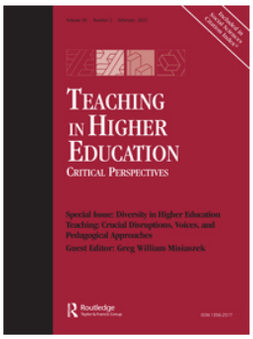

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Learning to focus on students: the effect of pedagogical training on university teachers' visual attention

Henna Vilppu, E. Anto and M. Murtonen

Department of Teacher Education, University of Turku, Turku, Finland

ABSTRACT

While the role of experience in teacher gaze has been widely studied, the role of pedagogical training remains underexplored, yet relevant in the higher education context where teachers might not have any pedagogical training. Utilising video clips of content- and learning-focused lecture situations, this triangulation mixed-method study explored the effects of a short pedagogical training on university teachers' visual attention on the elements of teaching-learning situations, their numerical evaluations of these situations and their experiences of changes in their thinking about teaching and learning. At the level of visual attention, the training was most effective for participants who did not have any previous pedagogical training: they focused more on students after the training. The reflections pointing to remarkable changes in thinking were as well made by teachers without previous pedagogical training. Additionally, all participants evaluated the learning-focused situations higher after the training. The pedagogical implications of the results are discussed.

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Pedagogical training; university teachers; eye tracking; visual attention; learning-focused teaching

Introduction

The idea of learning-focused teaching is that the teacher pays attention to students' learning and supports it instead of focusing only on the content to be taught (Vilppu et al. 2019). The focus on students' learning can be implemented at all levels of teaching, from planning to evaluation. Being able to focus on students probably enhances teacher-student interaction which has found to be crucial for student satisfaction (Wong and Chapman 2023) and their learning outcomes. One important phase is the actual teaching situation in which the teacher and the students meet. Many student-engaging and activating teaching methods have been introduced to help teachers focus on and better support their students' needs (e.g. Lonka and Ketonen 2012). However, we do not yet know much about how teachers in higher education pay attention to their students' needs in the teaching situation and, more specifically, what role visual attention plays in this process. Much research on teachers' visual perception has been conducted at primary

CONTACT Henna Vilppu henna.vilppu@utu.fi Department of Teacher Education, UTUPEDA Centre for University Pedagogy & Research, University of Turku, Assistentinkatu 5, 20014 Turku, Finland

and secondary school levels, but it is difficult to apply these results to higher education, where teaching situations are very different. For instance, at primary level, teachers may work with the same group of students for several years, whereas in higher education, the teacher may meet with the student group only once or a few times.

Teachers' visual focus in teaching situations has been studied in primary and secondary level education via their gaze. According to these studies, expert teachers' gazing is efficient, i.e. task-relevant (McIntyre, Mainhard, and Klassen 2017), knowledge-based, covers wide areas (Wolff et al. 2016), and it is focused on students (e.g. McIntyre, Mainhard, and Klassen 2017; McIntyre, Jarodzka, and Klassen 2019; Van den Bogert et al. 2014). Novices, on the other hand, tend to engage in a time-consuming and rather indiscriminate search for visual information (e.g. Van den Bogert et al. 2014; Wolff et al. 2016). Furthermore, they show longer non-student gaze durations compared to expert teachers (McIntyre, Mainhard, and Klassen 2017). While the role of experience is widely examined, the role of pedagogical training in teacher gaze remains underexplored. However, this seems relevant and worth studying, especially in the higher education context, where teachers might not have any pedagogical training, in contrast to the lower educational levels, where teachers in European countries are pedagogically qualified.

While short pedagogical courses have shown a promising effect concerning the development of teaching conceptions (e.g. Vilppu et al. 2019) and approaches (e.g. Ödalen et al. 2018) among novice and untrained university teachers, we do not know whether this effect can also be detected at the level of eye movements while viewing teaching situations. A previous study (Murtonen et al. 2022) showed that pedagogically trained university teachers tended to pay more visual attention to the students and less to the teacher than their untrained colleagues while observing teaching situations. Based on this finding, we were interested in this study whether the effect of participating in short pedagogical training can be seen in university teachers' focus of visual attention. Additionally, their evaluations of the success of teaching situations and the change in their own thinking about learning and teaching were used to support the eye-movement data. Thus, the study uses a triangulation mixed-method approach (Almalki 2016) combining quantitative eye tracking data and numerical evaluations with qualitative verbal summaries of participants' experiences of change in their thinking concerning teaching and learning to explore the effect of a short pedagogical training.

Development of learning-focused teaching skills

University teachers' ideas and practices concerning teaching have usually been examined through their conceptions and approaches to teaching. Teaching conceptions refer to the beliefs teachers have about teaching, and set a basis for why a teacher teaches in a certain way (Postareff and Lindblom-Ylänne 2008). Approaches to teaching, on the other hand, refer to the strategies adopted in teaching and inform about how a teacher would likely act in a teaching situation. Typically, conceptions are found to vary between teaching as transmission of knowledge and teaching as facilitation of learning (Kember and Kwan 2000; Prosser, Trigwell, and Taylor 1994; Samuelowicz and Bain 1992; 2001), and approaches between teacher-centred or content-focused and student-centered or learning-focused (Postareff and Lindblom-Ylänne 2008; Samuelowicz and Bain 1992;

Trigwell, Prosser, and Waterhouse 1999). Usually, conceptions and approaches emerge consistently in a way that teachers who see teaching as transmitting knowledge from teacher to students tend to choose teaching strategies that focus on delivering information (Trigwell and Prosser 1996; Kember and Kwan 2000). Correspondingly, teachers who view teaching as enhancing student learning tend to utilise learning-focused teaching strategies, such as encouraging students to construct their understanding through interaction and utilising the students' experiences in teaching. Thus, the conceptions of teaching can be seen to form a framework theory (Vosniadou 2013; Vosniadou and Skopeliti 2014; Vosniadou et al. 2020) the teacher uses in explaining and predicting everyday teaching situations, and affecting their approach to teaching.

The importance of the teacher's conception of and approach to teaching comes from the implications that they seem to have for student learning. In general, a content-focused approach to teaching is likely to be related to the adoption of a superficial approach to learning (Trigwell, Prosser, and Waterhouse 1999; Uiboleht, Karm, and Postareff 2018), which leads to a fragmented knowledge base (Lindblom-Ylänne, Parpala, and Postareff 2018). Again, a learning-focused approach to teaching seems to promote the adoption of a deep approach to learning, which often results in a coherent understanding of the subject (Entwistle 2009). Although the implications of teaching style for students' learning are not necessarily straightforward, students' cognitive activation seems to be a prerequisite for learning, and learning-focused, activating learning environments are assumed to initiate students' cognitive involvement more than traditional, content-focused settings (see Fischer and Hänze 2019).

The traditional dichotomy between content- and learning focused teaching approach and the related teaching conceptions seems to persist, although it has been criticised for being an oversimplification (e.g. MacFarlane 2014). Empirical studies have not always found support for the dichotomous patterns, but discovered new categorisations. For example, Virtanen and Lindblom-Ylänne (2010) proposed a category of 'teaching for academic achievement', consisting of multidimensional descriptions of interacting with students, and construction of students' new, research-based knowledge. Similarly, Case (2019) suggested a third approach, 'evidence-based practice', that skilfully focuses on both knowledge and pedagogical strategies to foster student engagement. Further, Wegner and Nückles (2015) brought forward yet another dimension neglected by the traditional dichotomous framework: universities as communities of practice where learning is seen as participation and enculturation into a subject community, in which the teachers are full participants. However, also the traditional framework can be seen as a continuum where teacher can hold elements of both content- and learning-focused approaches and the related conceptions, rather than a strict dichotomy. Therefore, content- and learning-focused aspects of teaching may as well co-exist in individual teacher's practices (e.g. Uiboleht, Karm, and Postareff 2016).

One of the most common ways to affect university teachers' teaching is through pedagogical training. Although pedagogical training is increasingly offered to university staff, and in some universities even required for them, in many instances, as in the context of this study, participating in training remains voluntary (Stewart 2014). Thus, while many academics are well prepared for doing research, not all have formal preparation for being teachers (Kane, Sandretto, and Heath 2002; Knight 2002).

Teachers enter pedagogical training with ideas and beliefs of teaching and learning based on their previous theoretical understanding and experiences, i.e, framework theories,

which might differ from current pedagogical theories (Vosniadou et al. 2020). In order to develop a professional understanding, teachers need to become aware of their personal beliefs and preconceptions, and start to ground their thinking on scientific knowledge (Helleve, Eide, and Ulvik 2023), a process where pedagogical training offers support. In pedagogical training, teachers are aimed to become aware of their approaches to teaching and the associated underlying beliefs and conceptions. With the help of this increasing pedagogical awareness, teaching practices can be developed (Postareff and Lindblom-Ylänne 2008). Some training approaches have been based on the conceptual change framework, with the aim of changing teachers' frameworks for conceptualising teaching and learning (Ho, Watkins, and Kelly 2001). Conceptual change is thought to proceed either through enrichment, referring to adding new information to existing conceptual structures, or through revision, involving more fundamental changes in beliefs or even at the level of the framework theory (Vosniadou 2013; Vosniadou and Skopeliti 2014).

Despite the increased offering of pedagogical training, it is not always easy to access due to limited study places and lengthy courses requiring regular attendance (Vilppu et al. 2019). These challenges have led to the development of low threshold, easily reachable, and timely online pedagogical training solutions, for which, for example, doctoral researchers and new faculty with no previous teaching experience are eligible (e.g. Murtonen et al. 2019). The idea of these online courses is to break down the traditional convention of beginning teaching at the university without any pedagogical training (Knight 2002), and thus to support early career academics in their first teaching experiences, which may be essential for their future teaching careers (Murtonen and Vilppu 2020).

Although one of the main goals of pedagogical training is to support learning-focused teaching practices (Saroyan and Trigwell 2015), it is not necessarily easy to achieve, and profound changes may be very slow (Postareff, Lindblom-Ylänne, and Nevgi 2007). In particular, teachers with extensive teaching experience seem more reluctant to change their teaching conceptions and practices compared to those with less teaching experience (Postareff and Nevgi 2015). In general, the research concerning the impact of pedagogical training on developing teaching conceptions and practices seems to be somewhat controversial: while the efficacy of pedagogical training programmes lasting less than six months to one year has been questioned (e.g. Chalmers and Gardiner 2015; Ödalen et al. 2018; Stes et al. 2010), some studies with shorter trainings have yielded promising results concerning changes in conceptions (Ho, Watkins, and Kelly 2001), especially with novice teachers (Vilppu et al. 2019). A recent meta-analysis by Ilie et al. (2020) showed that instructional development programmes for academics had an overall small effect on teachers' learning outcomes. However, the impact of these programmes has been reported based on self-reports and student-reported teaching behaviours. Thus, it would be interesting to see whether the impact of training can also be seen on the level of the participants' visual attention, i.e. eye movements.

The role of visual attention in teaching and methods for studying it

To teach effectively, teachers need to interact with and focus on their students to obtain information about students' learning by observing student behaviour in the classroom. Furthermore, teachers need to allocate their attention selectively to specific elements that are meaningful for student learning and disregard others in the complexity of

teaching–learning situations (Sherin and Jacobs 2011) and interpret the selected information appropriately (Jarodzka, Skuballa, and Gruber 2021). Selection and interpretation happen largely via visual perception, which can be captured via eye-tracking measures that offer timely and spatially accurate data on teachers' visual focus on classroom events (e.g. Gegenfurtner et al. 2020; Wolff et al. 2016). Because of the assumed close link between what the eyes are gazing at and what the mind is processing (the eye–mind hypothesis; Just and Carpenter 1980), eye fixation patterns are used to detect ongoing mental processes, combined with complementary methods such as think-aloud protocols or retrospective interviews (Van Gog et al. 2009). Eye-tracking measures offer a pathway to automatic processes, which might escape conscious awareness, and thus are not detected through self-report measures (Beach and McConnell 2018). Expertise research has revealed many interesting insights into measuring gaze duration; for example, longer gaze duration has been connected with depth of cognitive processing (Kuperman, Bertram, and Baayen 2008), importance of the viewed region (Reingold et al. 2001), and expertise in various domains (McIntyre, Mainhard, and Klassen 2017).

Studies on teacher gaze often utilise classroom videos, which provide authentic and motivating access to classroom events (Gaudin and Chaliés 2015) and are thus highly accepted as research methods (Dunekacke, Jenßen, and Blömeke 2015). Videos for research purposes may be clipped from authentic classroom events, or they may be scripted (Piwowar et al. 2018), thus enabling a clear focus on the targeted construct. An advantage in using video interpretations or video assessments is that they offer a standardised measurement (Dunekacke, Jenßen, and Blömeke 2015) and may reduce problems commonly associated with self-report measures (e.g. questionnaires and interviews), such as the risk of socially desirable responses (King and Bruner 2000; Vilppu et al. 2019).

While university teachers' focus on students has primarily been studied via their self-reported conceptions and approaches to teaching, it is essential to see where they focus their visual attention when viewing teaching situations. The eye-tracking method, combined with complementary measures, offers a new way to study teachers' focus on students, an area in which there is a paucity of research in the higher education context. A previous study showed that visual attention to important events during teaching preceded the formulation of a more accurate and learning-facilitating interpretation of the situation (Murtonen et al. 2022). Now, we want to further investigate whether attending pedagogical training has an effect on the visual attention of university teachers – are they able to focus more on students after studying the basic ideas of learning-focused teaching?

Aim of the study

The aim of the study was to examine the effects of a short online pedagogical training on participants' visual attention to elements of the teaching–learning situation (students, teacher, and slides), their evaluation of the teaching–learning situation, and their experience of the development of their own thinking about teaching and learning. The research questions were as follows:

After participating in a short online pedagogical training,

(1) How does participants' viewing of teaching–learning situations (visual attention on students, teacher, and slides) change?

(2) How do participants' evaluations of teaching–learning situations change?
(3) How do participants evaluate the development of their own thinking about teaching and learning?

Concerning all of the research questions, comparisons were made between pedagogically trained and untrained participants, as well as between current faculty and future faculty.

Materials and methods

Participants

The data collection for the study was conducted as part of a short online pedagogical training (see Context of the Study), in which a video viewing session in the eye-tracking laboratory was integrated both at the beginning and after the training. Video viewing sessions were a compulsory part of the training; however, participation in the study was voluntary, and thus, eye movements were recorded only for those participants who gave their informed consent to participate in the study. A total of 53 university teachers or doctoral students registered for the training, and 26 completed the training. Of the 26 participants, 20 gave their informed consent to use their data for research purposes, thus forming the final sample size. However, the eye-tracking data of both pre- and post-tests were usable for only 13 members of the sample due to typical challenges, such as calibration problems, in eye-movement studies (Holmqvist et al. 2011). The study received an ethical approval from the Ethics Committee for Human Sciences of the target university.

The 20 participants represented seven different faculties or units, and eight had previous studies in pedagogy or education. Ten of them completed all three courses, three participated in two courses, and seven participated in only one course. Of the participants, 13 were current faculty who had teaching duties at the university and seven were future faculty, referring to prospective teachers, such as doctoral students who did not yet have teaching duties at the university but might have them in the future (Södervik et al. 2024).

Context of the study

Studying the courses took place on an online learning platform, UNIPS.fi, where the participants studied one to three university pedagogical courses (1 European credit transfer and accumulation system (ECTS) credits each). The themes of the courses were: (1) Becoming a teacher – focusing on the basics of learning and teaching, such as constructivism, learning- and content-focused teaching, aligned teaching, motivation, metacognition, and approaches to learning. (2) Lecturing and expertise – questioning the critique of lectures, how to engage students, and the basics of the development of expertise. (3) How to plan my teaching – proposing a loop model for planning including learning goals, know your students, resources and learning environment, teaching methods and equipment, course tasks and workload, and evaluation. All the courses shared the same structure. They began with an independent study phase comprising self-study materials (e.g. journal articles, videos, glossaries, and quizzes) and a reflective essay written based on the

materials. The group study phase began after the essay was returned. The participants were divided into groups of four to six people. In these multidisciplinary groups, the participants read and commented on each other's texts online. Studying in the environment happened in English (for a more detailed description of the online learning environment, see Murtonen et al. 2019; Vilppu et al. 2019).

Procedure and measurements

The measurements took place at the beginning of the courses, i.e. before the participants became acquainted with the learning environment and content, and after the courses were completed. Thus, a pre-test–post-test design was implemented with the online pedagogy courses working as an intervention between the measurements. The courses were organised in parallel, each lasting five weeks.

In both the pre- and post-tests, the participants watched six short video clips (lasting from 1:34 to 2:49 minutes) of teaching–learning situations in an eye-tracking laboratory. The videos were scripted and acted according to the relevant literature (e.g. Postareff and Lindblom-Ylänne 2008) to focus on the targeted concepts, learning-focused and content-focused teaching. All the video clips represented lecture situations, with a teacher standing in front of a class presenting slides about the subject matter and students sitting in the lecture room (see Figure 1). In three of the clips, the teacher's teaching was more learning-focused (i.e. including student-activating elements, such as questions and pair discussions and improvising to construct teaching uniquely suited to students' needs), whereas in the other three clips, the teaching approach was more content-focused (i.e. focusing on transmitting information to the students, proceeding according to an exact, predetermined plan, and ignoring students' needs). All the participants watched the videos in the same order, starting from a content-focused situation, followed by a learning-focused situation, and so on.

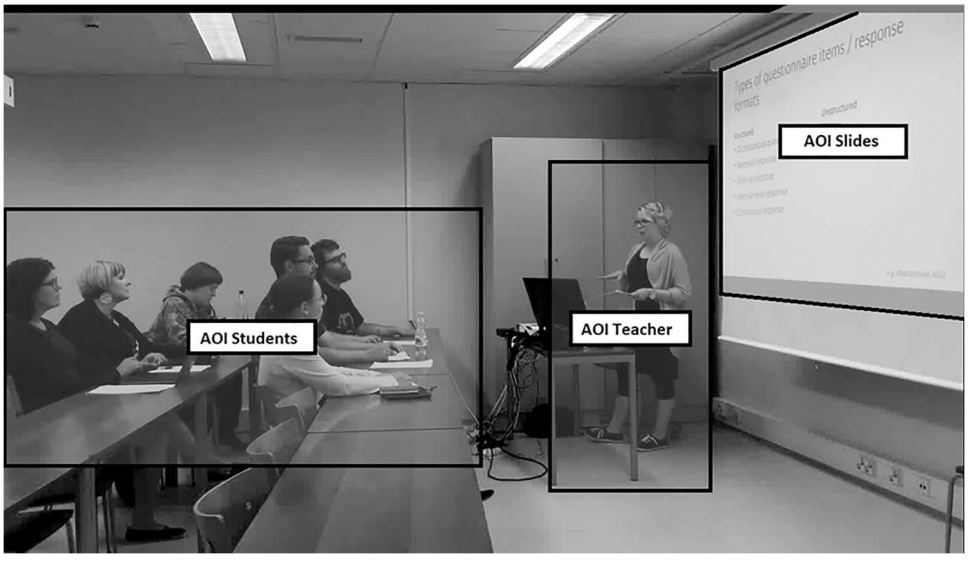

Figure 1. The areas of interest (AOIs) common to all the video clips.

While they watched each video, the participants' eye movements were recorded with a Tobii TX300 Eye Tracker (Tobii Technology, Inc., Falls Church, VA, USA). 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 guarantee a comfortable position, no supporting chin rest was used, since the eye tracker allowed even large head movements.

In a previous study (Murtonen et al. 2022), university teachers' conceptions of teaching were found to be related to their evaluation of the success of teaching; for example, the teachers who were learning-focused gave low ratings to the teaching situations portraying knowledge-transmitting teaching. Thus, in this study, we used numerical evaluations to obtain information about participants' teaching-related ideas. After watching each video, the participants were asked to rate the situation from the viewpoint of the success of teaching and learning on a scale from 1 to 5 (1 = very poor, 2 = poor, 3 = moderate, 4 = good, and 5 = very good).

To study the effect of the course on learning, the participants were asked to verbally reflect in the post-test whether they had noticed changes in their thinking about teaching and learning due to the training. We aimed to track the magnitude of their conceptual development in terms of enrichment or even revision (Vosniadou 2013; Vosniadou and Skopeliti 2014). Additionally, they were asked to answer a short questionnaire concerning background information.

Analysis

The eye-tracking data collected during the viewing of the video clips 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. All the video clips were divided into areas of interest (AOIs; see Holmqvist et al. 2011), that is, the regions in the stimulus in which the authors were interested: the students, the teacher, and the slides (see Figure 1).

Since the intake of visual information from the environment is assumed to happen largely during fixations, when the gaze is relatively still (Kok and Jarodzka 2016), fixations were used to identify where the participants focused their attention. We used the sum of fixation durations on each AOI to analyse the visual attention of the participants. Since 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 (see Murtonen et al. 2022). Thus, we would get information on how much each participant, in percentage terms, fixated on the students, on the teacher, and on the slides. Visual attention to areas other than AOIs (the so-called white space) was not considered, since the descriptive statistics showed that the number of white space fixations was minimal.

The ratings of the teaching–learning situations varying from 1 to 5 were reversed concerning the video clips representing content-focused teaching. Thus, the ratings of all videos were comparable in such a way that high values meant appreciation for learning-focused teaching. Due to non-normally distributed data in certain subgroups, the

changes in both visual attention and ratings of the teaching–learning situations were examined via non-parametric Wilcoxon signed ranks tests.

Participants' verbal reflections on the question of experiencing changes in their thinking of teaching and learning were transcribed verbatim and classified into three theory-driven categories, indicating no change in thinking, knowledge enrichment, or knowledge revision (e.g. Vosniadou 2013; Vosniadou and Skopeliti 2014). Reflections of learning in which new knowledge was added to the existing knowledge base, such as getting confirmation or clarification for one's ideas of teaching or supplementing the existing knowledge by adding new perspectives, were classified as knowledge enrichment. Knowledge revision is a more demanding process, requiring profound changes and restructuring of one's existing knowledge base. In our study, answers reflecting fundamental changes in thinking of teaching and learning, such as a change from seeing teaching as delivering content to ensuring learning, were included in this category. The length of the answers varied from 35 to 506 words, averaging approximately 188 words.

Results

The effect of short pedagogical training on viewing

The percentage share of participants' fixation durations for each AOI (students, teacher, slides) on each video was calculated. Durations from different videos were added together, so that the mean of the percentage share of fixation duration could be calculated for each participant on each AOI.

Group differences in visual attention to the AOIs within different participant groups were examined. In the pre-test, the groups of pedagogically trained vs. pedagogically untrained or the groups of future vs. current faculty had no statistically significant differences ($p > 0.05$).

When looking at the changes from pre-test to post-test of the whole group (n = 13), no statistically significant changes in visual attention took place in any of the AOIs (slides: $Z = -1.78$, $p = .08$; teacher: $Z = -.38$, $p = .70$; students: $Z = -1.29$, $p = .20$). When looking at the sub-groups from pre-test to post-test (Figure 2), among teachers with no previous pedagogical training, more visual focus was targeted at the AOI of students ($Z = -2.20$. $p = .03$) and less at the AOI of slides ($Z = -1.99$, $p = .05$), while there was no statistically significant change in visual focus on the AOI of the teacher ($Z = -1.57$, $p = .12$). Among the teachers who had previous studies in pedagogy or education, no significant changes were detected from pre-test to post-test in any of the AOIs (slides: $Z = -.31$, $p = .75$; teacher: $Z = -.52$, $p = .60$; students: $Z = -.11$, $p = .92$) (Figure 2).

Finally, the groups of future and current faculty were compared. Among the current faculty teachers, the percentage share of fixation durations on the AOI of slides decreased from pre-test to post-test; the change was statistically significant ($Z = -2.10$, $p = .04$; Figure 3). However, in other AOIs, the changes from pre-test to post-test were not statistically significant (teacher: $Z = -.42$, $p = .67$; students: $Z = -1.40$, $p = .61$). No statistically significant changes were found among future faculty, whose fixation patterns remained quite stable in all AOIs from pre-test to post-test (slides: $Z = -.14$, $p = .89$; teacher: $Z = -.14$, $p = .89$; students: $Z = -.41$, $p = .69$) (see Figure 3).

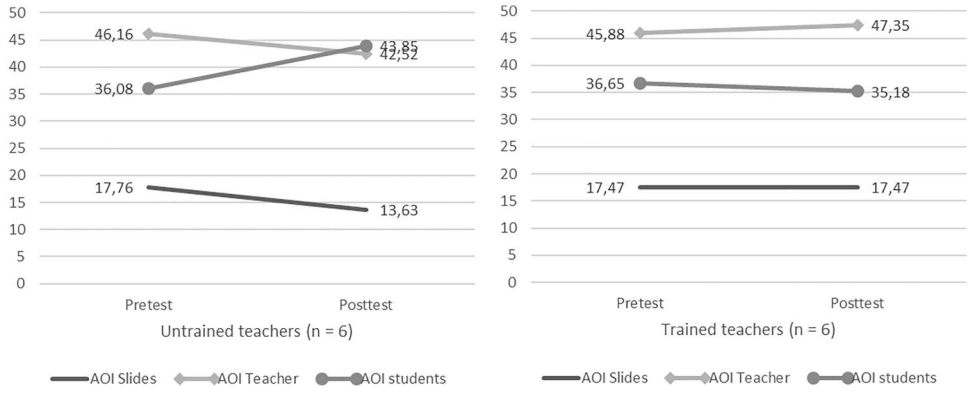

Figure 2. Untrained and trained teachers' visual attention from pre-test to post-test.

To conclude, when the levels of visual attention of the untrained teachers were compared to the other groups, there seemed to be a change in that they paid more attention to students and less to the slides at the end of the course. Additionally, current faculty reduced their visual focus to slides.

The effect of short pedagogical training on the evaluation of teaching–learning situations

Next, the effect of short pedagogical training on the evaluation of teaching–learning situations was examined through participants' ratings of the videos. After viewing each video clip, the participants rated the teaching–learning situation from 1 to 5. The scales for the content-focused situations were reversed, and all ratings were summed up. As can be seen in Table 1, all the participants shifted their ratings from pre-test to post-test in such a way that in the post-test they gave more positive evaluations of learning-focused situations than in the pre-test. The group of future faculty teachers changed their ratings the most from pre-test to post-test. Ratings of the current faculty were at a high level from the beginning of the course.

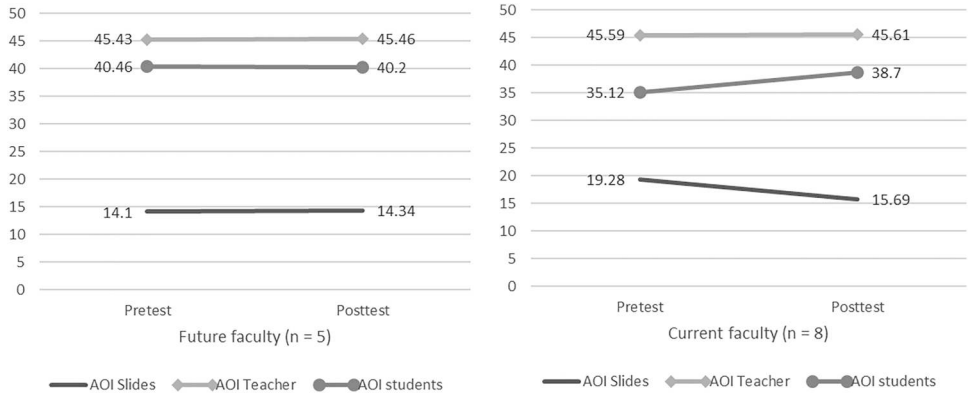

Figure 3. Future and current faculty teachers' visual attention from pre-test to post-test.

Table 1. Descriptive statistics and Wilcoxon signed ranks tests on evaluation of the teaching–learning situations within different teacher groups.

		Pre-test		Post-test				
Group	N	M	(SD)	M	(SD)	Difference	Z	*p*
All	20	3.97	(.32)	4.13	(.34)	.16	−2.01	.05*
UT	11	3.97	(.32)	4.12	(.42)	.15	−1.28	.20
PT	8	3.94	(.34)	4.15	(.26)	.21	−1.80	.07
FF	7	3.83	(.35)	4.19	(.34)	.36	−2.21	.03*
CF	13	4.04	(.29)	4.09	(.35)	.05	−.36	.72

Note. UT = untrained teachers, PT = pedagogically trained teachers, FF = future faculty, CF = current faculty. The scales for the content-focused situations were reversed. *$p < .05$.

Case analysis: the effect of short pedagogical training on the development of thinking about teaching and learning

Finally, we analysed the participants' reflections on how their thinking about teaching and learning had changed during the pedagogical training in relation to other measures utilising a case approach. In addition, we looked for examples illustrating changes in teaching conceptions and approaches to teaching, thus enrichment or revision of existing knowledge. One of the participants described no changes in thinking, while 14 referred to enrichment of their existing conceptions, and five described revision of their conceptions of teaching (see Table 2). Answers categorised as knowledge enrichment usually contained a change in one element of thinking, or confirming or supplementing one's previous thoughts. The five participants whose reflections were categorised as revision, mentioned several changes in their conceptions of teaching and learning, or even gave concrete examples of how they had now taken a new approach in their teaching. As can be seen in Table 2, the participants whose reflections illustrated revision did not have any previous pedagogical training.

In examining the respondents' descriptions in Table 2, we see that those categorised as revision referred to changes in their teaching conceptions or approaches to teaching, such as not focusing on delivering content but instead ensuring learning and engagement (ID 1), activating students (ID 2), and facilitating the students' learning process (ID 4). Some of these features can also be found in the descriptions of those categorised as enrichment.

Discussion

In this study, we explored the effect of short online pedagogical training on university teachers' visual attention to the elements of teaching–learning situations, their evaluations of these situations, and the experienced changes in their thinking about teaching and learning after participating in the training. Contrary to the most typical approaches of self-report questionnaires and interviews, we wanted to see whether the effect of pedagogical training could be seen in the level of teacher's visual attention, supported by the evaluations and self-perceived changes in thinking. As eye tracking shows automatic processes that might escape conscious awareness (Beach and McConnel 2018), we assumed we would tap into information-processing behaviours that cannot be captured by self-report measures. This mixed methods study triangulated quantitative eye tracking data with numerical evaluations and qualitative, verbal summaries of participants' experiences

Table 2. Case analysis of the participants (N = 20).

Case ID	Faculty / unit	Teaching experience	Previous pedagogical studies	Change in visual attention*	Change in ratings	Change in thinking**	Own experience of change in thinking about teaching and learning: examples of the answer
1	Economics	0–2 years	No	+13.32	+0.17	2	'The most fundamental change has been my almost complete shift to, you know, to making sure that learning actually takes place when I'm in the classroom … I have changed from first concentrating so much on delivering content … to making sure that they are curious, to formulating new questions or to challenge ideas. Most of all, my new approach has more to do with critical thinking and ideas to question their questions and question the answers that I've been giving, and I seek a justification for what the ideas are that I'm giving them … it's useful for me also that I begin to sort of shift the whole adaptation from a good presenter, and it takes away stress, as I'm not the only one doing the learning.'
2	Unknown	2–5 years	No	+3.94	−0.17	2	'This was a really eye-opening experience, since I have had difficulties sitting in a lecture as a student … In one of my recent lectures, I started this new system. I had a paper with questions they got to fill out during the lecture and a quiz at the end with the same questions … I noticed that my students activated every time I talked about topics related to the questions … I have started to look at teaching from a wider perspective than just a slide show.'
3	Medicine	No	No	+2.76	+0.17	2	'Earlier, before this course, I never tried to go deeply into the teaching because I was thinking I had, like, five years of experience and that's enough for me … this course was, like, wonderful, as I said in the beginning for me, now I can think better and better … I learned a lot of new things. I would like to improve, and I will continue.'
4	Economics	0–2 years	–	−10.56	−.17	2	'Yes, definitely … teaching can adopt different approaches to reach the students. Also, it is not only about how we teach, but how we facilitate the students' learning process … I think it has been really enlightening to know that the main point of teaching is to actually facilitate the students' learning and that also requires in turn that we think more consciously about our own teaching.'
5	Science & Engineering	No	No	–	+0.33	2	'I was not aware of many concepts … like the approaches of the learner, I think it was really useful. So yes, I think much of my previous thinking on learning and teaching has changed for the better.'
6	Medicine	0–2 years	No	+15.40	+0.83	1	'I think it became clearer how important it is to connect new information to the student's existing knowledge.'
7	Science & Engineering	No	No	+7.08	+0.67	1	'That it is important that they [students] feel that they are kind of a protagonist in the lecture and not that they are just receiving some kind

							of some knowledge from the teacher, but that their learning process is important and that they feel integrated and like a protagonist there.'
8	Humanities	0–2 years	Yes	+5.65	+0.17	1	'I have started to learn new perspectives … I guess I have certainly learned new building blocks in my teaching.'
9	Humanities	No	No	+4.10	0	1	'I have realised how many things you could take into account in teaching, and how difficult it actually is.'
10	Humanities	-	Yes	+2.11	+0.17	1	'Actually yes, because when I started the course, I thought lectures were the worst thing to have to sit in. Now, I realise that they're actually quite good, there, as a teaching method … depending on how well or how badly you prepare your lecture, it has a great influence on how the students react to it and how active they may be.'
11	Education	2–5 years	Yes	+1.64	0	1	'I learned some details about how you can produce a good lecture.'
12	Education	0–2 years	Yes	−.71	0	1	'I think I have gained confirmation for my earlier thoughts about teaching … Like, teaching is not just pouring out information, but interaction and activating prior knowledge and creating a reflective learning environment that supports learning.'
13	Science & Engineering	2–5 years	Yes	−2.00	−.17	1	'Understanding the idea of constructive alignment has made the teaching more meaningful, like it somehow facilitated my thinking.'
14	Law	0–2 years	Yes	−15.48	+0.67	1	'I'd say that I have a framework to start working and developing my skills, begin planning.'
15	Science & Engineering	0–2 years	Yes	–	+0.50	1	'Yes, it has changed, widened, I've learned new teaching methods and concepts.'
16	Education	No	Yes	–	+0.33	1	'Well, maybe I have had some confirmation [to my thinking], I have got more tools and theoretical background to support my thinking. … Like, that one should support students' learning and approach the topics from students' thoughts and questions … Like this old-style lecturing, I'm not aiming for that anymore that much.'
17	Humanities	2–5 years	No	–	0	1	'My thinking has maybe gotten more diverse … I learned some concrete ideas about how one should teach.'
18	University library	2–5 years	No	–	0	1	'A little, yes … I've got new viewpoints and competing ideas … I have more ideas to ponder when I plan my teaching.'
19	Economics	0–2 years	No	–	−0.33	1	'To some extent it has changed, but not radically, since I was thinking quite a lot of these things earlier … I've got confirmation for my thoughts.'
20	Humanities	0–2 years	No	–	0	0	'No, it hasn't changed much, if at all. Many of the ideas were already familiar to me, and there are some ideas that I simply disagree with, so that's why my thinking hasn't changed so much.'

Note. *visual attention to the AOI of students, percentual share of fixations; **0 = no change, 1 = enrichment, 2 = revision.

of change in their thinking. The results indicated that even a short pedagogical training was able to trigger changes in all the studied indicators from visual attention to teachers' ideas of teaching and learning.

Our findings showed that after participating in pedagogical training, visual attention to students increased among those university teachers who did not have any previous pedagogical studies. Furthermore, all participants, especially prospective teachers who did not yet have teaching duties at the university, evaluated learning-focused teaching–learning situations higher in quality and content-focused teaching situations lower in quality than before participating in the training.

Most of the participants identified changes in their thinking, either knowledge enrichment or more profound knowledge revision (Vosniadou 2013; Vosniadou and Skopeliti 2014). The reflections pointing to knowledge revision were made by teachers who did not have any previous pedagogical training. They referred to changes in their teaching conceptions and approaches to teaching, which were included in the content of the training. Thus, the training had an impact both on teachers' conceptualisations of their learning in the course and their visual attention. This also shows that the framework theory approach (e.g. Vosniadou et al. 2020) is suitable for analysing higher education teachers' self-evaluations of their pedagogical development.

In sum, it seems that even short online university pedagogy courses were able to change novice teachers' (i.e. pedagogically untrained or those not yet involved in teaching) visual attention, evaluation of teaching–learning situations and thinking of teaching and learning. The results are in line with a previous study showing that short pedagogical training has the potential to affect interpretations of teaching–learning situations among inexperienced teachers (Vilppu et al. 2019). Furthermore, it has been shown that pedagogically trained teachers paid more visual attention to students, especially in situations where the students were bored and not engaged in the teaching, thus requiring teacher interaction and intervention (Murtonen et al. 2022).

The strength of our study lies in the mixed-method approach and a sample consisting of university teachers participating in an authentic pedagogical training enabling pre-test–post-test comparisons. However, certain limitations need to be considered. The data collection within the training contributed to a modest sample size, although not exceptionally small, concerning the eye-tracking method (see Beach and McConnel 2018). In small samples, statistically significant differences are often undetected, indicating that we might have discovered an interesting phenomenon, since statistically significant differences were found. However, this exploratory study should be considered as a pilot, and further studies with bigger sample sizes are needed to consolidate the findings. Common with many other eye tracking studies, one limitation is that the study focuses solely on certain kind of teaching situations, that is, face-to-face classroom teaching, while at the university, teaching can take different forms from small group laboratory work to lectures with hundreds of participants. Further studies should be conducted to capture the diversity of teaching situations. Additionally, eye tracking studies with video observations tend to emphasise the 'reacting teacher', thus underestimating the role of planning of teaching (Nückles 2021). Our eye tracking design was simplistic, enabling us to get a rough idea of teachers' visual attention. The videos we used were filmed from the outsider's perspective, which is not typical compared to the teacher's perspective in eye-tracking studies (e.g. Van den Bogert et al. 2014; Wolff et al.

2016). However, in our study, the bystander perspective seemed justified, as the participants had to rate the success of teaching–learning situations, thus resembling a situation of evaluative peer observation (Torres et al. 2017).

Our study has some important pedagogical implications. First, it consolidates earlier findings that short pedagogical training have the potential to benefit early career academics in particular (Ödalen et al. 2018; Vilppu et al. 2019). Thus, pedagogical training should be offered before the first teaching tasks at the university, when teaching conceptions and approaches to teaching are being formed. Second, the potential of eye-tracking and video methods as tools for university pedagogical training should be studied further. For example, using video-stimulated recall to investigate teachers' awareness of their students' learning and their interaction skills could help make their thoughts visible and conscious (Consuegra, Engels, and Willegems 2016). Our results show that learning to focus on students also occurs at the level of visual attention, i.e. teachers should be taught to deliberately pay attention to students in teaching situations and to notice how students react to teaching and interaction, and when they need teacher intervention.

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ORCID

Henna Vilppu http://orcid.org/0000-0002-3329-686X
M. Murtonen http://orcid.org/0000-0003-2381-5731

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