pupils with specific behavioural challenges that require attention or an adapted pedagogical approach from the teacher. It can also involve, as in the present study or those of Seidel et al. (2021), Van den Bogert et al. (2014) or Wolff et al. (2016), pupils' engagement in the lesson.

The interest in the PV in relation to classroom management is explained by the close link between effective teaching and competent classroom management (Rosenshine & Roberts, 1986). Moreover, classroom management is a particularly significant challenge for less experienced teachers (Dicke et al., 2015; Nault & Fijalkow, 1999). According to TALIS, only a third of teachers feel they have received adequate training in classroom management. In FW-B, 35% of beginning teachers experience difficulties in this area, a figure which is significantly higher than the OECD average of 15% (Quittre et al., 2018).

A larger amount of research has been conducted on classroom management (n=11). Five of these studies focus specifically on pupil engagement (e.g. Goldberg et al., 2021; Schnitzler et al., 2021; Seidel et al., 2021), in particular their calling behaviour (e.g. Kosel et al., 2023) or the behaviour of particular pupils, the so-called on and off-task behaviour in class (e.g. Shinoda et al., 2021). In the latter case, as in the following research, the term “target pupils” is used. “Target pupils” are pupils who behave differently from their peers or from what is expected of them. For example, Wolff et al. (2016) or Wyss et al. (2021) focus on how teachers identify and respond to problematic behaviour or significant events that may occur in the classroom. This line of research aligns with that of Yamamoto & Imai-Matsumura (2013), who are specifically interested in how teachers identify pupil misbehaviour.

2.3.4. Results of the professional vision studies: University Supervisor Trainers vs. Pre-Service Teachers.

The assessment of the professional vision through fixed ET has not been applied equally to the study of UST and PT. Despite the growing interest in the PV through the lens of expertise

(Cortina et al., 2015), UST remain less studied than PT or teachers qualified as experts, as shown in Table 2.

Table 2: Double-entry table: distribution of participant groups in the studies included in the review (symbolised by a cross)

	University Supervisor Trainer	Expert Teacher	Novice Teacher	Pre-service Teacher
1		X		
2		X		X
3		X		X
4			X	
5				X
6		X	X	
7		X		
8				X
9		X	X	
10		X		X
11		X	X	
12	X			
13				X

Legend: The level of experience of the participants (all school levels combined) refers to Huberman's model (1989). The category of pre-service teachers' (PT) includes studies of teachers in training. By 'novice teachers' we mean teachers with up to three years' experience. Experienced teachers are those with at least four years' experience. Finally, the category of University Supervisor Trainer (UST) includes supervisors involved in initial teacher training at the University.

- *Focus on university supervisor trainers*

UST play a key role in the training of PT at university level. By combining the functions of trainer and researcher, UST bring considerable expertise in the field of education, enriching their pedagogy and contributing significantly to the development of training programmes. This combination of skills provides them with the specific knowledge, skills and attitudes required for their profession (Ping et al., 2018). The practice of UST has its own specificities, which are sometimes still considered opaque by some authors (Awaya et al., 2003; Bourke et al., 2018; Hadar & Brody, 2018; Paris & Gespass, 2001) or are often taken for granted without much thought to describing, contextualising and analysing them (Zeichner, 2005). The professional activities of teacher trainers are varied and go beyond teaching itself (Zeichner, 2005). They include developing the pedagogical skills of PT. In addition, UST collaborate and co-create pedagogical activities with trainees and supervisors. Cohen et al. (2013) complement this view by indicating that, in practical teacher education, a trainer's main tasks are the observation of PT and the provision of constructive feedback during their practical training.

In terms of UST results, Wyss et al. (2021) appear to be the first to study their PV using ET[4] . Their exploratory study looked at how UST (n=28; 18 women and 10 men with between 3.5

[4] A second study of trainers was conducted by Kaminskienė et al. (2023). However, it is important to note that this study used an eye-tracking device using glasses, which led to its non-inclusion in this article.

and 45 years' work experience) and PT (n= 28; 19 women, 9 men; experience unspecified) detected and interpreted critical incidents in the classroom, using both ET and verbal reports. The results (table 3) suggest that experienced UST have an increased ability to identify critical elements in a complex pedagogical situation, which is reflected in their viewing behaviour and verbalisations. The pre-service teachers, although they watched the same video, did not show the same selective attention to the critical incident and did not verbalise as many details.

Table 3: Full results of the study by Wyss et al. (2021)

Category	Observations by Wyss et al. (2021)
UST vs PT viewing behaviour	The UST showed significantly different viewing behaviour to the pupil teachers. They showed more fixations and a longer total fixation time on the key character in the video.
Critical incident response	Analysis of the verbalisations revealed that the UST were more likely to identify and verbalise "critical incidents" in the video. This is in line with expectations and highlights their previous professional experience and increased professional knowledge.
Importance of experience	The UST, because of their experience, were able to identify the relevant events in the video more accurately, whereas the pupil teachers did not identify these critical incidents as precisely.
Selective attention	Six UST demonstrated a selective focus on the critical incident, neglecting irrelevant elements while maintaining an overall view of other classroom activities.

- *Focus on pre-service teachers*

Pre-service teachers are in the process of acquiring and developing teaching skills, seeking to integrate educational theories and classroom practice. They are learners, often engaged in processes of reflection and adaptation to improve their teaching. They differ from novice teachers, who are new to the profession, and expert teachers, who not only have more knowledge, but also a more elaborate and coherent organisation of this knowledge, adapted to the situations they encounter (Lachner et al., 2016).

In terms of previous work (table 2), three studies are listed that were based on designs that compared the outcomes of PT with those of expert teachers. Expert teachers (n = 8) were studied alone (n = 2) or in combination with novice teachers (n = 3) and PT (n = 3).The results of these studies highlight systematic differences between experienced and less experienced teachers in terms of the PV. For example, six studies (e.g. van den Bogert et al., 2014; Wolff et al., 2016; and Yamamoto & Imai-Matsumura, 2013) report that compared to expert teachers, PT may have difficulty allocating their attention optimally, sometimes concentrating on less relevant elements. This tendency may have implications for their ability to manage classroom dynamics effectively. In contrast, Shinoda et al. (2021) found that expert teachers focus more on pupils engaging in off-task behaviours in the classroom, and do so with greater frequency than pre-service teachers. This study highlights a marked differentiation in the way in which experienced teachers and teachers in training perceive and respond to disruptive pupil behaviour. Finally, van den Bogert et al. (2014) highlighted the difficulties faced by PT in identifying critical incidents in the classroom compared with experienced teachers. Expert teachers focus their attention more on relevant information in the classroom, enabling them to allocate their attention effectively to the demands of supporting teaching and learning processes (Kosel et al.,

2023; Stürmer et al., 2017). Expert teachers also monitor pupils more regularly, whereas PT show greater variability in the frequency and duration of their eye movements (Wolff et al., 2016; Stürmer et al., 2017; Kosel et al., 2023; Yamamoto & Imai-Matsumura, 2013). In addition, expert teachers are able to process visual information more quickly than teachers in training (Van den Bogert et al., 2013; Wolff et al., 2016; Kosel et al., 2023). They also focus more often than PT on information relating to classroom management, indicating greater sensitivity to this essential aspect of teaching (Van den Bogert et al., 2014; Wolff et al., 2016). Finally, Yamamoto & Imai-Matsumura's (2013) study suggests that expert teachers' fixation time is more individual compared to PT and is aimed at identifying aspects relevant to learning processes in pupils.

2.3.5. Key points from the studies reviewed

The studies on the PV using fixed ET are uneven in terms of aims and population studied. Most of them focus only on classroom management, to the detriment of learning management or the two concepts, which are nevertheless reported as complementary. In almost half of the cases, the teachers whose PV was studied were experts whose results were often compared with those of PT or novice teachers. The studies found that the visual strategies used by inexperienced and experienced teachers differed. This suggests that, with experience, teachers are able to pick up relevant visual cues from video recordings of authentic lessons (e.g. Van den Bogert et al., 2014; Wolff et al., 2016; Yamamoto & Imai-Matsumura, 2013; Wyss et al., 2021) and interpret them appropriately (e.g. Wolff et al., 2015, 2016; Wyss et al., 2021). Therefore, Stürmer et al. (2017) and van den Bogert et al. (2014) suggest that it is important for PT to develop the ability to allocate attention efficiently and process relevant visual information quickly. Furthermore, research on the PV of UST is scarce and still exploratory in nature. Where it exists, it also points to differences between the ways in which UST and PT observe and reason about instructional situations.

3. Methodology

3.1. Hypothesis, research questions and method of analysis

Considering key points, the present study deliberately focused on UST and PT. Following Wyss et al. (2021), the aim of the present study was to investigate differences between the PV of UST and PT using ET in a laboratory context by viewing a video sequence. UST are recognised as experts in teaching, given their dual skills stemming from both their substantial experience in the field of education and their active involvement in research. This unique expertise gives them an in-depth perspective and nuanced understanding of educational practice. In this regard, the hypotheses of this study treat UST as expert teachers. Three research questions were formulated.

- Research question 1:

1.1 What are the specific elements that UST and PT focus on in relation to the actors in the video?

Considering that attention is more restricted in PT, we expect UST to observe a larger number of elements, including the on-screen trainee and groups of pupils, compared to PT (Yamamoto & Imai-Matsumura, 2013; Cortina et al., 2015; Stürmer et al., 2017; van den Bogert et al., 2014). To do this, several fixed zones were identified on the groups of pupils and a mobile AOI on the trainee (see 3.3.)

1.2. Do the UST pay more attention than the PT to pupils exhibiting off-task behaviour, with the PT being more interested in pupils participating positively in the lesson and in what the teacher is doing in the video?

Considering that UST focus on information relevant to classroom management while PT pay more attention to the conduct of the lesson through pupils who participate or are positive about the lesson (Pupil 2) (Stürmer et al., 2017; Cortina et al., 2015; Wolff et al., 2016), we expect UST to pay more attention to off-task pupils who might disrupt the smooth running of the sequence (Student 1, Pupil 3, Pupil 4). To this end, moving zones were created on the trainee and several target pupils (named E1, E2, E3 and E4). Zones E1, E3 and E4 correspond to off-task pupils, while E2 corresponds to a hyper-participatory pupil (see 3.3.).

1.3. What are the visual strategies employed by UST and PT with respect to the target pupil (named E1, E2, E3 and E4) in the video?

If UST indeed process visual information faster than PT (van den Bogert et al., 2014), we expect that UST eye scanning capabilities are more dynamic than those of PT. To this end, fixed and moving AOI are used to identify target pupils and their actions (see 3.3.).

- Research question 2:

2.1. When the trainee makes a planning error, what happens to the visual itinerary of the UST? The planning error involves forgetting to form the same groups of pupils as in a previous lesson in order to complete the activity, which causes an interruption in the instructions for the activity during the time needed to re-form the groups (see figure 4).

Considering that the UST regularly monitor the class (Stürmer et al., 2017; Wolff et al., 2016), we expect the UST to scan the class visually, focusing in particular on the target pupils (named E1, E2, E3 and E4) during the planning error. To address this, the screen is divided into 9 areas of similar size (see 3.3).

3.2. Presentation of the experimental medium

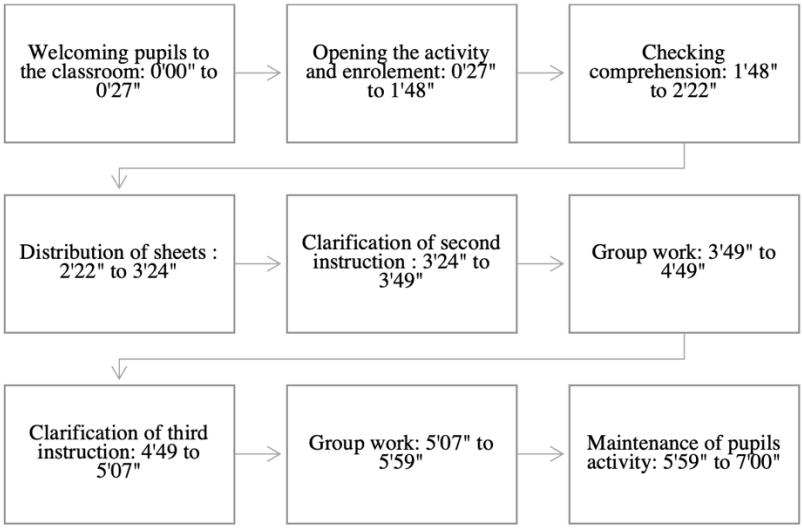
Although the extracts viewed on an ET are generally of short duration, we believe that a longer extract offers a more faithful representation of the complexity of the teaching environment and the interactions between the teacher, the pupils and the school environment (Jardozka et al., 2021). For this reason, we chose a 7-minute video extract representing an authentic geography teaching scene filmed in a class of 10-year-old pupils (elementary school). The sequence is filmed in a single shot without moving the camera (figure 3).

Figure 3: Composition of the class in the video extract.

Legend: I) trainee giving the lesson, E1) pupil throwing a paper ball; E2) very involved pupil; E3) off-task pupil; E4) pupil making a late arrival.

We opted for the presentation at the beginning of the lesson because, in accordance with the observations of Peretti & Muller (2013), the beginning of a lesson sets the "tone" for the whole session. This phase also involves many classroom management processes (Bourbao, 2010) that are independent of any subject. This allows us to explore essential aspects of teaching practice that go beyond the simple transmission of knowledge and therefore encompass a series of professional gestures (Bocquillon, 2020). In fact, with reference to Bourbao's (2010) categorisation, each of these moments in the lesson can be clearly defined with specific time intervals (figure 4).

Figure 4: Course sequence based on Bourbao's categorisation (2010)



The composition of the class (figure 3) is as follows: the trainee (I) is on the platform, while the pupils are divided into several working groups. A large group of 10 pupils is positioned to the left of the screen. Two groups of 4 pupils are in the centre of the video. A few pupils also appear on the right-hand side of the screen until they are put together for group work (at 3'49"), when

they all leave the frame. Among the pupils in the 4 groups who are still on the screen, some stand out before the work begins (at 3'49"; figure 4) and are identified: pupil E1 can be both involved in the task and sometimes off-task, as when he throws a paper ball[5], pupil E2 actively participates in answering questions and gives a demonstration next to the trainee on the platform, pupil E3 is off-task (she is drawing a dragon), and pupil E4 arrives late. Each of these events is characterised by its particular dynamic and a specific duration during which it can be observed in the observation window (table 4).

Table 4: Observation window for events in the video

Event	*Start of event*	*End of event*	*Observation window duration interval*
E1 action	0'35"	0'38"	0'3"
E2 action	0'40"	1'56"27"'	1'16"
E3 action	0	2'54"45"'	2'54"
E4 action	0'26"	0'50"	0'24"

3.3. Data collection method

Research questions require a holistic approach (Huang, 2018; see 2.2.). To this end, we superimposed several levels of fixed and mobile AOI. The AOI were identified on the basis of preparatory work by 3 independent coders. In order to determine the visually distinct and salient events in the video, these three coders 1) viewed the video without sound, 2) viewed the video with sound, 3) viewed the video with a mask revealing only one part of the screen at a time. Based on the elements observed, each coder created a timeline in which they targeted events considered important (for example, the target pupils). The comparison of these events (intercoder fidelity of 84.34%[6]; Cohen's Kappa coefficient of 0.71) was used to determine the AOI, which we describe in detail below.

More specifically, we first subdivided the screen into 36 fixed AOI of equivalent size, which were then grouped into 9 AOI of similar size (level 1) (see figure 6). These nine AOI are used to answer the second research question concerning the trainee's planning error. During the period when this error is displayed on the screen, each zone is identified as follows: zone 5 encompasses the teacher's position, with a partial extension into the lower part of zone 2. The other zones are dedicated to the environment in the video (zones 1, 2 and 3) and the pupils (zones 4, 6, 7, 8 and 9).

Secondly, we established several fixed AOI on the groups of pupils (left group, middle group, front group) and the environment (left board, middle board, poster, door, etc.) (level 2). Because of its dynamic nature, a mobile AOI was defined throughout the video for the trainee.

[5] In this article, it should be noted that pupil E1 is likely to display a variety of disruptive behaviours. Each of these behaviours has been catalogued and designated as a 'Target of Interest' (TOI), i.e. a specific point of interest for observation and analysis. Among these TOI, the paper ball was identified as the shortest behaviour in terms of duration, as shown in Table 4.

[6] The percentage of agreement was determined using the following formula: number of agreements / (number of agreements + number of disagreements) x 100 (Jansen et al., 2003 cited by Bocquillon, 2020). We have established a threshold of 80% as the satisfaction criterion, in accordance with Miles & Huberman (2003)

Thirdly, moving AOI were defined for the target pupils (E1, E2, E3 and E4) in order to capture their movements (for example, when they get up and leave their seats) (level 3). This was particularly necessary for E2 when he stood up and climbed onto the platform (6-second movement) and then returned to his seat (7-second movement) and E4 when she walked to her seat (3-second movement). Apart from these moments, the size of the AOI was relatively similar (we framed the upper body and head of each pupil).

In order to compare the visual strategies of the PT and UST in our sample on these target pupils, we carried out an equality of means analysis (T-Test). Specifically, 12 equality of means analyses were carried out, taking into account, for each group (UST / PT), the moving AOI of the target pupils (E1, E2, E3, E4) throughout the video and three oculometric indicators: time to first view (in seconds), fixation time (in seconds) and number of (re)visits (occurrence). Here we have considered the moving AOI on the target pupils to be identical despite the movements of E2 and E4, considering that this bias may have affected all the participants in the same way and that the time when E2 and E3 are moving remains relative to the whole of the sequence. Statistical tests were carried out using JASP software, maintaining a significance level of 5%.

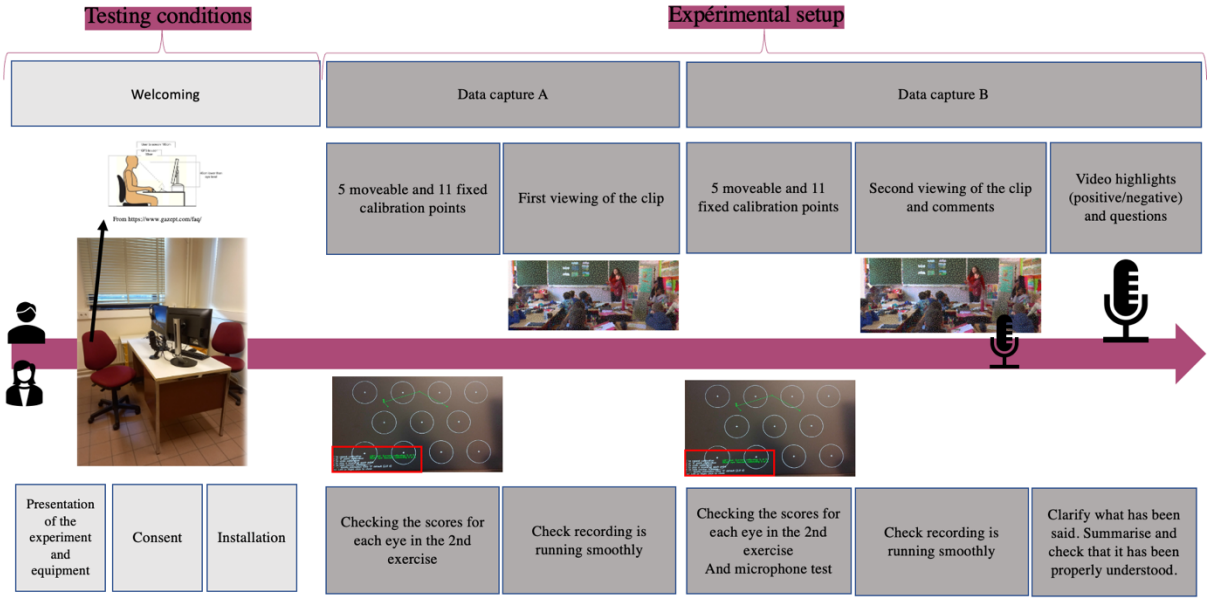
3.4. Description of the equipment and the eye-tracker

To ensure that the research is both affordable and reliable (Wang, 2022), we opted for an eye-tracker with a maximum sampling frequency of 120Hz. The device chosen was the GazePoint GP3HD, renowned for its accuracy and reliability in measuring gaze, fixations and saccades, while minimising data loss (Bai et al., 2022; Cuve et al., 2022). We used the Gazepoint Analysis Professional software, version 4.1.0, to analyse the ET data. This software offers various functionalities, including fixation trajectories to study eye movements and the definition of AOI to analyse specific regions of the screen.

3.5. Stages of the experiment

The experiment took place in a controlled environment specially designed for the research (figure 5) where participant and researcher faced each other, separated by the eye-tracking equipment. After calibrating their gaze, the UST and PT first watched the video extract in silence (viewing A). During the second viewing (viewing B), they were encouraged to comment on the video by verbalising their thoughts, with the aim of minimising periods of silence, in accordance with Roussel's (2017) 'simultaneous think-aloud protocols'. These verbal comments were recorded simultaneously with the participants' eye movements. For the purposes of this article, we will focus solely on the eye-tracking data collected from this second viewing. Between the two viewings, the participants are allocated a decompression period. During this break, the researcher checks that everything is running smoothly, reiterates the instructions for viewing B, checks the proper functioning of the microphone in collaboration with the participant before recalibrating the participant's view. Finally, each participant and the person conducting the experiment share the most salient observations from the video. The purpose of this phase is to validate the participants' statements, while allowing them to correct or confirm their comments (Mouchet, 2014 cited by Roussel, 2017). The researcher's role is limited to clarifying the elements at this stage of the experiment.

Figure 5: Experimental condition and data collection stages according to the participant (above the arrow) or the researcher (below the arrow).



3.6. Compliance with ethical standards

Our research was designed to comply with the ethical guidelines of the General Data Protection Regulation (GDPR; Art. 89.1), as well as the guidelines of the European Data Protection Board (EDPB). This compliance extended to all stages of the research, from the initial collection of visual data to its subsequent analysis. In the case of classroom videotaping, informed consent was obtained from all videotaped participants. In the case of minors, consent was obtained through forms signed by their parents or legal guardians. Special arrangements were made to ensure that children whose parents did not wish them to be filmed remained out of camera range. For the eye-tracking analysis phase, each participant was informed of the complete confidentiality of the filmed content. The data processing protocols were designed to ensure complete anonymity of individuals, both in the images and in the words recorded. Prior to each experimental session, detailed informed consent was obtained, outlining participants' rights regarding data confidentiality, anonymised use of data, and image rights**.**

3.7. Description of the sample and conditions of participation

The study included two types of participants, 6 UST involved in teacher training (Agrégation de l'Enseignement Supérieur (AESS) - Upper Secondary Education Teaching Certification) (group 1) and 16 PT enrolled in the AESS program during the academic year 2022-2023 (group 2).

Group 1 consists of six UST; five women and one man. Each of them met two acceptance criteria, i.e. having been a UST for at least two years and having been a teacher for at least three years (all levels combined) since, according to Huberman (1988) teachers' expertise increases from the third year onwards. Their average age was 36. Four of them have a doctorate in Psychology and Education, while two have a Master's degree in Education. Their teaching experience ranged from 8 to 26 years, with an average of 16 years. With regard to their specific experience as AESS UST, the UST had between 2 and 16 years of experience, with an average of 8 years, as UST. Participation in video feedback activities was reported by 5 out of 6 of the UST.

Group 2 consists of sixteen PT. Their selection is based on criteria that ensure their active involvement in AESS training, in particular their enrolment in the 'Planning, management and

analysis of teaching practices' course. On this basis, sixteen PT were selected. Their ages ranged from 22 to 54, with an average of 29. The PT came from the Warocqué Faculty of Economics and Management (n=10), the Faculty of Psychology and Educational Sciences (n=4) and the Faculty of Architecture (n=2) at the University of Mons. Generally speaking, their teaching experience was limited: 10 PT had never taught, and 5 PT had taught for less than 6 months. Only one PT (PT_15) had taught for 204 months.

4. Results

This article focuses on the oculometric data collected during the second viewing session (viewing B; figure 5).

4.1. Data validation

Data quality verification in our study takes place at two key stages. Firstly, during the experiment itself, with real-time monitoring via the control screen. Secondly, a second check is carried out before the data is analysed. We have defined three indicators for this check.

The first is based on the work of Chaudhuri et al. (2022) and focuses on the accuracy of the recording. Only records with error-free capture accuracy for at least 70% of their total duration are retained for analysis.

The second is the number of gaze exits and the third is the number of eye blinks during viewing A and B of the extract. This verification steps strengthened our confidence in the results, particularly for UST_5, which showed a high number of gaze exits compared with the average scores for the UST group, both on the first viewing (+3.8 times the average for the other UST) and on the second viewing (+2.6 times the average for the other UST). In this respect, we carried out two checks which enabled us to retain UST_5 in this study. Firstly, we validated the presence and completeness of the eye-tracking data for UST_5 in terms of the number of blinks. Secondly, we observed that the scores for UST_5 remained within a range of average scores for the other UST, with a maximum variation of two standard deviations from the general distribution.

4.2. Research question 1: type of actors observed

4.2.1 What are the specific points on which the University Supervisor Trainer and pre-service teacher gazes focus with regard to the actors in the video?

For this question, we identified an AOI on the trainee and on each group of pupils who remain in the image (level 2). In order to ascertain which AOI is looked at by the participants and for how long (Ju, 2019), the fixation indicator was used. Table 5 provides data on AOI fixation time, expressed as a percentage of fixation frequency (total AOI time was reset to 100% per participant).

Table 5: Average fixation time as a percentage per fixed AOI

AOI		Fixation time in percent (%)			
	Trainee	Group of pupils to the left (front)	Group of pupils to the left (background)	Group of pupils in the centre	Group of pupils in the foreground

Average for UST	33.9	27.9	2.5	17.9	17.8
Average for PT	39	27.1	1.7	16.9	15.3
Overall average	36.5	27.5	2.1	17.4	16.6
Standard deviation UST	6.1	4.3	0.4	8.3	2
Standard deviation PT	6.3	5.6	0.7	5.2	3
Overall standard deviation	6.2	4.95	0.55	6.75	2.5

Overall, both groups focused twice as much on the pupils (63.5%) as on the trainee (36.5%). This may be explained by the fact that there is a larger area on the screen dedicated to the pupils than to the trainee. The UST paid slightly less attention to the trainee (33.9%) than the PT (39.0%) while both paid similar attention to the pupils (UST= 26.4%; PT=26.0%). When we analyse the scores for each group of pupils, we find that attention was distributed in a similar way between UST and PT, with a greater interest in group 1 (m=27.5). The interest in group 1 can be explained a) by the fact that it includes pupil E2, who is very active, and b) because the group on this side of the class is the largest. The group of pupils on the left at the back received fewer views, with average scores ranging from 2.5% for UST to 1.7%. This result can be attributed to the fact that some of the pupils in this group are less visible, given the angle of view chosen by the camera filming the classroom scene.

On the basis of these scores, we could assume that there would be no significant differences in terms of mean and dispersion between the two groups of subjects, whatever the area of observation.

4.2.2. Do University Supervisor Trainers pay more attention to off-task pupils than the pre-service teachers, who are interested in pupils who participate positively in the lesson?

To assess the differences in eye fixation strategies between UST and PT with respect to the target pupils (E1, E2, E3 and E4), a statistical approach based on tests of equivalence of means was employed. This analysis divided the participants into two distinct groups: group 1 comprising the UST and group 2 comprising the PT. Three types of indicators, namely the scores for first viewing, fixation and (re)visiting fixed and/or moving areas of interest (AOI) linked to the target pupils, were subjected to tests of equivalence of means for each group (table 6).

Table 6: Descriptive statistics for scenes involving the target pupils for the 2 groups of participants

	Descriptive statistics					
	Group	**N**	**Mean**	**SD**	**SE**	**Coef. Var.**
E1 1st view	1	5	363.196	4.222	1.888	0.012
	2	12	336.119	87.010	25.118	0.259
E1 fixation	1	5	0.734	0.447	0.200	0.609

	2	12	1.473	2.502	0.722	1.698
E1 revisits	1	5	25.038	3.479	1.556	0.139
	2	12	6.823	6.362	1.837	0.932
E2 1st view	1	6	33.525	21.092	8.611	0.629
	2	16	24.346	11.966	2.991	0.491
E2 fixation	1	6	19.298	12.248	5.000	0.635
	2	16	24.081	5.550	1.387	0.230
E2 revisits	1	6	39.167	19.954	8.146	0.509
	2	16	32.398	7.246	1.811	0.224
E3 1st view	1	6	26.235	18.974	7.746	0.723
	2	16	54.501	22.892	5.723	0.420
E3 fixation	1	6	6.475	3.346	1.366	0.517
	2	16	5.854	3.956	0.989	0.676
E3 revisits	1	6	14.987	8.542	3.487	0.570
	2	16	6.688	6.750	1.688	1.009
E4 1st view	1	6	25.590	13.278	5.421	0.519
	2	16	24.348	12.338	3.085	0.507
E4 fixation	1	6	6.668	5.622	2.295	0.843
	2	16	9.029	9.226	2.306	1.022
E4 revisits	1	6	12.875	12.822	5.234	0.996
	2	16	6.008	6.027	1.507	1.003

For the scene involving pupil 1 throwing a ball of paper, the results show that the UST locate pupil E1 more quickly (m=336.119 sec.) than the PT (m=363.196 sec.) (Df=15; t= 0.682; p=0.505) and that they stared at the zone for less time than the PT (Df=20; t=-1.283; p=0.214), but returned to it more often than the PT (Df=20; t=1.2; p=0.244). It should be noted that only UST_5 was able to spot pupil E1 throwing a ball of paper. This finding is all the more interesting given that UST_5 had the highest individual eye-scan speed scores among the University Supervisor Trainers (29 m/s), thus exceeding the average for the group of UST (average of 26.4 m/s). These frequent gaze exits could therefore reflect a rapid and dynamic scanning of the visual scene, which could explain their ability to quickly detect the incident involving pupil E1.

In the scene involving the hyper-participatory pupil E2, the average results suggest that not only was he spotted more quickly by the PT (m=24.346) than by the UST (m=33.525seconds) (Df=20; t= 1.297; p=0.209), but that the PT maintained their gaze on this pupil 1.3 times longer (m= 24.081) than the UST (m=19.298) (Df=20; t=1.283; p=0.214). On the other hand, the UST

revisited the E2 zone (m=39.16 revisits) more often than the PT (m=32.39) (Df=20; t=1.2; p=0.244). Thus, the UST looked at this area for less time and more frequently than the PT. Statistically, the results of the T-tests indicate significantly different visual strategies for each of the 3 indicators and in the 2 groups of participants.

As for the scene involving pupil E3 drawing a dragon, the results indicate an average detection time that is twice as fast in the UST (m= 26.235) compared with the PT (m=54.2 seconds) (Df=20; t=-2.686; p=0.014) and twice as many revisits of the area by the UST (m=14.987 revisits) compared with the PT (m=6.688 revisits) (Df=20; t=2.395; p=0.027). Fixation time remained relatively similar between the two groups (m(UST)=6.475 and m(PT)=5.854) (Df=20; t=0.4; p=0.737), suggesting that the UST observed the off-task pupil with rapid and frequent glances, whereas the PT observed the pupil with longer fixations.

For the scene involving the pupil making a late arrival (E4), the latter was detected at the same time by the PT (m= 25.59 seconds) as by the UST (m=24.34 seconds) (Df=20; t=0.206; p=0.839). On the other hand, the PT (m= 9.029) fixed their gaze on pupil E4 for slightly less time than the UST (m= 6.668) (Df=20; t=0.582; p=0.567). In terms of revisits, the UST made the most (m=12.87) revisits, in a proportion that is twice that of the PT (m=6.008) (Df=20; t=1.735; p=0.098).

To answer the question of whether UST pay more attention to off-task pupils than PT, who focus on pupils who participate positively in the lesson, we can consider the characteristics of the pupils in the different scenes.

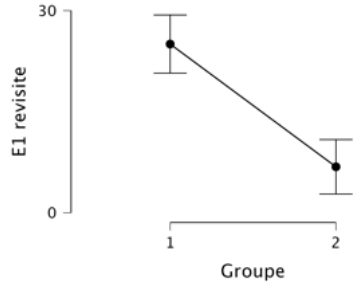
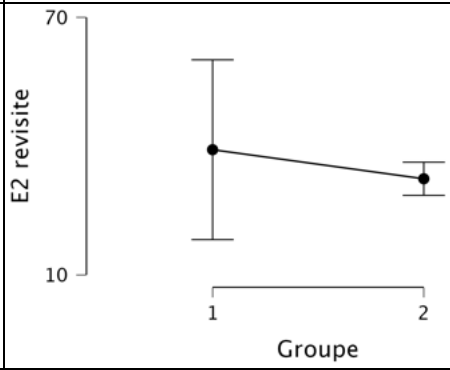
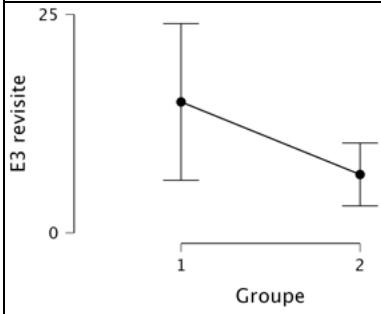
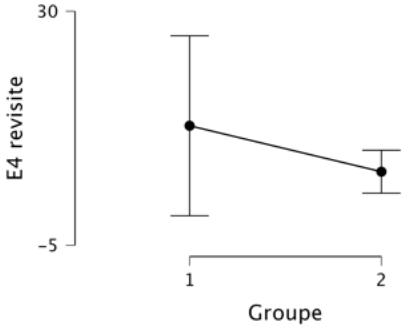
In our analysis, we identified E1, E3 and E4 as off-task pupils, while E2 is a pupil engaged in the teaching scene. The results indicate that UST tend to identify off-task pupils, particularly E1 and E3, more quickly than PT. However, they maintained their gaze on these pupils for shorter periods. On the other hand, the PT identified E2, the engaged pupil, more quickly than the UST and kept their eyes on him for a longer period of time.

These observations suggest that UST are more attentive to off-task pupils whereas PT focus their gaze on engaged pupils in particular. However, with the exception of E2, it is important to note that these differences are not always statistically significant.

4.2.3. What are the visual strategies employed by the University Supervisor Trainer and pre-service teacher with regard to the target pupils in the video?

The results of the T-tests highlight an important finding concerning the gaze strategy adopted by UST and PT. The scores reveal a significant difference between the groups of participants for each type of pupil (E1, E2, E3, E4) with regard to the frequency of revisiting (table 7). These differences were even more pronounced for the revisiting strategies in the E1 and E3 zones. More specifically, the results suggest that the UST tended to use the "glance" strategy by observing the zones more frequently but for shorter durations. In contrast, PT seem to prefer prolonged observation, i.e. they keep their gaze on the areas for a longer period of time before revisiting. This difference in visual strategy between the two groups of participants is particularly noticeable in the scenes involving pupils E1 and E3.

Table 7 : Number of visits by participant group for E1,E2,E3,E4. Error bars represent 95% confidence intervals.

Revisits in E1	Revisits in E2
t= 5.965	t= 1.2
p = <.001	p = 0.244
Df=20	Df=20
	
Revisits in E3	Revisits in E4
t= 2.395	t=1.735
p =0.027	p =0.098
Df=20	Df=20
	

4.4.3. Research question 2: Trainers' visual itineraries at the time of the planning error

The question looks at the visual itinerary of the UST when a planning error by the trainee is displayed on the screen (from 3'24" to 3'49" in the video). As a reminder, at this point in the video, zone 5 includes the teacher's position, as does the lower part of zone 2. The other zones are devoted to the video's environment (zones 1, 2 and 3) and the pupils (zones 4, 6, 7, 8 and 9). We chose to focus on exploring the visual itineraries of the UST after examining the percentage distribution of fixation and revisit time for the 9 zones (table 8).

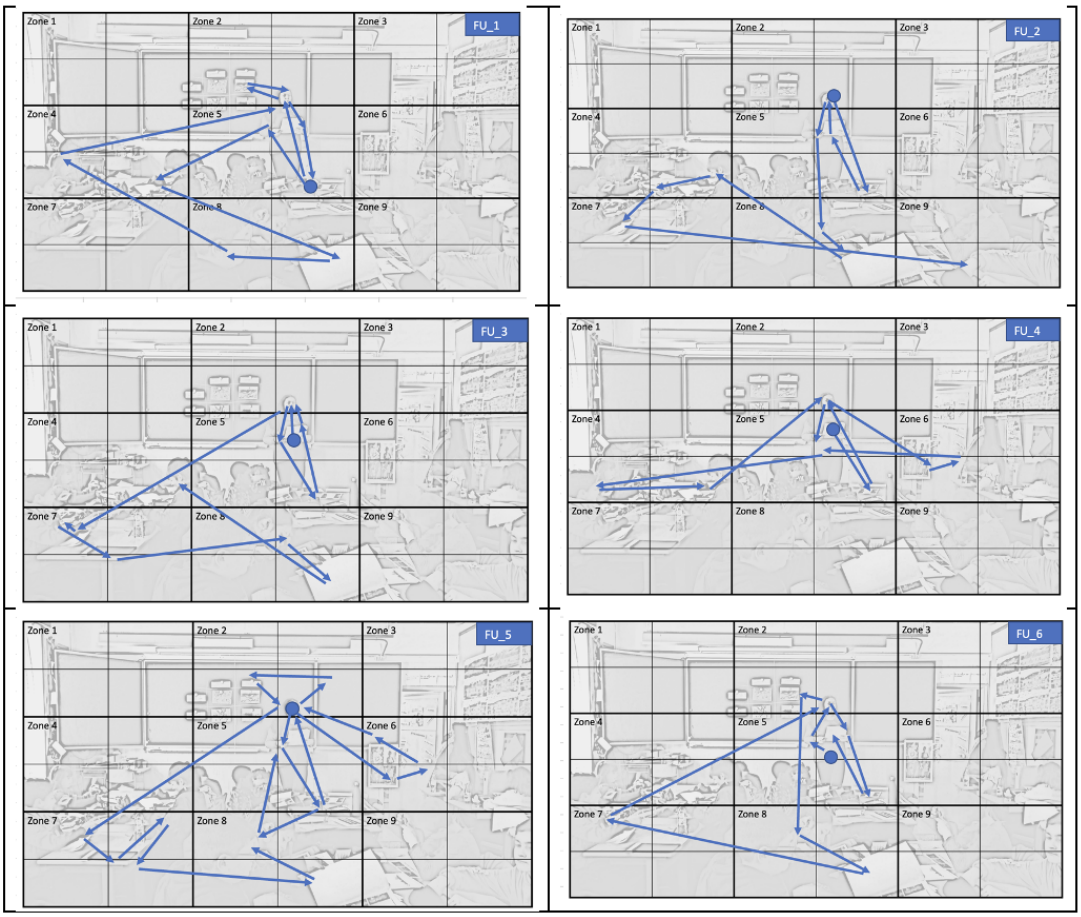
Table 8: Percentage of fixation and revisits by zone

	Fixation in %								
Zones	Z1	Z2	Z3	Z4	Z5	Z6	Z7	Z8	Z9
Average for UST	3.6	50.9	8.0	59.5	117.1	43.3	44.4	53.4	12.3
Average for PT	0.6	21.5	11.9	61.1	126.8	55.6	44.2	49.2	16.0
	Revisits in %								
Zones	Z1	Z2	Z3	Z4	Z5	Z6	Z7	Z8	Z9
Average for UT	4.3	92.2	15.5	119.0	206.0	71.3	83.7	96.7	27.3
Average for PT	0.7	59.8	21.1	98.6	179.4	99.7	76.6	59.5	41.4

The results show that UST and PT had an almost identical mean percentage of fixation on the teacher (mean = 59.5% for UST and mean = 61.1% for PT). However, the UST showed a 1.2 times higher rate of revisiting the teacher, placed in zone 5, (mean = 119) than the PT (mean = 98.6). These results suggest that, although both groups paid almost similar attention to the trainee, the UST used different visual strategies, focusing more on 'glances', unlike the PT who made longer, more focused fixations. Our aim is therefore to identify where the UST' attention is focused when their gaze is not directed towards the trainee.

To do this, we chose to explore the models of the UST using Chain Editing analysis (Huang, 2022). For greater legibility, we have manually reproduced the itineraries of the UST (figure 6). This also allows us to propose an analysis by reading direction and order of discovery following this text.

Figure 6: Reading direction and order of discovery of the elements with the longest fixations in UST. The beginning of the path is the circle.



The results highlight common gaze patterns. In the first stage, signified by the circle, the UST fix their gaze on the trainee giving instructions, with particular interest in the sheets of paper that the trainee is holding in her hand (UST_3, UST_4), the trainee's face (UST_2, UST_5) to which the gaze quickly moves towards (UST_6), as well as on the table where her belongings are located, including her lesson preparation book and materials (identifiable at the beginning of the lesson) (UST_1). This illustrates their potential preoccupation with the trainee's teaching materials. Next, we observe for 5 UST a series of successive fixations occurring between the trainee's face (UST_1), her hands, the space where she stores her belongings (UST_2, UST_3, UST_4, UST_6). This can be explained by the fact that the trainee is tilting her head or sighing. Three UST look at the sheets on the board (UST_1, UST_5, UST_6). These UST may have

turned their attention to the board for several reasons. Firstly, they may be checking whether the trainee was using visual resources or teaching aids to correct her mistake. In addition, the trainee's comment about forming the pupils into groups who had "*taken photos this morning*" may have prompted the UST to examine the illustrations on the board to better understand the context and the instructions given.

Then, when the trainee turned towards the group of pupils in zone 4, we observed a rapid eye movement by the UST in this direction, towards this zone. The movement continues most often into zone 7 where the disruptive pupil (E1) is located for 3 UST (UST_3, UST_5, UST_6). This may be a reminder of the rapid "surveillance" tactics that the UST had implemented for this pupil, perhaps in response to previous behaviour or previously established expectations. The other three UST adopted a more focused scanning strategy, concentrating either on zone 4 where the trainee directs her gaze, perhaps in order to observe clearly what is happening there, or on zone 8 (with the group in the foreground) at the moment when the off-task pupil (E2) straightens up to listen.

Beyond these similarities, divergences in the visual scanning of the UST were observed. For example, UST_4 and UST_5 directed their gaze to zone 6 towards pupil E4, showing an interest in his act of distributing sheets and the fact that he is looking for a place to put down the remaining sheets. In addition, UST_5 has a more extended scanning dynamic, suggesting a livelier visual reactivity, as we detailed in research question 1. Furthermore, UST_3 fixes his gaze clearly on pupils E1 and E3, who are known for their problematic behaviour at the beginning of the video. This focus may reveal a particular sensitivity on the part of this UST to pupils with behavioural problems within the class. It may also underline their interest and ability to identify and maintain vigilance around key elements of class dynamics. These individual variations are a reminder of the subjective aspect of visual observation and the influence of each UST's own experiences and concerns in determining their eye scan.

5. Discussion, limitations, and outlook

5.1. Discussion

This study aims to fill a gap in the current literature by focusing on the activity of UST and, more specifically, by exploring the process of video observation using ET, while comparing their strategies with those of the PT they are supervising. To do this, we analysed data obtained from eye tracker-assisted viewings by 6 AESS trainers and 16 PT in French-speaking Belgium. The 7-minute video extract shows the start of a lesson given by a trainee teacher. At the same time, each UST and PT was invited to comment on the video in real time and to explain the elements they considered significant. Before analysing the data, precautions were taken to ensure the quality and reliability of the results. Factors such as the number of gaze exits and the blink rate were examined and taken into account when interpreting the conclusions drawn from this study.

Taking into account recent advances in the literature, three research questions were defined, relating to the object (a) and observation strategies (b), taking into account the four pupil profiles, as well as the visual pathways during the on-screen presentation of a planning error by the trainee (c).

In doing so, the first sub-question questions the actors observed by the participants. In our sample, there do not seem to be any significant differences in terms of mean and dispersion

between the two groups of subjects, whatever the area of observation. This tends to run counter to previous work (e.g. McIntyre & Foulsham, 2018; Cortina et al., 2015 and Wolff et al., 2016) which indicated that expert teachers focus more on pupils compared to pre-service teachers.

The second sub-question looked at the detection of specific pupil behaviours through 4 target pupils representing pupils who are inattentive (E1), hyper-participatory (E2), drawing (E3) and late (E4). The results showed that in our sample, as in Shinoda et al. (2021) and Wolff et al. (2016), UST tended to identify all these pupils more quickly and particularly pupil E3, who was identified twice as quickly as in PT. In contrast, the PT mainly focused on the actively participating pupil, thus adopting a distinct perspective in their observation compared to the UST group. These differences were determined on the basis of three indicators examined by means testing, namely first sight (faster for UST than for PT), fixation duration (longer for PT than for UST) and revisits (more for UST than for PT). The revisit indicator stood out and the differences were significantly confirmed.

In PT, fixations tended to be of longer duration, accompanied by fewer revisits. The diversity of visual approaches between the groups reflects distinct methods of visual classroom analysis. The UST focus on pupils with disruptive behaviours, suggesting proactive management of classroom dynamics and the ability to quickly detect situations requiring intervention (Wolff et al., 2016; 2017). The use of glancing strategies may have the function of optimising monitoring while maintaining an overview. For their part, PT focus on the hyper-participatory pupil (E2), demonstrating their concern for commitment to learning, as already highlighted by some authors (e.g. Goldberg et al., 2021; Lipowsky et al., 2007; Livingston & Borko,1989; Cortina et al., 2015; Wolff et al., 2016). It is interesting to note that in the whole sample, only UST_5 was able to visually identify one of the shortest behavioural deviations of E1 - throwing a paper ball. However, UST_5 displayed the highest individual eye scan speed scores among the UST (29 m/s), exceeding the group average (average of 26.4 m/s). These frequent visual movements may suggest a rapid and dynamic scanning of the visual scene, potentially at the origin of their ability to quickly detect the incident involving pupil E1.

The third sub-question focuses on strategies for rapid identification, fixation and revisiting on the AOI dedicated to the target pupils (E1, E2, E3 and E4). Comparative analysis of the results reveals significant differences between UST and PT, particularly with regard to revisiting strategies. In practice, the UST tended to systematically adopt "glance" strategies for all the target pupils, in particular for the disruptive pupil (E1) ($t=5,965$; $p=<.001$) and the off-task pupil (E3) ($t=2,395$; $p=0,025$), which was not the case among the PT.

For the second research question, we examine how participants focused their gaze when a planning error by the trainee is present on the screen. UST and PT showed similar interest in the trainee, but UST made more revisits towards them. This suggests, again, that UST use "glances", whereas PT focus on longer fixations. The specific analysis of the UST' gaze itineraries also reflected common elements (itinerary centred on the trainee, her personal teaching tools and where she gazed), but also divergent elements (e.g. checking pupils who had shown disruptive behaviour at the beginning of the lesson).

In summary, our analyses converge with Wyss et al.'s (2021) exploratory study in suggesting that UST adopt visual strategies distinct from those of pre-service teachers, thus aligning their approaches with those of expert teachers in other studies using ET. Within these strategies, we highlight two important points: a) the emergence of dynamic and floating visual strategies among UST, characterised by more frequent revisits and shorter duration fixations; and b) the

divergence in the observation of highly active pupils in the classroom between UST and PT. In addition, our research highlights the importance of classroom management for UST as regards pupils who are not engaged in the task. These elements remind us of the crucial importance of eye scanning in the classroom, an effective professional teaching gesture that is widely recognised (e.g. Bissonnette et al., 2020) and essential for successful classroom management. This concept, first defined by Kounin (1970) as 'with-it-ness', involves active visual scanning to ensure adequate attention and support for all students, particularly those less involved. This ability to proactively monitor and respond to classroom behaviour distinguishes experienced teachers (Grub et al., 2022). As experts, UST play a fundamental role in the development and transmission of this skill to PT, highlighting its importance in the repertoire of professional teaching gestures.

5.2. Limitations and outlook

The study has certain limitations. Firstly, although the majority of the results appear to be consistent with previous work, we have few direct comparisons with other UST. This limits our ability to fully assess the specificity of visual strategies in UST compared with other UST populations. Moreover, beyond its physiological aspect, the act of seeing and noticing is a dynamic process involving the creation and transmission of meaning in coherence with the communities of practice within which the PT evolves (Wyss et al., 2021). All the UST in our sample are affiliated to the same academic institution. It is therefore possible that their interests, such as classroom management, are linked to the broader concerns of this institution.

In addition, the analyses were unable to explain certain results in relation to the participants' teaching experience. Although they were tested, the experience variable did not seem to influence visual behaviour as such for either the more experienced PT (e.g. PT_15) or the UST (e.g. UST_2). It would therefore be interesting to supplement these results with a qualitative analysis of the comments made during viewing and a multi-case approach to certain results, including those of UST_6. Similarly, our analyses were not able to differentiate the results according to the training stream of the PT. This limitation may be due to an imbalance in the distribution of the sample across these different streams. This difficulty in differentiating the results may also reflect the fact that the teaching practices remain unknown to the PT, which may indicate a limited familiarity with the specific teaching practices or teaching methodologies within each of the training streams, as already pointed out by Bocquillon (2020).

To conclude, as in the study by Wyss et al. (2021), our study focused on a limited number of UST, which limits the general scope of the conclusions. To improve the understanding of the variability of visual strategies of UST, we suggest collecting more data from a larger and more diverse sample of UST including training supervisors. We also recommend broadening the selection of videos by including a variety of teaching situations of different levels of complexity. In addition, a multidimensional approach, as advocated by Gegenfurtner et al. (2011, 2018, 2023), could be adopted by combining ET with qualitative interviews, observations or neuroimaging.

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