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University teachers' focus on students: Examining the relationships between visual attention, conceptions of teaching and pedagogical training

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Abstract

Teachers' focus on their students' learning is considered central in high-quality, student-centred university teaching. This frontline eye-movement research asks whether teachers' focus can be observed at the intersection of the visual and conceptual levels. It introduces a novel way to study teachers' visual attention combined with verbal interpretations, including numerical ratings of the success of teaching when they observe teaching situations. Teachers' visual attention and interpretations were further studied in connection to their prior pedagogical training and teaching experience in years. Two short videos depicting teaching during a lecture, including different types of trigger events, were presented to teachers (N = 49) who were asked to think aloud while watching. The first video's trigger was students becoming bored during a content-focused teaching situation, and the second video's trigger was the teacher replying in an engaging way to students' questions in a learning-focused teaching situation. The results showed that pedagogically trained teachers paid more visual attention to the students than did their non-trained colleagues, especially in content-focused teaching situations. Teaching experience did not have any effect on visual attention or interpretation in this study. The teachers who paid more visual attention to the students in the content-focused teaching situation noticed in their interpretations that the students were not active, expressed higher learning-facilitating teaching conceptions and gave lower numerical ratings for the teaching situation. In conclusion, pedagogical training seems to promote university teachers' ability to pay visual attention to students in teaching situations and interpret these situations from the students' perspective, i.e. focus on student learning.

Keywords: visual attention, conceptions of teaching, university pedagogical training, facilitation of learning, eye tracking

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Introduction

To achieve better learning outcomes, university teachers are expected to focus on their students' learning to be able to support it instead of merely focusing on delivering the content to them (Prosser & Trigwell, 2014; Vilppu et al., 2019). Focusing on students' learning is often used as a synonym for good teaching that acknowledges and answers students' needs to foster learning. Learning-focused or student-centred teaching is often called for; however, it is not yet very clear what focusing on students' learning means for teaching. Focusing on students' learning can take place at many levels, starting with the curriculum and building the environment and courses such that they support students' learning actions (Entwistle, 2005). However, what it means in a teaching situation in which a teacher and students are present remains unclear. Questions such as how university teachers monitor and gain knowledge about their students during a teaching situation, e.g. a lecture, to guide their teaching actions have remained unanswered.

Teachers' readiness to facilitate university students' learning has been studied in terms of their conceptions of teaching and learning (Samuelowicz & Bain, 2001) as well as their approaches to teaching (Prosser & Trigwell, 2014). A relationship between teachers' and students' approaches has been found (Gibbs & Coffey, 2004), indicating that teachers' approaches do have an effect on their teaching and on their students' learning. The studies on university teachers' conceptions and approaches use the methods of self-report questionnaires and interviews, which reveal only some aspects of teaching, such as their intentions (Trigwell & Prosser, 2004) or their underlying orientations and beliefs (Samuelowicz & Bain, 2001). More knowledge is needed about how teachers perceive, interpret and make decisions in certain teaching situations (Blömeke et al., 2015). In secondary school settings, eye-movement studies have revealed interesting information about expert teachers' perceptions compared to novices. For example, experts tend to look longer at students (McIntyre et al., 2017) and focus their attention on areas where relevant information is available (Wolff et al., 2016). In general, previous studies have claimed that novice teachers are not able to focus on students' learning as deeply as more experienced teachers (e.g. Levin et al., 2009), and they may use only bottom-up visual noticing instead of knowledge-based top-down processes that allow shifting of attention from attention-capturing events to pedagogically meaningful events (e.g. Theeuwes, 2000). We lack this type of information concerning university teaching, that is, how more experienced or better educated teachers differ from novices and on what levels, besides conceptions and approaches, differences may occur.

The teaching situations in higher education are different from those in secondary school classrooms; thus, research on higher education settings is needed. This study aimed to discover whether focusing on students can be observed at the visual level and whether visual attention is related to different teaching conceptions. By using eye-tracking measurements and retrospective think-aloud, we investigated how university teachers perceive and interpret different kinds of teaching situations. In addition, the effects of prior pedagogical training and teaching experience were studied. We begin the paper by describing university teachers' expertise requirements and the teaching context and move on to consider what is meant by learning-focused teaching at the university level. We then proceed to the question of focus on the visual level, i.e. visual attention and finally propose video cases as a method to gain deeper insight into university teaching.

Teachers' Pedagogical Expertise in the University Context

Teachers' professional learning of pedagogy, i.e. the development of their pedagogical expertise, can be understood as a complex process whereby changes in knowledge, orientation and skills pertain to one's conception of teaching and actions as a teacher (Garner & Kaplan, 2019). These changes often require a change in the teacher's identity as well. The teacher's core identity has traditionally been defined as a subject expert

who transmits subject knowledge to students, while contemporary views of teaching highlight the role of the teacher as a learning process expert who fosters active, self-regulated and collaborated learning in students (Vermunt et al., 2017).

University teachers are typically highly educated experts in their own subject domain, but they often lack pedagogical qualifications, unlike their colleagues in primary and secondary schools. Thus, although university teachers excel in the content knowledge of their own discipline, they may lack pedagogical knowledge. In addition, they may lack pedagogical content knowledge, which refers to how pedagogical knowledge can be implemented in their own disciplinary areas (Shulman, 1987). It is problematic that university teachers have no pedagogical training, since, according to expertise research, excelling in one's own disciplinary subject does not necessarily make one an expert in teaching the subject (e.g. Ericsson, 2008).

Knight (2002) argued that without pedagogical training, it is typical for university teachers to adopt their own teachers' teaching style, even though they know it might not be the best way to promote student learning. Persuading teachers who have been teaching at university for a long time to take part in pedagogical training can be difficult. In addition, teachers with extensive teaching experience can be reluctant to change their teaching conceptions and practices (Postareff & Nevgi, 2015). In contrast, pedagogical training at the beginning of a university teaching career can be very effective (e.g. Vilppu et al., 2019). Thus, teachers' pedagogical expertise levels may vary greatly in the university context.

The university teaching environment is unique and different from those of primary and secondary schools. According to Doyle (2006), a school classroom situation includes features such as a large quantity of events and tasks taking place multidimensionally and simultaneously (e.g. interruptions and other unpredictable situations that require immediate attention). It also includes a common set of experiences that form a history for the class and have an impact on future events. Compared to this, a traditional university lecture could be described as a more unidirectional situation, with the teacher lecturing and usually no surprises occurring; in addition, it likely includes certain norms and traditions concerning the university culture for students about how to behave in a lecture. At the university, students and the place where teaching takes place may be different in every lecture, and the teacher often has neither a common history with the students nor personal contact with them. This creates a unique environment in which the research results from other educational levels cannot be directly applied.

Focusing on Students at the Level of Conceptions and Approaches

University teachers' pedagogical expertise has mostly been studied from the perspective of their conceptions of and approaches to teaching. University teachers' conceptions of teaching have been found to vary between teaching as facilitating learning and teaching as transmitting knowledge (Kember & Kwan, 2000; Samuelowicz & Bain, 2001). The former conception includes the idea that the most important task in teaching is to support students' learning processes and to create learning environments that 'scaffold' learning, whereas the transmission conception indicates that the most important task in teaching is to deliver information to students. Teachers' approaches to their teaching, i.e. the strategies they adopt, have been categorised into learning-focused and content-focused approaches (Postareff & Lindblom-Ylänne, 2008). The learning-focused approach refers to teaching strategies in which the teacher's aim is to foster students' deep learning processes by activating their knowledge construction. In contrast, with the content-focused approach, the teacher's intention is to transmit knowledge to students without attempting to activate them.

A rather high correspondence between conceptions and approaches seems to exist. Teachers who consider teaching as transmitting knowledge tend to adopt a content-focused approach to teaching, whereas teachers

who view teaching as supporting students in building their own understanding more often adopt a learning-focused approach to teaching (Kember & Kwan, 2000). Teachers' approaches to teaching have been shown to relate to their students' approaches to learning (Gibbs & Coffey, 2004; Prosser & Trigwell, 2014; Uiboleht et al., 2018), indicating that a learning-focused approach to teaching encourages the use of a deep approach to learning. Students' adoption of a deep approach to learning seems to indicate that they will achieve higher-quality learning outcomes (Uiboleht et al., 2018). Thus, teachers' actions and conceptions seem to have important effects on the success of student learning.

Focusing on student learning and being able to support their learning process also requires skills other than understanding how learning happens, along with an intention to support it. For example, engaging students in lectures has been shown to be an important medium for focusing on students and fostering their active learning (Lonka & Ketonen, 2012). Many university teachers still use the traditional lecturing approach, with the dominant view of teaching as the transmission of knowledge, probably because they teach the way they were taught (Knight, 2002). This unidirectional method of lecturing does not give the lecturer much information about students' learning. Teaching methods that engage students are seen as central in giving teachers information about students' prior knowledge, goals and motivation in studying and motivating students to learn in more depth (Lonka & Ketonen, 2012). To apply engaging teaching methods, a teacher needs to be sensitive to students' nonverbal messages in a teaching situation.

To be able to monitor, react to different situations and support students' learning processes, teachers need pedagogical knowledge and skills that guide their own teaching. According to expertise studies, a skill needs to be deliberately practiced to develop (Ericsson, 2008). Thus, practicing teaching without deliberate training probably does not help university teachers develop; they need pedagogical training to acquire pedagogical expertise. Current pedagogical training for university teachers aims to facilitate conceptions of teaching that enhance learning and learning-focused approaches to teaching, and there is evidence that this training has a positive effect on teachers' conceptions and approaches to teaching (e.g. Postareff et al., 2007; Stes & Van Petegem, 2011).

Focusing on Students at the Visual Level and Noticing Important Events

In addition to university teachers' focusing on their students' prior knowledge, intentions, goals and study progress, teachers need visual information about their students during a teaching session to be sensitive to their nonverbal messages concerning their learning. Focusing on students at the visual level means paying visual attention to students. Eye-movement studies offer information about where viewers focus their attention and how they process classroom situations when observing teaching (Wolff et al., 2016). Eye movements as such are not sufficient to provide information about teachers' thinking, since there is only a hypothesis about the connection between eye and mind (e.g. Just & Carpenter, 1980), but when combined with teachers' verbal interpretations, they can help us to understand teachers' thoughts.

While focusing means deliberately paying attention to the overall situation, noticing means that one actually perceives an important event when it happens. Noticing refers to the ability to focus attention on events that are pertinent to teaching and learning (Grub et al., 2020), and knowledge-based reasoning implies the ability to apply knowledge about teaching and learning to interpret these events as well as the ability to draw relevant conclusions. Lachner et al. (2016) argued that the skills in both noticing and interpreting are knowledge-based in that teachers' knowledge guides their attention and interpretation of crucial events.

Compared to novices, expert teachers possess more extensive, elaborate and coherently organised knowledge structures. Through teaching experience, teachers integrate formal professional knowledge with their personal

and practical knowledge, thus strengthening their ability to perform effectively (Wolff et al., 2021). The differences between experienced and novice teachers' visual processing of classroom information have mainly been studied at the primary (e.g. Pouta et al., 2020) and secondary school levels (e.g. McIntyre et al., 2017; Stahnke & Blömeke, 2021; Wolff et al., 2016). The level of expertise has been shown to influence the noticing and interpretation of classroom events. For example, expert teachers' noticing is efficient (McIntyre et al., 2017) and knowledge-based, covers wide areas (Wolff et al., 2016) and is focused on students (e.g. van den Bogert et al., 2014; Stahnke & Blömeke, 2021). Novices, on the other hand, tend to engage in a more time-consuming and rather indiscriminate search for information (e.g. Wolff et al., 2016). Furthermore, with regard to knowledge-based reasoning, novices tend just to describe classroom events, while experts explain and integrate the meaning behind what they see (e.g. Wolff et al., 2017). A novice may notice only so-called bottom-up events that capture visual attention, while experts use knowledge-based top-down processes that allow them to shift their attention from attention-capturing events to pedagogically meaningful events (e.g. Theeuwes, 2000).

Utilising Videos in Studying University Teachers' Focus on Students

During the last decade, video-based assessment has become frequent in both teacher training and teacher training research (Dunekacke et al., 2015; Gaudin & Chaliés, 2015), and many studies focusing on visual processes utilise classroom videos. There are many advantages to using video assessment: it provides a standardised measurement, it is close to the complex reality of pedagogical situations, and, due to this perceived authenticity, it is usually considered motivating and highly accepted by the participants. Further, compared to written or still picture cases, videos can integrate both verbal and nonverbal information, such as facial expressions, gestures, movements, postures and even emotional states. Scripted videos also enable the inclusion of trigger events (König et al., 2014), i.e. pedagogically meaningful events, which the teacher should notice in order to be successful in learning-focused teaching. As a research method, video assessments may also avoid problems commonly related to self-report measures, such as those inherent in Likert scale questionnaires and interviews, which rely on self-perception and are thus prone to credibility issues (see Vilppu et al., 2019).

Higher education teachers' focus on students has usually been studied through their conceptions and approaches with fairly traditional self-report measures, such as questionnaires and interviews (e.g. Postareff & Lindblom-Ylänne, 2008; Trigwell & Prosser, 2004), which do not necessarily measure actual teaching practices, but aims and beliefs concerning them. Thus, new methodological perspectives and tools would allow for new knowledge of teachers' pedagogical expertise. Considering the varied and constantly changing university teaching situations and differing backgrounds of university teachers and students, analysing practical teaching situations to obtain general knowledge of how teachers' teaching actions correspond to their conceptions would be challenging. Therefore, viewing and interpreting videotaped teaching situations could offer a methodology for approaching this question.

Recently, many studies have integrated eye-tracking methodology into video viewing (e.g. Wolff et al., 2016; Wyss et al., 2020), and thus, have also focused on visual processes. The viewer's attention is central to how classroom situations are visually processed, where viewers' eye movements offer insight (Wolff et al., 2016). Because of the link between where the eyes are gazing and what the mind is engaged with (the eye–mind hypothesis; see Just & Carpenter, 1980), viewers' eye fixation patterns can be used to investigate their ongoing mental processes during viewing. However, eye tracking has its limitations, and as such, it does not necessarily relate anything about how the viewer comprehends the scene. Thus, eye-movement data require many

inferences about the underlying cognitive processes, since they do not explain why a viewer was looking at certain representations (van Gog et al., 2009). To reduce the number of researchers' inferences, complementary methods, such as concurrent or retrospective reporting, are utilised alongside eye movements.

Present Study

This study aimed to extend knowledge about university teachers' focus on their students by examining whether the focus can be observed at the visual level in addition to the conceptual level. We studied teachers' conceptions of teaching with regard to their visual attention, noticing the trigger event and rating the success of the observed teaching. Furthermore, the effects of pedagogical training and teaching experience on visual attention and teaching conceptions were examined. Comparisons were made between pedagogically trained vs. untrained and novice vs. more experienced teachers. The research questions of the study were as follows:

1) To what extent do university teachers pay visual attention to students in comparison with the other two central elements of a lecture, the teacher and the slides, when watching videotaped teaching situations with inbuilt trigger events?

2) Do teachers notice inbuilt trigger events in videos by paying attention to students at the intersection of the visual level and teaching conceptions? Are these in line with their numerical ratings of the success of teaching situations?

3) How are teachers' prior pedagogical training and the length of their teaching experience connected with their visual attention to students and their conceptions of teaching?

Since pedagogical training aims to foster learning-facilitating conception of teaching, we assumed that pedagogically trained teachers' interpretations of the videos would reflect a stronger learning-facilitation conception of teaching than their untrained colleagues, due to their more sophisticated knowledge base (Lachner et al., 2016). The main hypothesis for this study was that pedagogically trained teachers would pay more visual attention to students than their untrained colleagues would, especially in a situation where top-down processes would be needed to shift teachers' attention to important phenomena (Theeuwes, 2000). Furthermore, we used numerical ratings as evaluations given by teachers on teaching situations to confirm that our analysis of their interpretation was correct. Thus, the ratings needed to be in alignment with the interpretations. The role of teaching experience might be more ambiguous among university teachers than among primary and secondary school teachers, who are all pedagogically trained. Work experience alone does not help people develop their expertise, but deliberate practices such as training are needed to gain high-level skills (Ericsson, 2008). From this standpoint, we assumed that the length of previous teaching experience would not strongly differentiate teachers in their visual attention and conceptions of teaching but that previous pedagogical training would promote paying more attention to students' learning both visually and verbally (see Figure 1).

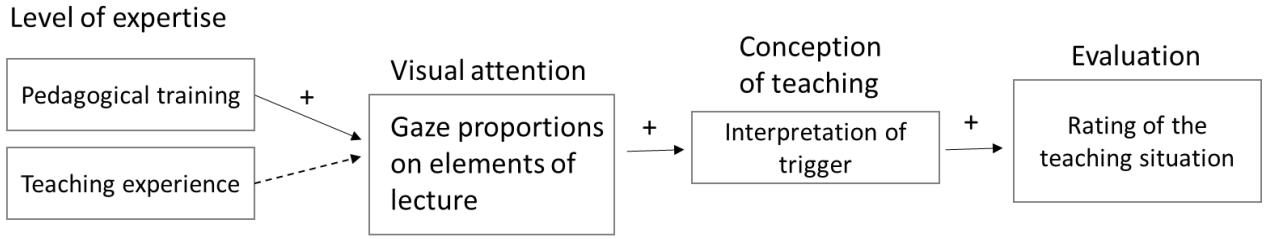


Figure 1. Hypothesised model of the connections between visual attention and conceptions of teaching among university teachers

Methods

Participants

The target group of the study comprised university teachers and doctoral students who either had or did not yet have teaching tasks at the university. They had all applied for voluntary university pedagogy training (N = 51). The measurements took place in the beginning of the training. Watching the video vignettes was part of the training, but the trainees could choose whether they wanted to take part in the study. Thus, participation in the study was voluntary, and informed consent was obtained from the participants. Ethical approval for the study was granted by the Ethics Committee for Human Sciences of the target university.

As two members of the target group declined to participate, the response rate was 94%. Thus, the number of participants was 49. Twenty (42%) participants had earlier pedagogical training, which varied from a university pedagogy course bearing 1 study credit (according to the European credit transfer and accumulation system, ECTS) to a subject teacher degree bearing 60 ECTS, whereas the rest had no previous pedagogical training. The participants represented seven faculties. Their teaching experience varied, but most of them had been teaching at the university for less than 10 years: nine (19%) had no teaching experience, 14 (29%) had a maximum of 2 years' teaching experience, 13 (27%) had been teaching for 2 to 5 years, 10 (21%) for 5 to 10 years, and two (4%) had been teaching for over 10 years in at least one course per academic year. Information on one participant's faculty and teaching experience was missing from the data. Those doctoral students who had no teaching experience at the university were considered prospective teachers who might be given teaching duties in the near future. Due to the consistency of the sample, teachers were divided into novices (n = 23, with no teaching experience or a maximum of 2 years) and more experienced teachers (n = 25, with more than 2 years of teaching experience) for further analysis.

Apparatus and Materials

A Tobii TX300 Eye Tracker (Tobii Technology, Inc., Falls Church, VA, USA) was used to collect the participants' eye movements. The eye-tracking component was integrated into a 23-inch high-resolution monitor, with a maximum resolution of 1920 × 1080 pixels. The eye-tracking camera sampled data binocularly at a rate of 300 Hz, with a reported gaze accuracy of 0.4°. To ensure that participants were as comfortable as possible while watching the video vignettes, no supporting chinrest was used, since the eye tracker allowed even large head movements.

Two custom-made videos were used in the study, with actors as teachers and students. The videos were designed and filmed by the researchers of this paper, who were familiar with the local lecturing culture. Both videos shared the same simple layout, and they were filmed from the same angle and from an outsider's perspective of the classroom. In both videos, there was a scene in which students were sitting on the left, the teacher was standing in the middle and the screen was on the right (see Figure 2). The first video was 1 minute 33 seconds in duration, and the second was 1 minute 36 seconds; both depicted a situation in the middle of a lecture.

To focus on the targeted constructs, the videos were scripted (König et al., 2014) by a group of experienced university pedagogy educators and researchers. They aimed to represent typical and realistic university

teaching–learning situations, since the perceived authenticity of the video material was important (Seidel et al., 2011). Research methodology was chosen as the topic of teaching for both videos, since it was considered to be quite domain-general, neutral and equally understandable for teachers from different disciplines. The videos were filmed from the side to allow the three important elements of the setting (teacher, student and slides) to be clearly visible. Only a few students were shown on the video to reduce the number of spontaneous movements that could draw observers' attention.

Both videos incorporated a pedagogically interesting situation, a so-called trigger event (see also Vilppu et al., 2019). We expected these built-in pedagogical events to trigger certain reactions and interpretations in teachers depending on their conceptions of teaching. Both videos were scripted according to the relevant literature (e.g. Postareff & Lindblom-Ylänne, 2008) to describe a content-focused (CFTS) and a learning-focused teaching situation (LFTS). The first video presented CFTS, in which a teacher is lecturing about devising interview questions. She is very focused on transmitting her topic and is not paying any attention to the audience. The students are sitting and looking bored. One is yawning, another is tapping her phone and some are conversing with each other. The trigger in the first video was the teacher totally ignoring the students and their off-task behaviour. The situation is reminiscent of a typical situation requiring classroom management (Wolff et al., 2021) and thus noticing that students are not attending to the lecture.

The second video presented an LFTS, in which a teacher is lecturing about observation as a research method when a student interrupts her with a question concerning the ethics of observation. The teacher thinks a while and then prompts the students to have discussions in pairs for a few minutes. The trigger here was the teacher's positive reaction to the student's question, followed by engaging the students instead of directly answering the question by herself. Thus, there is space and flexibility for changes in her teaching plan; the teacher sees students as active participants and relies on their ability to find the answer and process the knowledge themselves (Postareff & Linblom-Ylänne, 2008). Additionally, the teacher's positive reaction to the interruption implies a good, safe atmosphere in the seminar room.

The order of presentation of the videos was selected due to the assumed priming effect of the LFTS video, meaning that after seeing the teacher's behaviour of engaging the students, the participants would be more likely to notice the missing engagement in the CFTS video.

Procedure

The data collection procedure began with an orientation (see Table 1). For each participant, the eye tracker was calibrated using 9-point calibration at the start of the data collection. To maximise calibration accuracy, participants were requested to take as comfortable a position as possible to prevent changes in position during the recording. Participants sat approximately 60 cm from the screen on a manually adjustable chair. After calibration, they were given instructions regarding the session. The participants were told that they would be watching different lecturing situations and rating them from the viewpoint of teaching and learning. On the second watching of each video, they would be asked to think aloud about their interpretation of the situation. After the instructions, the participants watched a rehearsal video and practiced the think-aloud procedure.

Table 1. The study's procedure

	Video viewing		
Orientation			Questionnaire
	CFTS-video	LFTS-video	

	Content-focused teaching situation	Learning-focused teaching situation	
Calibration + Instructions + Rehearsal video	First watch + Rating + Second watch and simultaneous think-aloud + Rating and explanation	First watch + Rating + Second watch and simultaneous think-aloud + Rating and explanation	Background questions

After the orientation, the actual data collection started. The participants watched both videos twice in the same order. After the first viewing, they rated the situation from the viewpoints of teaching and learning on a scale from 1 to 5 (1 = very poor, 2 = poor, 3 = moderate, 4 = good and 5 = very good). The second viewing took place immediately after the rating. They received the following prompt: "Now, you are asked to watch the previous situation again and simultaneously think aloud about your interpretation of it. Explain what is going on from the viewpoint of teaching and learning." They also had a change to correct their rating. Such an open approach was considered advantageous, since it is in no way preconditioned by the researchers and thus purely elicits the viewer's perspective (Kaiser et al., 2015). During the second viewing, the video's sound was muted so that it would not interfere with the think-aloud process. If there were prolonged silences at the beginning of the viewing, the participants were prompted to verbalise what they were thinking about in the situation. They were allowed to continue their verbalisations even after the video vignette ended. Since the think-aloud took place during the second watch, it can be considered retrospective; however, it was conducted without a gaze overlay of the first watch as a cue.

The participants' eye movements were recorded each time they viewed the videos. However, only the eye movements of the first viewing were used in the analyses, since these were considered to represent so-called "pure" viewing; as such, they are comparable to an authentic teaching situation as a one-time event without the possibility of reviewing the situation. After finishing the video viewing, the participants answered a short background questionnaire. Due to calibration problems and common problems with eye-tracking data quality, such as data loss (Holmqvist et al., 2011), the data of only 41 participants in the CFTS video and 40 participants in the LFTS video were available for the analyses out of the total of 49 participants. The percentage of gaze samples with at least one eye detected was 82.92 for the CFTS video and 82.07 for the LFTS video.

Analysis

Analysis of Visual Attention when Watching Teaching Situations

The participants' viewings of the videos were analysed using Tobii Studio version 3.4.5. (Tobii AB, Danderyd, Sweden). Additionally, the numerical data from Tobii Studio were transferred to the IBM Statistical Package for the Social Sciences (SPSS), version 25 (IBM Corp., Armonk, NY, USA), which was used for further analyses. The videos were divided into areas of interest (AOIs), that is, the regions in the stimulus from which the authors were interested in gathering data (Holmqvist et al., 2011). Since both videos depicted the same scene, the same AOIs were used on the students, the teacher and the slides (see Figure 2).

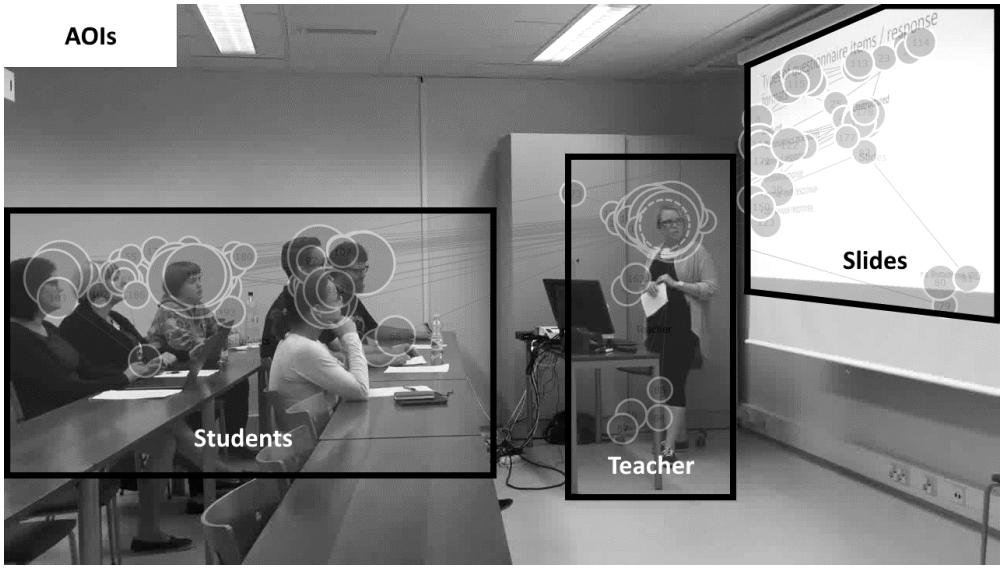


Figure 2. The common AOIs used in both videos with an example scan path

Fixations and saccades as eye-tracking parameters are thought to reflect voluntary, overt visual attention (e.g. Duchowski, 2007). The intake of visual information from the environment is assumed to happen largely during fixations (Kok & Jarodzka, 2016), which usually reflect the desire to focus attention on a certain object of interest. Thus, fixations were considered useful for identifying where teachers focused their attention. The sum of fixation durations on each AOI was chosen to analyse the visual attention of the participants, i.e. for how long they had watched each AOI.

As we were interested in the division of fixation time for each participant between different AOIs, the sum of fixation durations on each AOI was used to calculate the percentage share of fixation time for each AOI. Thus, we would get a viewing profile of each participant (i.e. how much they would, in terms of percentage, fixate on the students, the teacher and the slides). We expected more fixations on the relevant regions to indicate deeper cognitive processing or the importance of a region (e.g. Grub et al., 2020). The so-called white space, i.e. the visual attention on areas other than AOIs, was not considered when calculating the provision of fixations. This decision was based on descriptive statistics showing that the number of white space fixations was minimal. The eye-tracking data were normally distributed, thus enabling the use of independent samples t-tests.

Analysis of Video Interpretations

The think-aloud protocols were transcribed verbatim and analysed qualitatively using NVivo 12 software (Alfasoft AB, Göteborg, Sweden). The analyses were performed by the second and last authors, who are pedagogically qualified teachers and researchers in the field. Theory-based content analysis was used to analyse the interpretations of the triggers. The structure of the coding scheme continuum was derived from the theory of teaching conceptions (e.g. Kember & Kwan, 2000; Samuelowicz & Bain, 2001). In the continuum from 1 to 5, 1 represented a strong knowledge-transmission conception and 5 represented a strong learning-facilitation conception of teaching. In the analysis of the LFTS video, the scale was skewed towards the knowledge transmission end of the continuum, since critical or knowledge transmission reflecting comments on that video were scarce. The descriptions of each category were based on what emerged from the think-

aloud protocols. Both the think-aloud during the viewing and the summing up of the ratings after the video viewing were analysed when deciding to which category each participant's answer belonged. Multiple rounds of open coding were conducted to reach the current coding scheme (see Table 2).

Table 2. Coding scheme of the video interpretations: Teachers' reactions to the trigger event from the perspective of knowledge-transmission and learning-facilitation conceptions.

	CFTS VIDEO (Content-focused teaching) Trigger: Students not attending	LFTS VIDEO (Learning-focused teaching) Trigger: Teacher engaging students
Category	Description	Description
1 = Reflecting strong knowledge-transmission conception	Does not notice the trigger. Praising the teaching or focusing on the presentation.	Interpretation of the trigger from the knowledge-transmission perspective. The teacher performs poorly, since the structure of the teaching suffers from a student's interruption OR the teacher should give a clear answer to the student's question.
2 = Reflecting knowledge-transmission conception	Notices the trigger but does not suggest that the teacher should react to it. If suggestions for improvement are given, they are related to the presentation (e.g. there should be more pictures in the slides).	Mere description of the situation without taking a positive stand on teacher's learning-focused performance OR neutral interpretation.
3 = Reflecting characteristics of both conceptions	Notices the trigger and suggests that the teacher should do something (e.g. have a break or somehow get students' attention), but no clear mentioning of supporting student learning.	A superficially positive view of the situation/the teacher's performance is good (no arguments given). No specific mention of the trigger.
4 = Reflecting learning-facilitation conception	Notices the trigger. Suggestions for improvement are related to facilitating students' learning (e.g. engaging/motivating students, increasing interaction).	The teacher's performance is considered good because she reacts positively to the student's question (the trigger); mentions facilitation of learning.
5 = Reflecting strong learning-facilitation conception	Strongly notices the trigger. Teaching is considered very poor since the students are not learning. Suggestions for improvement are related to students' learning (e.g. engaging students, fostering their own thinking). The interpretation is given clearly from the viewpoint of learning.	Praises teacher' reaction to the trigger. Mentions students' knowledge building OR the pedagogy behind not answering the student directly. Viewpoint of deep learning (noticing that the teacher is changing their original plan to answer students' needs and interests).

In the following, citation examples are presented to illustrate the classes in the coding scheme. Participants are referred to as P and the identification code, such as P1. The next example of an interpretation of the CFTS video was classified in Category 2, reflecting a knowledge-transmission conception, since the participant noticed the trigger of the students not focusing but did not suggest that the teacher should do anything about it.

> *I see that the students are looking quite bored and concentrating on their own business. … I don't know why. I don't think it is the style of teaching, but maybe the topic. … I don't see anything special to criticise about the teacher's actions; this is very typical university teaching. (P50)*

In another example of the CFTS video, the participant interpreted the trigger from the viewpoint of learning. This interpretation reflected a strong learning-facilitation conception of teaching (Category 5):

> *From the viewpoint of teaching, it clearly seems that, in this situation, the conditions for learning new things are not very good. … Only a few students are following the situations and the teacher's teaching style seems to be one in which her message doesn't reach the students very well. (P47)*

The next excerpt from the interpretation of the LFTS video was classified as reflecting a knowledge-transmission conception (Category 2). The participant just described the situation, but neither indicated whether the teacher performed well nor interpreted the trigger from the viewpoint of teaching and learning:

> *In this scenario, the lecturer was still giving this lecture, but this time, she considered the students' interest in the topic and made them discuss it as group work. (P8)*

A second example from the LFTS video was classified as reflecting a strong learning-facilitation conception (Category 5). In this excerpt, the teacher's teaching actions, i.e. the trigger, were considered good, since she changed her original lecture plan according to what the students showed interest in.

> *… The teacher was able to compromise her original lecturing plan, and when there was a question, instead of directly answering it, she made the students ponder it and this way they would have a more concrete learning experience. (P21)*

Interrater reliability was calculated for the interpretations of the triggers for 25% of the data using Cohen's weighted kappa. Substantial agreement was reached for both videos, indicating fair reliability (CFTS video: 66.67%, weighted kappa = 0.739; LFTS video: 58.33%, weighted kappa = 0.639).

Analysis of the Connections Between Targeted Concepts

Spearman's correlations were utilised to examine the relations between targeted concepts. The rating scale of the CFTS video was reversed so that it would be comparable to the ratings of the LFTS video. A path analysis was conducted using the Mplus software (Version 8.4, Muthen & Muthen, 2019) to portray the possible causal linkages between the target variables to better understand the processes and mechanisms behind the phenomenon. Path analysis was chosen because it allows for inferring and testing a sequence of causal links between variables of interest and examining the relationship between multiple predictor and criterion variables simultaneously (Barbeau et al., 2019). Missing values were handled by employing full information maximum likelihood (FIML) in the model estimations. FIML can handle missing data (MAR) in an optimal way (Muthén & Muthén, 2017).

Results

Teachers' Visual Attention in Teaching Situations

First, the teachers' visual attention on both videos was examined. On the CFTS video, the pedagogically educated teachers watched statistically significantly more at the students (Cohen's d = .77) and almost statistically significantly less at the teacher (Cohen's d = .64) than their untrained colleagues (Table 3). The effect sizes were moderate (Cohen, 1988). On the LFTS video, the differences pointed in the same direction as on the CFTS video but were not statistically significant. There were no statistically significant differences between the teaching experience groups in either video (see Table 4).

Table 3. Percentage share of fixation time for each AOI in teaching situations in the CFTS and LFTS videos between pedagogically untrained and trained university teachers

		Pedagogical training		*t(37 or 38)*	*p*
		no (*n* = 21–22) *M, SD*	yes (*n* = 17–19) *M, SD*		
CFTS video (Content-focused teaching situation)	AOI Teacher (%)	33.70, 10.45	26.07, 13.35	2.02	.05
	AOI Students (%)	42.35, 17.95	56.16, 17.82	-2.44	.02*
	AOI Slides (%)	23.95, 14.57	17.77, 10.18	1.54	.13
LFTS video (Learning-focused teaching situation)	AOI Teacher (%)	49.79, 9.49	45.50, 12.27	1.23	.23
	AOI Students (%)	35.66, 11.94	42.65, 15.49	-1.59	.12
	AOI Slides (%)	14.55, 7.19	11.85, 7.44	1.14	.26

Note. The number of teachers varied in the videos due to missing data (CFTS video: 21 untrained and 19 trained teachers; LFTS video: 22 untrained and 17 trained teachers). *$p < .05$

Table 4. Percentage share of fixation time for each AOI in teaching situations in the CFTS and LFTS videos between novice and more experienced university teachers

		Teaching experience		*t (36-38)*	*p*
		0–2 years (*n* = 17–18) *M, SD*	>2 years (*n* = 21–23) *M, SD*		
CFTS video (Content-focused teaching situation)	AOI Teacher (%)	30.74, 11.64	29.26, 13.23	.37	.72
	AOI Students (%)	49.10, 17.28	49.79, 20.83	-.11	.91
	AOI Slides (%)	20.16, 9.12	20.94, 15.37	-.20	.84
LFTS video (Learning-focused teaching situation)	AOI Teacher (%)	48.68, 10.29	47.17, 11.57	.43	.67
	AOI Students (%)	39.51, 12.58	38.35, 15.31	.26	.80
	AOI Slides (%)	11.81, 5.37	14.48, 8.64	-1.17	.25

Note. The number of teachers varied in the videos due to missing data (CFTS video: 17 novice and 23 more experienced teachers; LFTS video: 18 novice and 21 more experienced teachers).

Teachers' Verbal Interpretations of Teaching Situations and Triggers

Overall, the participants' interpretations of the LFTS video included more notions about learning facilitation (M = 4.08, SD = 1.00) than their interpretations of the CFTS video (M = 3.16, SD = 1.11) (Figure 3). No significant differences between trained and untrained teachers (CFTS video: $t(46)$ =.09, p = .93; LFTS video: $t(46)$ = -.67, p = .50), nor in relation to teaching experience (CFTS video: $t(46)$ = 1.67, p = .87; LFTS video: $t(46)$ = -.70, p = .49), were found concerning the interpretations. We assume that the LFTS video was easier for the participants to interpret, since there were more happenings on the video, such as the teacher and the students being actively engaged in collaborative learning processes. Thus, the LFTS video trigger was able to capture watchers' attention (bottom-up) and no shifting of attention elsewhere was needed (Theeuwes, 2000). The CFTS video where the lecturer was unidirectionally lecturing and the trigger was that students were passive resulted in more variation in teachers' interpretations.

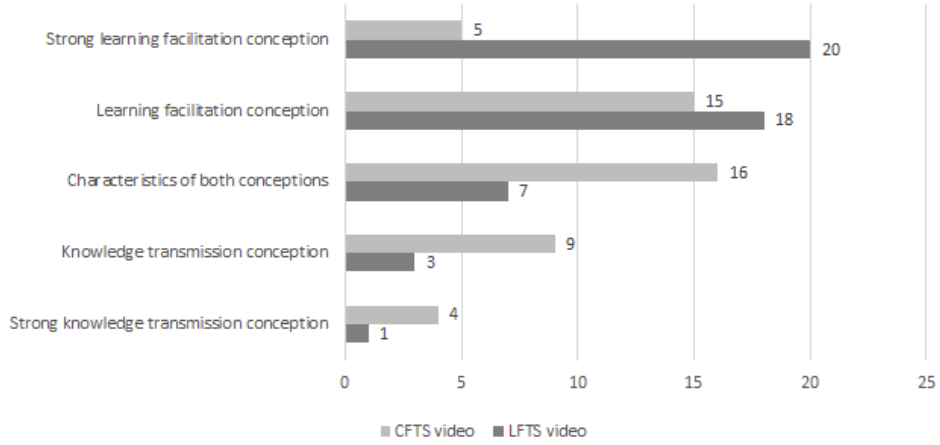


Figure 3. The division of classified video interpretations of CFTS (content-focused teaching situation) and LFTS (learning-focused teaching situation) videos

Teachers' Numerical Ratings of the Teaching Situations

Teachers' ratings of the success of the teaching situation were higher overall concerning the LFTS video (M = 4.33, SD = .56) than the CFTS video (M = 3.43, SD = .74), showing that the teachers considered the LFTS video to illustrate a better situation in terms of teaching and learning. No significant differences in ratings were found between untrained and trained teachers (CFTS video: $t(46) = .29$, $p = .77$; LFTS video: $t(46) = .35$, $p = .73$) or novice and more experienced teachers (CFTS video: $t(46) = -.23$, $p = .82$).

A Path Model of University Teachers' Visual Attention and Interpretations in Teaching Situations

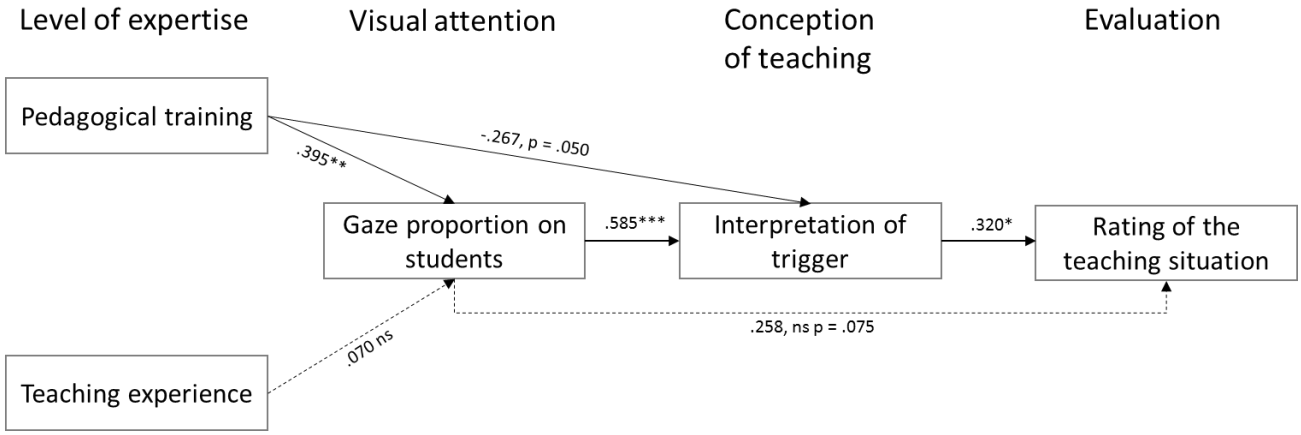
Finally, path analysis was conducted to portray the causal linkages between the target constructs. The CFTS video was selected for the path analysis because it resulted in more variation in participants' eye movements as well as their interpretations and ratings; thus, its explanatory power was expected to be stronger. The AOI of students was used as the basis of the model, since noticing students' passivity was central in the CFTS video. The correlations among the studied variables are shown in Table 5.

Table 5. Means, standard deviations and correlations (r_s) among study variables

	1	2	3	4	5
1. Visual attention to students	1	.43**	.36*	.36*	.04
2. Interpretation		1	.47**	-.01	-.04
3. Rating			1	.00	.03
4. Pedagogical training (1 = no, 2 = yes)				1	.17
5. Teaching experience					1
M	49.34	3.16	3.43	-	-
SD	18.95	1.11	0.75	-	-

*$p < .05$, **$p < .01$

The path analysis is depicted in Figure 4. The fit indices indicate that the model fits the data well: $\chi^2(3) = 2.30$, $p = 0.512$, CFI = 1.00, TLI = 1.00, SRMR = .04, RMSEA = .00, 90% CI = [0.00, 0.223].



Note. ***p < .001, **p < .01, *p < .05, ns = not significant

Figure 4. The final structural model with standardised path coefficients (n = 47)

In this model, two paths were examined: 1) the effects of pedagogical training on the rating given to the teaching situation and 2) the effects of pedagogical training on video interpretation. The first path did not result in any significant indirect effects. However, in the second path, the indirect effect of visual attention on students as a mediator between pedagogical training and video interpretation was significant: $\beta = 0.231$ (p = .019; 95% CI = [.051, .463]). In addition, an almost significant direct negative effect of pedagogical training on video interpretation was found: $\beta = -0.267$ (p = .050; 95% CI: [-.505, -.016]), meaning that if the teacher was not able to visually focus on students, she would not produce an accurate verbal interpretation. The relationships proposed in the model explain 16.2% of the variance in visual attention on students, 28.9% of the variance in video interpretation and 24.7% of the rating of the teaching situation. Thus, pedagogical training seems to affect teachers' visual attention to students, which is further associated with video interpretations and video ratings. In other words, pedagogically trained teachers gaze more at the students, and gazing at them further engenders more learning-focused interpretations and aligned ratings of the teaching situations. In addition, there was a small negative direct effect of pedagogical training on verbal interpretation, indicating that pedagogically educated teachers used fewer learning-focused explanations of the situation if they did not pay visual attention to the students. Thus, visual attention seems to be central to interpreting students' learning situations.

Discussion

Focusing on students' learning is a central element in high-quality university teaching (e.g. Prosser & Trigwell, 2014). Previous studies have shown that teachers who express a learning-facilitation conception of teaching, i.e. who consider teaching as supporting students' learning, more frequently report a learning-focused approach to teaching in practice, while those who consider teaching as transmitting knowledge tend to adopt a content-focused approach in their teaching practices (Kember & Kwan, 2000). Pedagogical training, even a short one, has been shown to enhance teachers' learning-facilitating conception (Vilppu et al., 2019).

While prior studies on university teaching have mainly used self-report questionnaires and interviews, we broadened the scale to include eye-tracking methodology. We investigated whether teachers' focus on students could be found at the intersection of their teaching conceptions and visual attention. Based on previous studies, we hypothesised that pedagogically trained teachers would express more learning-focused views; thus, we expected a connection between previous training and focus on students, on both the visual and the interpretation levels. The analyses of verbal interpretations of the videos revealed both learning-facilitation and knowledge-transmission conceptions in teachers. When analysing only the verbal interpretations of the videos, we found no differences between the pedagogically trained and untrained or novice and more experienced teachers.

Our results concerning teachers' visual attention to students showed that pedagogically trained teachers fixated more on the students than their untrained colleagues did. The difference was statistically significant in the content-focused teaching situation (CFTS) video, where the students were passive and bored, but not in the learning-focused teaching situation (LFTS) video, where the teacher actively engaged students in learning. Pedagogically, the situation of the CFTS video, in which students were passive, would need teacher attention and intervening action. Only a few studies have addressed the recognition of possible situations that need teacher's action (Grub et al., 2020), of which our trigger event in CFTS video is an example. We claim that the trained teachers, due to their more elaborated knowledge base (Lachner et al., 2016), were more competent in noticing, i.e. paying visual attention to the problematic situation and interpreting it adequately. The cognitive theory of the top-down and bottom-up control of visual attention supports our finding: after the teacher's teaching actions, i.e. lecturing on the CFTS video, had captured watchers' attention (bottom-up), the trained teachers used their attentive processes to shift their attention elsewhere (top-down) to focus on important things (e.g. Theeuwes, 2000). In our case, the learning-facilitating conception helped pedagogically trained teachers shift their attention from the lecturing teacher to students when an action-needing event, i.e. boredom and passivity, occurred.

Analyses of teachers' visual attention to the other elements of the lecture, the teachers and the slides, showed no statistically significant differences. However, teachers' visual attention to the lecturing teacher when viewing the CFTS video was statistically almost significant and in the direction of our hypothesis, showing that the untrained teachers paid more attention to the teacher than the pedagogically trained teachers did. Previous studies have shown that experts tend to fixate more often and for a longer duration on relevant areas, whereas novices look more frequently at irrelevant areas (Grub et al., 2020). Similarly, our pedagogically trained teachers paid more visual attention to the students, noticed the trigger event and evaluated the situation in terms of learning-facilitation conception. The untrained teachers probably did not notice students' boredom as a relevant phenomenon since they did not pay enough visual attention to the students. This is probably because, according to their knowledge-transmitting teaching conception, what the teacher does is most important.

In our study, teaching experience measured in teaching years was not connected to visual attention and interpretations. This result contrasts with studies on the lower levels of education (e.g. Stahnke & Blömeke, 2021), in which experienced teachers differ from novices. There are many reasons for this contrasting result. At lower educational levels, teachers are usually pedagogically trained, unlike in universities, where university teachers may totally lack pedagogical education. Thus, to compare the settings, we would need a study in which we have pedagogically trained novice and expert university teachers. Our sample comprised mainly novice teachers, so more profound studies including teachers with extensive experience will be needed in the future. The university teaching environment also differs significantly from that of other educational levels; for example, a teacher may not always teach the same students and the place where teaching takes place may

always be different. Thus, we argue that the results of other educational levels' eye-tracking studies cannot be directly applied to higher education. On the other hand, our study is in line with expertise research results that found training to be more important than experience (e.g. Ericsson, 2008). Thus, it may be that in the university environment, having at least some pedagogical training is more important than having long teaching experience without pedagogical education.

The other possible concerns of this study included the rather small sample size for quantitative modelling; this may affect the reliability of the statistical analyses, although it is comparable with other eye-tracking studies (see Beach & McConnel, 2019). On the other hand, in small samples, the effects are often undetected; this might indicate that we have discovered an interesting phenomenon that needs to be confirmed in future studies. The division of teachers into two groups with either less or more than two years of experience can be considered a problematic solution. However, the small sample size and the fact that most of the teachers were novices did not allow many other solutions. Another concern was that the order in which the videos were watched was not randomised for the participants. However, we think that the order in which the videos were shown (first the content-focused scenario, then the more appropriate learning-focused scenario) was justified to tap into participants' conceptions of teaching. Showing the more favourable teaching video first could have affected their interpretations in the second video. The videos seemed to differ in their discriminatory power, which proved better for the CFTS video. We assume this was because the trigger event was the passivity of the students, which required visual attention to the AOI of students. Furthermore, it was subtler than the trigger event in the LFTS video, requiring the participants to look at areas other than the most obvious, the teacher, who was talking all the time. In addition, in the eye-tracking data analyses, the visual attention on areas other than AOIs was not considered, since the number of the so-called white space fixations was minimal. However, since the AOIs were of different sizes, the participants might have looked at some of the AOIs accidentally more than others. In future studies, this should be considered in the analyses. In this study, the teachers watched teaching situations on a video, which is different from being in a real teaching situation and looking at their own students. University teachers' gaze at their own teaching situations needs to be studied in the future, which raises its own methodological questions (Cortina et al., 2015). However, using this simple eye-tracking design, we were able to conduct operationalisation and analysis of the data and obtain support for our hypotheses, which will lay the groundwork for more complex studies.

University teachers are an interesting group to study, since many of them lack pedagogical training, as opposed to primary and secondary school teachers, who are usually pedagogically qualified. This novel study showed that pedagogical training is important for university teachers to develop their ability to notice important events in lecturing situations. The type of video viewing used in this study appeared to be a suitable instrument for measuring university teachers' visual attention and related conceptions of teaching. We suggest that video interpretations combined with visual attention reflect teachers' conceptions of teaching and offer new insights into the area of research, which has traditionally been studied almost entirely using self-reporting instruments (see also Vilppu et al., 2019).

Our findings are very important, meaning that when a trained teacher notices on a visual level that the students need engaging, they may be able to engage them in active learning, which is considered central in high-quality teaching (cf. Lonka & Ketonen, 2012). In contrast, if a university teacher has no pedagogical training, they may not be competent in noticing situations where students need engaging. This finding proves that visual attention plays a central role in teachers' ability to focus on students.

Key Points

- Visual attention combined with verbal interpretations offers a frontline method for studying university teachers' pedagogical expertise.
- Pedagogically trained teachers paid more visual attention to the students in a situation where the students were bored and did not attend to the lecture.
- Teachers who paid visual attention to important events during teaching were also able to formulate a more accurate verbal interpretation, reflecting a learning-facilitating conception of teaching.
- Previous pedagogical training has explained differences in visual attention and verbal interpretations.
- Teaching experience as measured by the number of years teaching was not connected to visual attention and verbal interpretations.

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