Innovative Frameworks for Teacher Noticing: Video Insights into Pre-Service Trainee's Practices

Scott J. Threlfall

School of Education, University of Bolton, United Kingdom
S.Threlfall@Bolton.ac.uk

ABSTRACT

Teacher noticing is a fundamental aspect of effective teaching, yet its influence on instructional practice is not well understood. This paper presents an extended framework for teacher noticing, alongside two innovative assessment tools: the Initial Teacher Education Noticing Continuum (TEN) and the Noticing Observation Framework (NOF). Utilising a mixed-methods approach within an intrinsic case study involving nine pre-service trainee teachers, the research uncovered significant insights into the participants' professional vision. The TEN demonstrated notable sophistication in trainees' skills for selecting, reasoning, and responding, while the NOF revealed that noticing plays a crucial role in developing teacher competency. As the study progressed, the participants exhibited marked improvements in their teaching practices. These results underscore the importance of structured frameworks in elucidating the relationship between teacher noticing and effective instruction, offering valuable implications for teacher education programmes.

Keywords: noticing, professional vision, video, reflection, pre-service, trainee teachers

1. Introduction

Reflective practice is often associated with desirable professional attributes such as personal and professional growth, the ability to challenge existing practice, and acting and thinking professionally (Rodgers, 2020; Bruster & Peterson, 2013; Hickson, 2011; Mann et al., 2009). Furthermore, it is essential that trainee teachers reflect on the basis that effective reflection allows them to think critically, to solve problems, and to improve their classroom practice (Slade et al., 2019; Iqbal, 2017; Tripp & Rich, 2012). All teacher education programmes require trainee teachers to reflect (Cubero-Pérez et al., 2019; Walshe & Driver, 2019), and trainees are regularly instructed to engage in various forms of reflection. Consequently, the role of reflection and the notion of the teacher as 'reflective practitioner' have become well established (Mckenzie, 2015; Colin et al., 2013; Boud, 2010; Tummons, 2007; Rogers, 2002). However, whilst the role of reflection in the context of teacher training is widely acknowledged, the problem remains that trainees repeatedly struggle to improve their ability to reflect and the opportunity to use reflective thinking to enhance their teaching practice is limited (Rodgers, 2020; Mckenzie, 2015).

Trainees struggle to utilise reflection to make effective decisions in their classrooms as they look to bridge the gap between theory and practice (Walshe & Driver, 2019). Similarly, prospective teachers have difficulties confronting, analysing, and evaluating their own practice (Farrell & Ives, 2015). Teacher educators have, therefore, explored ways to scaffold trainee teacher reflection; the use of video is one such approach (Walsh & Driver, 2019). As a means to slow down reflection, in attempting to allow trainees to gain more understating of their practice, and in allowing them to 'notice' what occurs in the classroom, the use of video

observation technology for teacher reflection has become increasingly popular in Initial Teacher Education (ITE) (Gaudin & Chali, 2015; Goeze et al., 2014). Video provides more time for learners to reflect upon, notice, (Xu et al., 2019; Van Es et al., 2017) and respond to what happens in the classroom and to their students' needs. Consequently, the use of video in teacher professional learning has grown considerably over the past decade (Castro Superfine et al., 2019).

Multiple studies have investigated the use of video in teacher education (e.g. Atal et al., 2023; Gröschner, 2023; Lepp et al., 2023; Qian et al., 2023; Sert, 2023; Tomczyk et al., 2023; Leung et al., 2021; McCullagh, 2021; Bacova, 2019; Chen et al., 2020; Simpson & Vondrová, 2019; Chan et al., 2018). With other developments in addition to this growing research body such as technology, availability, the switch from analogue to digital, user competence, and the increasing ubiquity of mobile devices, it comes as no surprise to see an increase in the use of video to support learning in teacher education.

However, Sherin and Van Es (2009) note that few studies examine the effects of viewing video on teachers' practices outside of professional development and far too little is known about how video supports teacher learning. Furthermore, the gap grows in the research literature as there are very few studies that consider the use of video in the context of ITE in the FE & Skills Sector (14+) in the UK. This study contributes to addressing these omissions. The aim, objectives and research question for this study are presented below:

Aim: To enhance pre-service (FE & Skills Sector) trainee teachers' noticing skills as a means to improve their teaching practice, via the use of video observations of their own teaching practice.

Objectives: To create, develop and implement a noticing continuum that scaffolds support to guide trainee teachers' noticing, analysing, and responding skills (professional vision) over time; to create, develop and implement a noticing observation framework that allows for the scrutiny and assessments of classroom practice.

Research Question: How does the application of a noticing continuum impact trainee teachers' noticing, analysing, and responding skills (professional vision), and does this have an impact on future teaching episodes?

1.1. Teacher Noticing & Professional Vision

When trainee teachers reflect upon their practice using video, they have the opportunity to notice (Luna et al., 2023; Xu et al., 2019; Van Es et al., 2017), analyse, and interpret their teaching. Consequently, and as they develop their ability to notice, they may then, subsequently, expand their professional vision (Bacova, 2019; Simpson & Vondrová, 2019). Over the past decade, research has increasingly explored the concept of teacher noticing by documenting its role in teaching expertise (e.g., Amador et al., 2023; Gotwalt, 2023; McCulloch et al., 2023; Vondrová et al., 2023; Wang & Oliver, 2023; Amador et al., 2021; Walkoe et al, 2020; Fisher et al., 2019; Estapa et al., 2018; Sherin & Russ, 2015). The literature indicates that noticing for pre-service trainees (PT) may vary somewhat depending upon level (elementary, middle, secondary) in which the professional noticing takes place (Floro & Bostic, 2017; Krupa et al., 2017). Variants of teacher noticing have been the focus of research for some time (Fisher et al., 2019), researchers define it in a multitude of ways, and its origins can be traced back to the early 1970s.

Throughout studies that consider teacher noticing, the 'connecting thread' is making sense of how individuals process complex situations (Jacobs et al., 2010). Sherin and Van Es have provided the most extensive body of work on noticing in mathematics education (Sherin,

2001/2007; Sherin & Han, 2004; Sherin & Van Es, 2005/2009; Van Es & Sherin, 2002/2006/2008). In simple terms, noticing is important on the premise that when teachers pay attention to and notice what happens in the classroom, then they have more chance of responding to their students' needs. Van Es and Sherin (2002) agree on the importance of the need for teachers to be able to adapt instruction in the moment and to be able to notice aspects of classroom interactions so that they can reform their teaching.

Sherin and Van Es (Sherin, 2001, 2007; van Es & Sherin, 2008; 2006; 2005; 2002) were among the first to develop and publish a comprehensive programme of research focused on mathematics teachers' noticing. In doing so, Sherin and van Es (Sherin, 2001, 2007; Van Es & Sherin, 2008), as does this paper, drew on Goodwin's (1994) notion of professional vision (PV) as "socially organized ways of seeing and understanding events that are answerable to the distinctive interests of a particular social group to develop the notion of 'professional vision for reform teaching" (p.606). Sherin (2007) describes PV as consisting of two main subprocesses: 'selective attention' (SA) (how the teacher decides where to pay attention at a given moment-ability to notice) and 'knowledge-based reasoning' (KBR) (how a teacher reasons about what is noticed based on their knowledge and understanding-interpreting significant features). Furthermore, that these two cognitive functions act interdependently; that is to say that the kinds of interactions a teacher notices will likely influence how they reason about those events.

Chan's research (see Chan, 2023; Chan et al., 2021; Chan et al., 2018) provides an excellent point of reference to understand how others have developed teacher noticing; particularly in Chan et al's. (2021) paper where they discuss the "divergences in understanding of teacher noticing" (p.4). Important elements of the paper indicate that through the work of other researchers, the original understanding of teacher noticing, as proposed by Sherin and van Es, has been adapted and modified. Chan et al's. (2021) comprehensive review of 29 articles regarding teacher noticing found that studies operationalised teacher noticing in different ways; the vast majority of studies focused on attention and interpretation, with few considering a third element, 'next steps' as they call it.

2. Redefining the Framework for Professional Vision

In this section, I argue that the concepts of professional vision (PV) and teacher noticing should be aligned with research that identifies a crucial third element in teacher noticing (Chan, 2021; Luna, 2018; Benedict-Chambers & Aram, 2017; Benedict-Chambers, 2016; Rosebery et al., 2016; Barnhart & van Es, 2015; Weiland et al., 2014; Jacobs et al., 2010). Van Es and Sherin (2021) support this view by discussing the notion of "shaping," emphasizing that noticing involves more than merely observing and interpreting classroom events.

Therefore, noticing is an active process, not a passive one, and as Van Es and Sherin (2021) note, it is more complex than previously understood. I propose that PV can be conceptualized as a combination of three components: selective attention (SA), knowledge-based reasoning (KBR), and the resulting response (R) that follows:

1. Selective Attention (SA) refers to the teacher's ability to focus on specific aspects of classroom interactions. This could involve noticing a student's engagement level or identifying misconceptions during a lesson.

2. Knowledge-Based Reasoning (KBR) involves interpreting what has been noticed through the lens of pedagogical knowledge. For instance, a teacher might recognize a particular pattern in students' responses based on their understanding of effective teaching strategies.

3. Response (R) represents what the teacher chooses to do after noticing and interpreting the event. This can vary significantly:

- Cognitive with no action: The teacher reflects on the situation without any immediate change in practice.

- Cognitive with effective action: The teacher makes an informed decision that positively impacts student learning.

- Cognitive with ineffective action: The teacher's response may not lead to the desired outcome, indicating a need for further reflection.

This framework highlights the idea that noticing involves a sequence: first, teachers selectively attend to events, then they interpret these events based on their knowledge, and finally, they respond in some manner. Understanding these interactions is essential, particularly if the goal of research into noticing and PV is to empower teachers to better meet their students' needs in future teaching scenarios.

To illustrate this expanded framework, I propose three interrelated dimensions (see figure 1). This diagram underscores the non-linear and interconnected nature of PV, showing how each component influences the others, thus emphasizing the complexity of teacher noticing in practice.
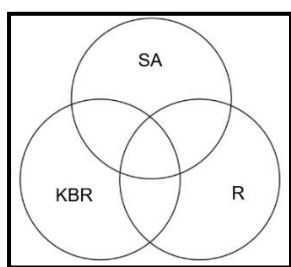

Figure. 1: A Framework for Professional Vision

3. Methodology

3.1. Positionality, Methodology and Design

This investigation adopted a non-foundational, inter-subjective and interdependent position (Smith & Sparkes, 2008), wherein there was a commitment to both the proposition that there is no real world independent of our knowledge of it (ontological relativism) and an epistemological constructivism. In this way, the participants' narratives presented in this study were formed in a dynamic and storied interface between events, imagination, significant others, routines and habits (Sparkes, 2009). Furthermore, this investigation adopted a mixed methods (MM) methodology with an intrinsic case study (Stake, 2003) research design.

3.2. Methodological Synergy: Unpacking Teacher Noticing with Mixed Methods

A mixed methods approach is increasingly justified in research on teacher noticing, especially given that prior studies have primarily relied on qualitative methods. This approach allows for a more comprehensive and nuanced understanding of this complex phenomenon, addressing a notable gap in the existing literature. Qualitative data, such as interviews and observations, provide rich insights into the cognitive processes of teacher noticing, including the thoughts, beliefs, and interpretations that shape teachers' perceptions of classroom events (Strøm &

Fagermoen, 2012). However, incorporating quantitative data—such as structured protocols [as used with the TEN here], or assessments of teacher knowledge [as deployed in this study using the NOF]—broadens the perspective on the impact of noticing on instructional practice. Quantitative data can help identify patterns and relationships between specific noticing skills and changes in teaching behaviors, thus contributing to a more holistic understanding of the teaching-learning dynamic (Fleming et al., 2018).

The integration of qualitative and quantitative data in mixed methods research can illuminate aspects of teacher noticing that may remain obscured when using a single method. For example, while qualitative insights can reveal the subjective experiences and cognitive processes involved in teacher noticing, quantitative data can provide measurable evidence of how these processes influence student learning outcomes; and in this research context, how noticing sophistication correlates to teacher competency and effective instructional practice. Recent studies have emphasised that mixed methods can address the limitations of qualitative research, such as subjectivity and limited generalisability, thereby offering a more robust framework for understanding educational phenomena (Bergman et al., 2023; Creswell & Plano Clark, 2021).

Moreover, the current educational landscape demands that research methodologies evolve to capture the complexities of teaching practice. The increasing emphasis on data-driven decision-making in education highlights the need for empirical evidence that combines the richness of qualitative insights with the reliability of quantitative metrics. A mixed methods approach not only allows for triangulation of data but also supports the development of theories that are grounded in both lived experiences and observable behaviors (Pérez & Huerta, 2022). By integrating diverse data sources, researchers can gain a deeper understanding of how teacher noticing influences instructional decisions and student learning outcomes, thus advancing the field in a way that aligns with contemporary educational challenges. Hence, as the field continues to evolve, the call for mixed methods research in teacher noticing becomes more pressing, offering pathways to enrich both theory and practice in education.

3.3. The Mixed Methods Typology

There are many different typologies of mixed methods design available to the researcher (Walker & Baxter, 2019; Creswell, 2008; Green, 2008; Hall & Howard, 2008; Green et al., 1989). Creswell and Plano Clark (2007) present a clear and effective framework for approaching mixed methods which identifies three decisions central to informing the design of a mixed methodology study (see figure 2):
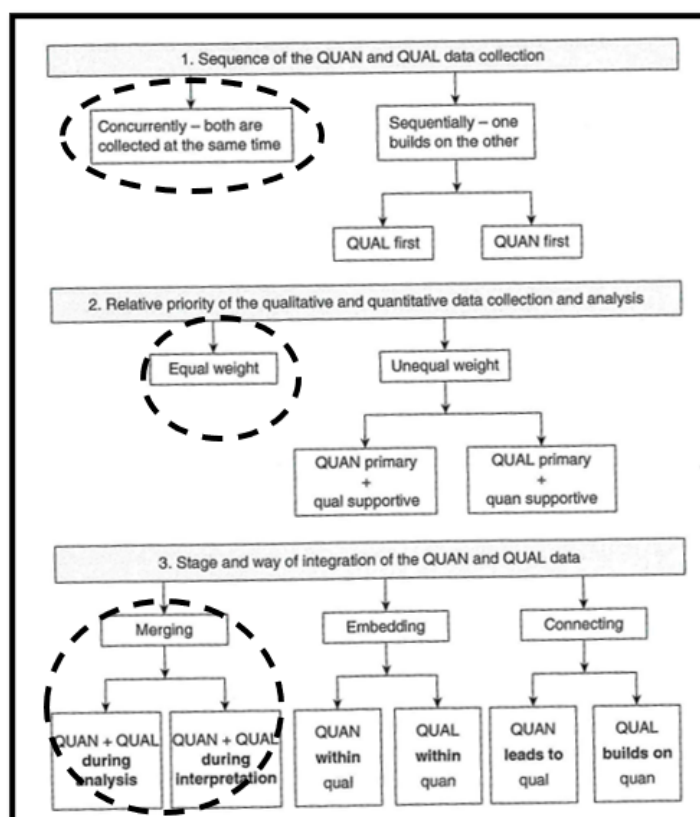
Figure 2. The Three Decisions that Inform Mixed Method Study
(Adapted from Creswell and Plano Clark, 2007).

Decision one refers to the sequencing of the mixed methods study; will data be collected at the same time, using both qualitative and quantitative methods together, or will the different methods be deployed sequentially. Two, what is the priority given to those methods in terms of use. For example, do qualitative methods predominate the mix (QUAL/quant), perhaps quantitative are used most frequently (QUANT/qual), or are they employed in the study with similar proportion and equal weighting (QUAL/QUANT or QUANT/QUAL). Decision three considers the integration and the stage of the methods (Creswell & Plano Clark, 2007). Cara (2017) refers to Creswell and Plano Clark's (2007) model noting that in decision three, it might be that the researcher uses quantitative data to identify a specific sample from which data may be collated qualitatively. Moreover, and similarly, qualitative data at the design stage of the research process may help with the development of quantitative instruments for field work (Cara, 2017).

When applying the framework to this investigation; decision one means that the sequencing of the qual and quant data occurred concurrently (the methods used over the participants' programme of study meant that qualitative and quantitative measures occurred at the same time during the data collection schedule). For decision two, a QUAL/quant priority mix was evident (Biesta, 2010). Finally, and regarding decision three, qualitative and quantitative data were merged, both during analysis and interpretation stages. The dotted circles in figure 2 identify these three decisions accordingly.

3.4. Participants

All pre-service trainees who had enrolled onto the 20-21 FE & Skills ITT PGCE programme were invited to join the research (n=18). There were a variety of subject specialisms within the cohort: Sport (*n*=8), Chemistry (*n*=2), Biology (*n*=3), Business (*n*=2), Law (*n*=1), Politics (*n*=1)

And Psychology (*n*=1). A purposive sampling strategy was deployed which considered suitability judgments. Consequently, 9 participants were identified as appropriate for the investigation; 6 with Sport specialisms (all identifying as male), 3 with Biology (all identifying as female).

3.5. Methods

The three methods used for this study were as follows:

- The Initial Teacher Education Noticing Continuum (TEN)
- The Noticing Observation Framework (NOF)
- Focus Group

3.5.1. The Initial Teacher Education Noticing Continuum (TEN)

Lienhardt et al. (1991) suggested that experienced teachers can notice '*check points*' effectively when scrutinising video recordings of teaching practice. Conversely, novice practitioners may struggle and regularly provide descriptive events of what they see to be happening on video (Lienhardt et al., 1991). Sherin and Russ' (2015) made reference to the need for schema for teaching, to fill a research gap, that allow teachers to draw on in making sense of these kinds of classroom interactions. In this way, Fisher et al. (2019) investigated the implementation of an instructional module on preservice elementary teachers' professional noticing of children's mathematical thinking. Findings indicated that attending and interpreting showed statistically significant increases. At this juncture in the discourse, the process of using scoring systems in this context such as ratings, rankings, and levels was becoming more common (Fisher et al., 2019; Stockero & Rupnow, 2017). Similarly, and more recently, Walkoe et al. (2020) found that engaging teachers in annotating and tagging videos of mathematics classrooms allowed them to notice what classroom-based issues need attending to and how they could be interpreted more effectively.

Similarly, the TEN (see Table 1) was created and developed for this investigation as an original contribution to knowledge to enable the gradual development of the trainee teachers' PV to be captured and to contribute to the research literature that has looked to establish measures of teacher noticing. In doing so and aligned to the framework proposed in figure.1, the TEN measures the level of sophistication of the three key qualities of PV: Selective Attention (SA); Knowledge-Based Reasoning (KBR); and Response (R). The TEN was implemented on 3 occasions, early, mid-year, and end of programme, with each of the participants (*n*=9); 27 measures in total, over the full duration of the participants' PGCE. Using the Statistical Package for the Social Sciences (SPSS) data taken from the TEN was applied to a series repeated measures ANOVAs to compare Levels of Sophistication (LOS) (Dependent Variable) on the three variables of Selective Attention (SA), Knowledge Based Reasoning (KBR) and Response (R).

During the noticing sessions, participants would make 'call-outs' indicating that they wanted to pause the video and discuss what they had noticed. I then made assessments during our discussions based upon the levels of sophistication that the trainees displayed in each of the three elements (SA, KBR & R) along the noticing continuum (see Table 1), ensuring that I used the descriptors within each component to allow me to identify the levels of sophistication used (low, medium or high). Moreover, how I asked questions, or if I asked them at all was an intriguing concept. I moved between a coaching and mentoring continuum with the aim to develop the research participants' ability to notice and to reflect with independence and increased levels of effectiveness as the study progressed. As the investigation developed, my

intention was to move towards a stronger coaching and non-directive approach (General Teaching Council for Scotland, 2020). Consequently, I would be able to help the developing trainee to draw upon their growing experience, knowledge, skills, and abilities to look for solutions to issues themselves as they developed their noticing and reflective skills.

Zugelder (2019) notes that systemic help for novice teachers can help them reach a level of competence and confidence that pays long-term dividends. Furthermore, that when novice teachers engage with supportive and accomplished practitioners as mentors or as coaches, they are more likely to experience satisfaction and success. I have considerable experience of mentoring and coaching, with 17 years of experience in Higher Education, having led 12 different study programmes to date, having been a teacher trainer for over a decade, and as an advanced teaching practitioner having coached and mentored numerous colleagues across different organisations as a means to develop their teaching proficiency. Therefore, I was able to facilitate debate in accordance with my knowledge, skills, and experience and specifically in line with the 'agentic context' (Stokes et al., 2020) here, that of noticing and reflection. Consequently, the incidents in which I engaged in mentoring [directive] or coaching [non-directive] occurrences were recorded during the noticing sessions, as were data pertaining to what specifically was noticed during the professional discussion, e.g., behaviour for learning (BFL), body language (B); communication (C); differentiation; group work (G); rapport (R); pace of instruction (P) etc; the codes to what was specifically noticed were recorded on the TEN as the meetings progressed.

Table 1.
The Initial Teacher Education Noticing Continuum (TEN)

Noticing Continuum		*Level of Sophistication*		
		Low (1)	**Medium (2)**	**High (3)**
Professional Vision	**Selective Attention (SA)**	Trainee misses incident and teacher trainer has to identify	Trainee is hesitant in identifying issue and requires reassurance	Trainee is assured and independently identifies and selects issue
		Code:	Code:	Code:
	Knowledge-Based Reasoning (KBR)	Little sense of highlighted event; no elaboration or analysis; little or no use of evidence to support claim	Begins to make sense of highlighted event; some use of evidence to support claims	Effective understanding of highlighted event; consistent use of evidence to support claim
		Code:	Code:	Code:
	Response (R)	Almost fully teacher led discussion; trainee struggles to identify an effective response	Trainee is partially supported in identifying what would be, or what was suitable response	Trainee leads discussion around suitability of response and clearly articulates and effective action
		Code:	Code:	Code:

3.5.2. The Noticing Observation Framework (NOF)

Sherin and Van Es (2008/2009) did not 'presuppose' that teachers would apply the behaviours developed in their research in any direct manner during their teaching. There were no explicit considerations as to how to take the information discussed 'back to the classroom'. Estapa et al. (2018) confirmed that whilst noticing allows one to attend, interpret, and reflect on classroom interactions, how these opportunities and interactions influence future classroom practice remained relatively unknown. More recent evidence continues to highlight the lack of research that considers the impact of noticing on classroom practice. For example, in Theelen et al's. (2019) study, results indicated that whilst participating pre-service trainees improved in noticing within classroom events and in applying a more theory-based terminology to describe these events, they did not measure how such developments contributed to the participants' future teaching skills. This was also true for Walkoe et al. (2020) when exploring the construct of teacher noticing and PV; the research notes that developments in teachers' attending and interpreting abilities were evident but again, there was no focus upon an effective response to an interpretation and the implications for instructional practice were not assessed.

In another original contribution to the research literature, the Noticing Observation Framework (NOF) (see Table 2 for a section of the framework) was developed for this study and allowed the trainees participating to be provided with detailed and specific feedback regarding their teaching practice that was aligned to the Education and Training Foundation's (2018) Professional Standards for Teachers and Trainers in the UK. Moreover, the instrument offered summative classifications of the trainees' practice that were more supportive for the novice teacher, e.g., 'a good start' as opposed to 'standards met'. Over the [academic] yearlong data collection period for this investigation, this observation framework was implemented with each participant on three separative occasions, 27 times collectively. As participants completed the TEN, this was followed up with me observing their video recorded teaching practice using the NOF. In doing so, data were attained that showed how noticing opportunities and interactions influenced future classroom practice, which until now, have remained relatively unknown, and particularly over extended time scales as deployed in this study. Further descriptive statistics were produced for this method to identify mean scores over time [3 separate assessments of all trainees' (n=9) teaching practice]. In line with the X axis scoring system in the framework, where 1 denotes 'excellent practice', 2 'making very good progress', 3 'a good start', and 4 'not yet effective'; lower mean values over time thus indicate improved teaching practice. Standard deviations to show levels of data variance were recorded, Partial Eta Squared measures were documented to identify effect size, and Pairwise comparisons were considered.

Table 2.
A Section of the Noticing Observation Framework (NOF)

	ETF (2018) Professional Standards	Excellent Practice (1)	Making Very Good Progress (2)	A Good Start (3)	Not Yet Effective (4)
Teaching & Resources	**3. Inspire, motivate, and raise aspirations of learners through your enthusiasm and knowledge**	Outstanding oral and non-verbal communication skills. Excellent approaches used to explain concepts.	Clear and animated delivery. Good oral and non-verbal communication skills. Concepts explained effectively	Clear delivery. Oral and non-verbal communication skills adequate. Key concepts explained satisfactorily.	Some non-verbal communication skills are ineffective. Insufficient approaches used to explain key concepts
	4. Be creative and innovative in selecting and adapting strategies to help learners to learn	A wide range of questioning techniques used to promote deeper understanding and learners' questions are handled effectively to promote learning.	Questioning techniques used effectively throughout the session to develop learning and learners' questions are dealt with well.	Some questioning used to engage learners, recap and consolidate and most learner questions dealt with appropriately	Ineffective or no questioning of learners or Inappropriate reaction to learners' questions.
		Learning environment fully exploited to enhance learning	Learning environment organised to engage all learners in the session.	Learning environment organised to facilitate intended activities.	Learning environment disorganised and/or not set up in advance.
		Well-chosen examples used to illustrate theories and/or practice.	Examples used successfully to illustrate theories and/or practice	Appropriate use of examples and references.	Inappropriate/inadequate use of examples and references
	5. Value and promote social and cultural diversity, equality of opportunity and inclusion	Excellent range of high quality, creative resources which promote diversity through effective examples.	Good range of appropriate, well-produced resources which promote diversity.	Satisfactory resources to support learning and some reference to diversity.	Resources poorly produced, stereotypical or inaccurate. Little or no awareness of diversity issues.
	6. Build positive and collaborative relationships with colleagues and learners	Level of support provided takes account of the changing learner needs.	Support for learners is clearly identified and managed	Some learners provided with individual help/support	Individual support for learners is lacking
	11. Manage and promote positive learner behavior	Highly effective group/individual learner management	Good management of individuals and group activities	Satisfactory management of individuals and group activities	Classroom management so weak that little learning can take place.

3.5.3. Focus Group

Method three occurred after the other methods had been conducted, wherein all participants attended a one hour, one off focus group. The meeting was recorded via the Zoom platform for ease of access/attendance and to support the process of transcription. Braun and Clarke (2006) distinguish between two levels of themes that may emerge from focus groups, semantic and latent. Semantic themes lay within the explicit or surface meanings of the data, with the analyst not looking for anything beyond what a participant has said or what has been written. Conversely, the latent level of analysis looks beyond what has been said, thus starting to examine underlying ideas, assumptions, and conceptualisations (Braun and Clarke, 2006). This method was adopted during this study, with all data analysed thematically by each word.

4. Results

4.1. The TEN

Data yielded from the TEN align to the first part of the research question as highlighted in italics: Research Question: *How does the application of a noticing continuum impact trainee teachers' noticing, analysing, and responding skills (professional vision),* and does this have an impact on future teaching episodes?

For SA, there was a significant main effect of Sophistication F (2,16) = 5.88, $p<.05$. Partial Eta-Squared =.42 which indicated a small effect size. Pairwise comparisons (Bonferroni) revealed that the mean scores at Time 1 and Time 3 were significantly different ($p< .05$). The remaining pairwise comparisons were non-significant. A similar pattern of results was also found for KBR, with an overall significant main effect of Sophistication across the three-time points F (2,16) = 4.93, $p<.001$. Partial Eta-Squared =.78 which indicated a large effect size. Pairwise comparisons revealed a significant increase in Sophistication between Time 1 and Time 2 ($p<.01$) and Time 1 and Time 3 ($p<.001$). The difference between Time 2 and Time 3 was non-significant. For the R condition, a significant main effect of Sophistication over time was found F (2,16) = 24.47, $p<.001$. Partial Eta-Squared =.75 which indicated a large effect size. Again, pairwise comparisons revealed a significant increase in sophistication between Time 1 and Time 2 ($p<.05$) and Time 1 and Time 3 ($p<.001$). The difference between Time 2 and Time 3 was non-significant. Finally, in observing the main effect of each condition exclusively, the three time point scores for each condition were summed, and a repeated measures ANOVA was performed. This analysis explored the difference in LOS in each category. The descriptive statistics are shown in Table 3. The results revealed an overall difference in sophistication across the three conditions (SA, KBR, and R) F(2,16) =24.58, $p<.001$. Partial Eta Squared =.75 which suggested a large effect size. Pairwise comparisons indicate that whilst there was a significant increase in the levels of Sophistication between SA and KBR ($p<.05$) and SA and R ($p<.05$), the difference between KBR and R was non-significant.

Table 3.
Mean and Standard Deviation LOS by Category

	Mean	Std. Deviation	N
SA	4.7778	1.20185	9
KBR	7.1111	.78174	9
R	7.0000	.50000	9

Furthermore, Table 4 presents a summary of mean scores and standard deviations for each dimension of the TEN (SA, KBR, R) across the three time points as a means to complement the statistical narrative emerging here.

Table 4.
Descriptive Statistics Per Dimension (SA, KBR, R) over 3 Time Points

	Mean	Std. Deviation	N
SA1	1.11	.333	9
SA2	1.56	.726	9
SA3	2.11	.782	9
KBR1	1.56	.527	9
KBR2	2.56	.527	9
KBR3	3.00	.000.	9
R1	1.44	.527	9
R2	2.56	.527	9
R3	3.00	.000	9

Data returned indicate that PT makes sense of incidents worth attending to (SA) in significantly ($p<.05$) sophisticated and progressive ways. Other compelling evidence indicates that whilst the trainees made clear progress in the SA condition, in comparison to how they analysed and interpreted those incidents (KBR), this component [SA] of the trainees' professional vision was less effective. There is also significant ($p<.001$) evidence to claim that trainees 'make sense' of what they notice in the KBR condition (analysing and interpreting) in ways which also show significantly ($p<.01$) high levels of sophistication, with significant ($p<.001$) progress made from the start to the finish of the study (time 1 to time 3), this element of their professional vision seemingly more effective than their aptitude to select incidents worthy of attention (SA). Likewise, and analysing how the PT 'make sense' of the R condition, a significant ($p<.001$) level of sophistication over time was found, with further compelling evidence presented showing this element of their professional vision is more effective than their capacity in the SA condition, whilst being proportionate to the KBR variable.

When considering cumulative prevalence of what was noticed (see figure 3), it was expected that throughout the study the trainees would notice incidents worth attending to in some of the categories initially proposed. This was the case and unsurprisingly so; as an experienced teacher trainer it was clear that these are the constituent parts of teaching, learning and assessment. More difficult to predict was the occurrence of incidents in each of those areas, with any such forecasts being dependent upon an awareness of how the trainees would notice, and how their students would behave in line with learning outcomes that changed for every session. Therefore, there were no expectations, rather there was interest when waiting for the data to emerge. Questioning and extending student learning through effective teacher-student dialogue is a difficult skill to master. Moreover, communicating content in clear and differentiated ways is another key facet to effective instructional practice. Consequently, it is not surprising that these two issues (see figure 3) were most prevalent in what was noticed via video viewing; it was anticipated that these issues would have been areas to focus on and develop with the participants. That said, careful consideration needs to be given here to an assumption that prevalence is synonymous with practice that is not yet effective, this may not have been the case. When students made 'call outs' to stop the video, to identify practice to attend to, the majority of time was spent focusing on areas for development. However, there were on the odd occasion noticing opportunities considered where trainees discussed effective practice and how best they may consolidate such pedagogical attributes. Consequently, the TEN could be further developed here, and code used to represent each category including a plus (+) or a minus (–) could be a quick and effective way of indicating if the noticing incident considered practice that was effective (+) or not (-).
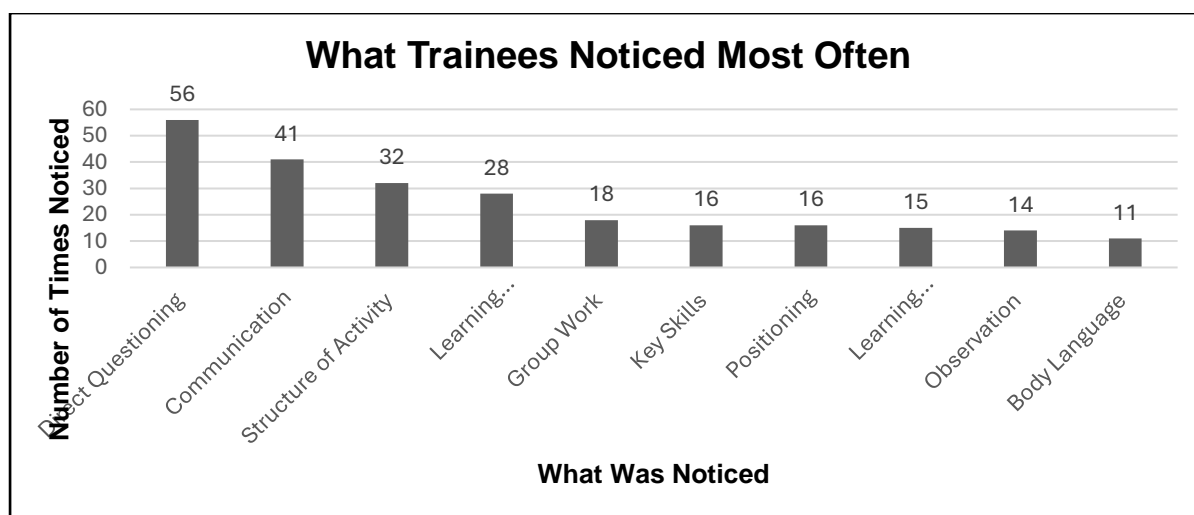
What Trainees Noticed Most Often

Figure 3. What Was Noticed by Category

Collectively during the investigation there were 317 incidents where I scaffolded support with a mentoring process, and 659 occasions where a coaching method was implemented. Therefore, between all occurrences of mentoring and coaching (976 incidents in total), 32.48% were recorded as mentoring, with 67.52% being identified as coaching. Moreover, and in all nine cases, and following the three episodes of noticing for each participant, coaching incidents were more prevalent than mentoring over time (see figure 4); linear trend lines for each dependent variable are also shown.
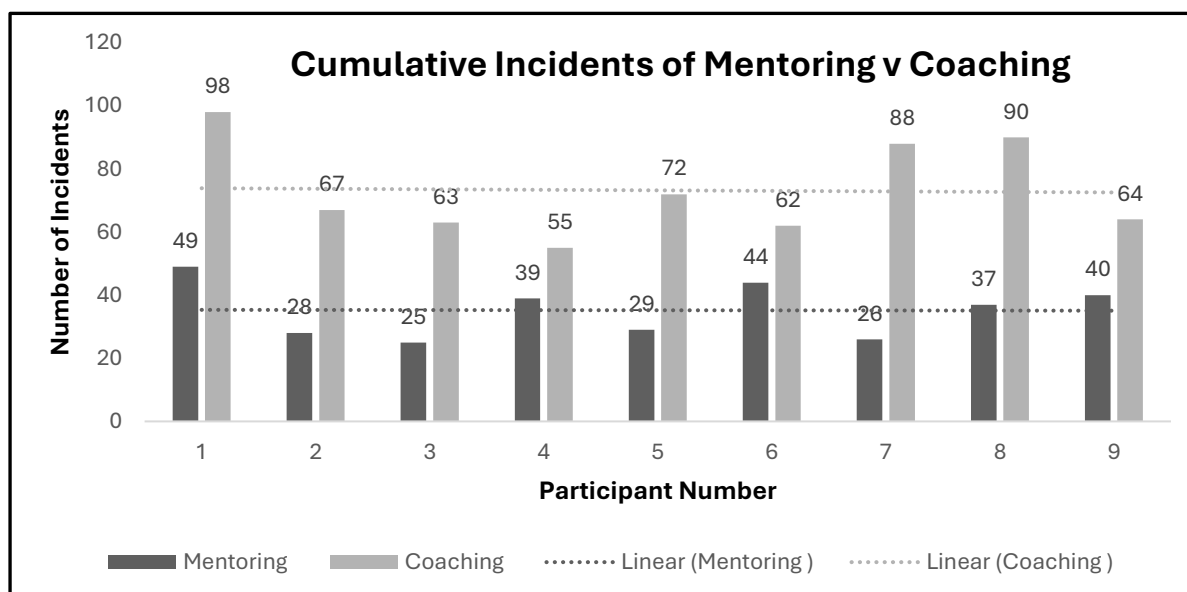
Cumulative Incidents of Mentoring v Coaching

Figure 4. Prevalence of Mentoring v Coaching Incidents

This data emerging here align to Goeze et al's. (2014) thinking that collaboration and guided instructional support/scaffolding does allow trainees to be 'cognitively flexible' when using video to reflect. The role of the facilitator cannot be understated here, an experienced professional who can effectively enable appropriate scaffolding, as Christ et al. (2017) suggest, allowed for key ideas to be highlighted, for the clarification of meaning, and provided opportunity for the trainees to engage in a deeper analysis of their practice via video viewing. Tripp and Rich (2012) highlighted the need for a systematic set of procedures to guide reflection, whilst Van Es et al. (2014) called for research that provided insight into the "evolution of facilitation" (p.353), this investigation offers such insights.

4.2. The NOF

Findings presented here that pertain to the NOF align to the latter part of the research question as highlighted in italics: Research Question: How does the application of a noticing continuum impact trainee teachers' noticing, analysing, and responding skills (professional vision), *and does this have an impact on future teaching episodes?* The descriptive statistics (see Table 5) for this measure show that mean scores (how trainees rated collectively in each of the ETF standards) decreased over time. In line with the X axis scoring system in the framework, where 1 denotes 'excellent practice', lower mean values over time thus indicate improved teaching practice. Additionally, standard deviations are consistent in that they show similar levels of variance. Data met assumptions of normality with few low and high measures recorded with most results occurring towards the centre of distribution: $F(2,16) = 17.96$ ($p<.001$). Partial Eta Squared shows a moderate to high effect size.

Table 5.
Noticing Observation Framework Descriptive Statistics

	Mean	Std. Deviation	N
1	44.7778	4.99444	9
2	36.6667	2.69258	9
3	31.8889	4.72875	9

Pairwise comparisons (see Table 6) show a mean difference between measures 1 and 2 of 8.1 ($p<.016$), between measure 2 and 3 of 4.8 ($p<.013$), and between 1 and 3 of 12.9 ($p<.006$).

Table 6.
Noticing Observation Framework Pairwise comparison

(I) IMP	(J) IMP	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference	
					Lower Bound	*Upper Bound*
1	2	8.111[*]	2.150	.016	1.627	14.596
	3	12.889[*]	2.840	.006	4.323	21.455
2	1	-8.111[*]	2.150	.016	-14.596	-1.627
	3	4.778[*]	1.222	.013	1.092	8.464
3	1	-12.889[*]	2.840	.006	-21.455	-4.323
	2	-4.778[*]	1.222	.013	-8.464	-1.092

The data presented above is extremely pleasing to see, the trainees had made continued progress with their teaching practice, and this suggests that teacher noticing may be a central concept of teacher proficiency and effective instructional practice. The difficulty in making this less than definitive claim lies in establishing the direct link between noticing, in this instance, using the TEN, and how this single and standalone measure influenced the trainees' performance in the NOF (their classroom practice). The participants in this study were also making continued progress on their preparatory teacher training programme at the same time, and thus, this no doubt exerted some influence over findings.

Also worthy of mention here is the use of the ETF professional standards as a means of assessment for the NOF. Subsequently, these standards have provided an effective means from which to assess the trainees' classroom practice. Aligned to the claims that the ETF (2022) make, this also promoted opportunities for the participants to develop their teaching and learning through reflecting on their practice and in guiding decisions on what could be developed and improved. A final note pertaining to the NOF, it was always an aspiration of this investigation that it would lead to improved teaching performance for the participants; if they were to give their time and efforts to this research process then it was seemingly fitting for them to be rewarded in this way. Consequently, I was very much aware of this throughout my

scrutiny of the PT's video footage, and as Crabtree (2019) advocates, I was continually reflexive when evaluating the trainees' practice as not to make overestimates in line with this desirable outcome. At the same time, and whilst this element of careful reflexive consideration may have minimised bias, the constructivist epistemology in action here cannot therefore claim a value-neutrality from what has emerged. Consequently, it might be that a further means to minimise the potential of assessment error in this way comes from inter rater reliability. For example, and in line with Sawada et al's. (2002) study, other teacher educators could have independently scrutinised a subset of the videos. Therefore, estimates of interrater reliability could be obtained by computing a best-fit linear regression of the observations of one observer on those of the other. Otherwise, assessors might watch videos together to come up with co-constructed measures of performance, with a subgroup of those observations moderated by other colleagues.

4.3. The Focus Group

All trainees agreed that research has clearly impacted their ability to notice to high levels of effectiveness. Moreover, there was a consensus that noticing had impacted their classroom practice, and that they could respond quicker to the demands of the classroom. All agreed that noticing should appear on spiral curriculum in preparatory teacher training programmes, the first introduction to noticing to be in with the micro teach and then spiralling in at different times in the curriculum as trainees become more sophisticated with their noticing. The notion that this investigation had supported their noticing aptitude is commensurate with evidence seen in Table 3, and the levels of sophistication that the participants demonstrated in the three variables (SA, KBR, and R); there was an overall and significant ($p<.001$) difference in sophistication across the three conditions.

4.3.1. Dialogic Openings

Mann and Walsh (2017; 2013) offer an interesting insight from their work, one that is also applicable to this study, the concept of dialogic reflection. From a sociocultural perspective, dialogic reflection is advantageous to learning and development because it enables 'interlocutors' to engage in discourse with themselves and others thus potentially facilitating the construction of knowledge (Mann & Walsh, 2013). Moreover, we should be embracing a dialogic/collaborative view of reflection [and I argue here for teacher noticing], that allows the possibility of "richer articulation and analysis", and a view that fits with the position of the social constructivist views of professional development (Mann & Walsh, 2017, p.39); and that also aligns to the epistemological positionality that this study adopts. Likewise, Li and Walsh (2023) argue that the process of dialogic reflection leads to more in-depth reflection and has greater impact on learners in terms of their autonomy and ownership of development. Li and Walsh's (2023) study indicated that "reflective practice develops incrementally over time, both in terms of teachers' ability to notice and interpret, with support provided at different stages" (p.372). Moreover, that dialogic reflection plays a significant role in teachers' development in both cognition and practice. Correspondingly, Chung (2023) continues the line of argument developing here and indicates that various researchers have emphasized the importance of reflection in teacher development and promoted the use of dialogue as an opportunity to collaborate, share experiences, and co-construct knowledge (see Vermunt et al., 2019; Svendsen, 2016; Tam, 2015 cited in Chung, 2023).

Mann and Walsh (2017) observe the ways in which understandings of new practices are gained through dialogue, noting the "importance of the 'give-and-take' in the dialogue, where interactants seek clarification, demonstrate understanding or approval, and even disagree" (p.193). In doing so, they adopt a "micro-analytic approach to transcripts, following the

principles and theoretical underpinnings of conversation analysis (CA)" (p.190). Consequently, they were interested in CA as a means to assess how "interactants achieve intersubjectivity (or shared understanding), in order to gain an *emic* (insider) perspective on a particular interaction" (p.190); and in asking what the deem as the key question in CA, why this, why now? The focus group data extract below presents a transcript and then CA of the shared understandings gained via this method.

Focus Group Data Extract

Participant 3: So, it [noticing via video viewing] gives me like – okay - this needs - this thing needs to be observed in my practice - I need to be thinking about doing this - it tells me what to focus on (1.0) tells me that I should be more cautious about this bit [element of my teaching practice] and then again - the use of video has been great - like (0.6) not only in the three times I reflected with you in the 121s - I used the videos on other occasions too - the visual element [also] worked well for me
(4.0)

→ *Researcher: can you give me some practical examples P3*
→ *(2.0)*

Participant 3: So, it gives me like what's working and what's not working - I can see my learner's [needs] more compared to when I'm teaching - when my mind is diverted - but when I'm reflecting with you using video recordings I can focus on the learners - what they are doing and what they are saying- their body language as well
(3.0)

→ *Participant 4: = It's been really beneficial when we've actually looked at video with you - and you know (0.6) I think I'll do that again - but then you actually don't because it's not normal after a lesson and you focus on the next lesson you focus on the next day of work because that's the pressing issue to focus on – so it's finding the time to use video (0.8) video is definitely beneficial though - but finding the time to do it is quite difficult*
(2.0)

→ *Researcher: what do others of you think then*
(2.0)

Participant 7: I agree – the video has been useful to look at our practice – finding time is tough- but it should be built into teacher training
(1.0)

→ *Researcher: Ok then, can you all give me a thumbs up if you agree that noticing has been useful for developing your classroom practice – a neutral thumb for somewhat – and a thumbs down for you not finding noticing useful (all 5 gave a thumbs up)*

From this data-led dialogue we see further evidence of the trainees advocating the use of video as a means to notice. Participant 3 starts but presents a rather generic response. Consequently, I facilitate a long and deliberate pause, see key point marker one, where I'm careful not to interject, and wherein I'm discreetly inviting him to continue [to take the dialogic floor]. However, I have to further extend the question thread verbally and invite the trainee to provide some practical examples at the second key point indicator. Subsequently, participant 3 offers an interesting insight into how noticing via video viewing supports his classroom practice. Thus, there is evidence here that the effective design and implementation of well-structured learning experience with iterative reflection cycles and collaborative feedback can boost preservice teacher actions, improve conscious awareness, and self-regulation. Moreover, we often say to trainees, when your practice become less about you, and more about your students, then you're getting it. In this way, teacher trainees that are in the early stages of their preparatory programmes tend to focus predominantly on themselves, worried about time management, confidence, and just getting through the lesson. Consequently, the needs of their learners can take a back seat. As Fatiha et al. (2013) remind us, we have seen these patterns in teacher education for some time, and it is not until trainees have survived the initial shock of

their training that novices are able to begin to concentrate on the important areas of long-term planning, overall student goals, and individual students' needs. Clearly this is not preferential and the whole premise of teaching and learning is that we progress students' learning. Participant 3 specifically focuses in on this point and acknowledges that video viewing had allowed him to notice more effectively in this context. Furthermore, and at the third key point marker, I once again develop co-constructed discourse through pause and silence; participant 4 takes advantage and the dialogic platform. Again, here we see him advocating the use of video to notice but with the caveat identified that time to engage in noticing can be problematic. At the fourth marker, I open the dialogue further and get agreement and confirmation from participant 7 that the noticing process has been useful, and that time is a factor to be considered when noticing via video viewing. At key point four I seek shared understandings from others. Finally, and at the concluding marker, I use a strategy that I use to assess students' learning in the classroom, but as a dialogic facilitator. Consequently, I ask the trainees to self-assess in line with the statement regarding the impact of noticing on their classroom practice. I use this strategy to assess student's progress towards their learning outcomes in lessons, but it certainly proved effective here to as a means to confirm the theme that had developed through this collaborative discourse

5. Discussion

The findings and evidence presented do allow for good insight into the research question. Further scrutiny of the data produced provide evidence that support and contradict initial expectations. When looking at the data yielded, the application of the TEN did allow for clear insight into the trainees' noticing, reasoning and responding skills (professional vision), and it has clearly had an impact on future teaching episodes.

For example, for SA, it was hoped that there would be a significant main effect of sophistication. Indeed, this was the case, and significantly with $p<.05$, thus indicating that the trainees became more efficient [sophisticated] at noticing. Moreover, it was assumed that levels of sophistication with SA would have progressed quickly initially with smaller gains latterly as the study advanced. However, the pairwise comparisons contradicted this expectation and there was only significant difference ($p<.05$) apparent between measures one and three. For KBR, and similar to SA, it was assumed that that there would be a significant main effect of sophistication; a significance of $p<.001$ supporting this prediction. Additionally, and in line with expectations, KBR data generated do show levels of sophistication that did develop quickly initially with lesser increases latterly; the pairwise comparisons confirming this with significant differences only noted between measures one and two ($p<.01$), and one and three ($p<.001$), the difference between two and three not significant. For the R (response) condition, a pattern emerged in the data in line with KBR. In this way, expected levels of sophistication did develop over time ($p<.001$), and again, quicker initial gains were apparent with a slowing of progress for the PT thereafter (time one to two ($p<.05$); time one to three ($p<.001$); time two to three not significant).

Additionally, there was difference in sophistication across the three conditions (SA, KBR, and R) $p<.001$, and this was unsurprising, in that it was unlikely that the PT would show the development of linear levels of sophistication in each of the three conditions over time. Furthermore, initial expectations were that PT would perhaps show higher levels of sophistication in SA and that they would find more challenge in KBR and R, having to reason and discuss an appropriate response to what they have noticed in SA. However, and in contrast, the pairwise data in addition to the mean scores for each condition show that the trainees exhibited less sophistication in being able to identify noteworthy occurrences to attend to (SA).

Consequently, data indicate that the participants needed support in noticing but that their aptitude to reason what was noticed, and thereafter, to suggest an appropriate response to that scenario was more effective [than SA]. Furthermore, the data yielded from the NOF has clearly allowed for the assessment of the impact of noticing on future teaching episodes. In this way, the measure worked effectively as a follow up activity to the TEN and if research on teacher noticing is to make continued progress, more studies should look to measure a tangible outcome from the noticing process, be that its impact on teaching practice, or increments in knowledge and understanding.

5.1. Relationship to Literature

A point of interest when reviewing the research literature relevant to this research question, and specifically noticing, are the limiting timescales over which noticing has been recorded in most studies (e.g. see Amador et al's. (2021) systematic literature review), and as Chan et al. (2021) remind us, the sometimes-vague methodology applied to such research activities with several studies failing to make their research positions clear. Consequently, it was difficult to make comparisons in future studies and the view on teacher noticing with such short timescales in place has been somewhat limited and lacking breadth. In contrast, this investigation has expanded the understanding of teacher noticing over an extended period. Moreover, it does so over the full duration of teacher trainees' study programme (a PGCE over one full academic year), with a rigorous methodology that has been made explicitly clear, whilst developing and implementing the TEN and the NOF. Therefore, and as Amador et al. (2021) called for, future studies that investigate teacher noticing, be they focused on teacher education or professional development more broadly, can make easier reference points and comparisons to this transparent research methodology, and it provides effective progress to the current discourse on teacher noticing.

Furthermore, it appears that Frederiksen's (1992 cited in Van Es & Sherin, 2002) thinking on the SA condition was accurate, with the author referring to this variable as *'call-outs'*, and with Frederiksen (1992) arguing that teachers can be supported to be able to identify and notice particular events in their classroom interactions. Sherin and Van Es (2005) concur, noting that there will be changes over time in what teachers notice, and they [novice teachers] can be supported in developing such skills; data yielded here do support this notion. Also noteworthy and relevant at this point of the discussion is Sherin and Russ' (2015) view that that teachers do notice some things in the classroom but that they can sometimes overlook other elements; the lower (4.7) mean data for the SA condition here falling short of the mean data recorded for KBR (7.1) and R (7). Thus, on the basis of the evidence available, it seems reasonable to suggest that trainee teachers do repeatedly overlook incidents that perhaps an experienced teacher would find significant. Other research seems to validate this line of argument with Lienhardt et al. (1991) indicating that novice practitioners may struggle to notice. Furthermore, Lienhardt et al. (1991) argue that novice practitioners regularly provide superficial and descriptive accounts of what they do happen to see occurring on video. In contrast, this research provides convincing evidence to the contrary, indicating that PT do notice with significant levels of sophistication present. Similarly, Sherin and Van Es (2008/2009) video clubs research also supports this evidence, the research findings indicating that participants do develop their professional vision through video viewing. That said, considered within the lines of this data must be an awareness of the lower comparative levels of proficiency shown in the SA variable compared to the two others (KBR and R), and that supplementary factors need to be considered when providing a challenge to the work of others in the literature.

For example, the experience and the skill of the researcher in facilitating an effective scaffolded noticing session may have had impact on the data. Austin et al. (2020) reminds us that if ineffective scaffolding is in place to support reflection with video, then superficial reflections will emerge and have limited impact upon learning. We see from the evidence concerning [significant] levels of sophistication present in the three conditions [SA, KBR and R] those trainees displayed far from descriptive accounts of their reflections when using video. Additionally, the participants' focus group data show high levels of satisfaction with the scaffolding process, with PT recommending use on all teacher training preparatory programmes. Therefore, it seems reasonable to suggest that the scaffolding process throughout this study has been effective, and as Christ et al. (2017) remind us, has afforded opportunity for the trainees to take advantage of the effective facilitation process in the 121s, thus helping them [the PT] to articulate ideas, show understanding, and to engage in levels of analysis that are sophisticated and transformational. These findings concur with others' views in that effective levels of scaffolding (Sun & Van Es, 2015; Tripp & Rich, 2012) and the use of appropriate mentoring and coaching behaviours (Stokes et al., 2020; Zugelder, 2019) are a prerequisite to effective reflection, satisfaction and 'success' with novice teachers.

Aligned to the constructivist epistemological positionality that this study adopts, and wherein the participants' narratives presented in these data sets represent a dynamic and storied interface between events, imagination, significant others, routines and habits (Sparkes, 2009), it's well placed at this juncture to consider the social-cultural element to collaborative teacher noticing. "One of the most influential perspectives on learning and professional development which has relevance to the process of reflection is the socio-cultural learning perspective" (Mann & Walsh, 2017, p.10). Castanelli (2023) notes that sociocultural learning theories (SCT) start from philosophic foundations that accentuate our connection with our environment. Thus, from the sociocultural viewpoint, "we are not isolated entities affected by context but are always a part of the social whole and cannot be separated from it" (Castanelli, 2023, p.382). Consequently, thinking and acting arises from active engagement and participation in activity and practice (noticing in this instance), wherein we both effect change and are changed in authentic social contexts (Castanelli, 2023).

Yousef and Mahameed (2022) refer to Vygotsky's sociocultural theory of learning, which was originally systematized in Russia in the 1920s and 1930s and became accessible to the Western world in the 1960s. "From a Vygotskian perspective, human cognitive activities take place in cultural contexts; the individual's relationships to others define his/her subjective life inside society" (p.241). Faldet et al. (2023) discuss the credibility of this perspective noting that Vygotsky's ideas are an important frame of reference for current educational thinking and constitute a central perspective within the field of education and SCT. Sarmiento-Campos et al. (2022) agree, arguing that Vygotsky's SCT is one of the most important theories in learning and has had a significant impact on how instruction is theorised. Mann and Walsh (2017) also acknowledge Vygotsky's work as 'central' to the SCT paradigm, where an "individual's learning potential depends on another" (p.11), and where an expert teaching practitioner can scaffold support to a novice. Vygotsky's coined the idea of 'scaffolding' support via the Zone of Proximal development (ZPD); this happens during an interactive activity when a novice and an expert work together to accomplish the desired result and is particularly applicable in the context of the application of the TEN (Sarmiento-Campos et al., 2022). McLeod (2023) writes clearly about this concept, indicating that the ZPD refers to the difference between what a learner can do without help and what they achieve with guidance and encouragement from a skilled other. Furthermore, that it [the ZPD] represents tasks beyond the learner's current abilities but are attainable with the help and guidance of the more knowledgeable other; thus, the term proximal refers to skills the learner is close to mastering, with challenge presented that

is not too hard or too easy (McLeod, 2023). This was a focus for this study in guiding the participants through the noticing workshops and in deploying mentoring and coaching strategies that allowed the preparatory teachers to develop their PV. Consequently, the role of those experienced others, that have the privilege of facilitating practitioners' professional vision via noticing cannot be underestimated. In this way, it's crucial if noticing is to be an effective strategy to support preparatory teachers, or practitioners more broadly, that those mentoring and coaching the trainees are conversant with how to scaffold support in ways that align with Vygotskian perspective, the ZPD, and the key role they play in the development of potential for intellectual growth [of the novice] through social interplay.

As was for Mann and Walsh (2017), it is argued here that this data-led evidence-based approach to reflection via video capture allows trainees and educators more widely to access an appropriate platform from which they have the potential to transform their practice. Further, that in doing so, constructivist, socio-cultural and dialogic openings are perhaps necessary to fully embrace the data-led possibilities wherein the role of the experienced other is essential in the co-constructed Vygotskian process of scaffolding; where an advance practitioner supports the novice to extend their learning beyond their current aptitude. Further still, in doing so, those that scaffold support in these ways are well placed if they engage in dialogic interplay and interlocutors (Mann & Walsh, 2017), thus understanding the power of silence, the need for negotiated understandings, disagreements, and as a consequence, embracing the possibility of a "richer articulation and analysis" (Mann & Walsh, 2017, p.39) of their data.

Also worthy of debate here is figure 1, 'The Framework for Professional Vision'. The literature informs us that teacher noticing has been operationalised in different ways (e.g. see Chan et al., 2021). Furthermore, that most studies focus on two elements of noticing, selecting and interpreting. It is argued here that this view of teacher noticing is limited and misses opportunity. Consequently, it would be prudent to see the discourse in the research literature develop more effectively in this way, for more studies to investigate and seek to understand this third element to noticing, that of a 'response'. Consequently, this investigation aligns with those few academics in the literature that do agree that there is more to noticing than attending and interpreting (e.g. Van Es & Sherin, 2021; Blömeke et al., 2015; Jacobs et al., 2011), an active and nuanced process that should preferably lead to the assessment of its [noticing's] impact on teaching practice.

Estapa et al. (2018) confirm that whilst noticing allows one to attend, interpret, and reflect on classroom interactions, little is known regarding how these opportunities and interactions influence future classroom practice. Therefore, applying the findings of this study to the research literature to compare and/or contrast the data that has emerged is difficult as to date this knowledge has been lacking. That said, what is known from this research though is that the descriptive statistics do significantly (see Table 5) show that noticing is, as Blömeke et al. (2015 cited in Van Es & Sherin, 2021) posit, central to a model of teacher competency and effective instructional practice, and as van Es and Sherin (2021) themselves put it, "at the crux of developing responsive interactions focused on students' ideas—capturing the invisible, moment by moment attention and sensemaking teachers engage in" (p.1). The progressive improvements of the trainees' classroom practice here not only supporting the idea or assumption that this may be true but provide convincing evidence that this is most certainly the case.

Consequently, this study makes no assumptions that it [noticing] might apply to follow up classroom practice. Rather, it has clearly shown here that is has had a significant impact with continued improvements in teaching practice evident. Consequently, future research should also investigate the impact of noticing on practice if it is to gain more momentum and impetus

as a go to resource and method for aspiring teachers and educators more broadly. Moreover, Simpson and Vondrová (2019) argued that PT focus their efforts more on the teacher [themselves] than their pupils, and they seemingly concentrate more on pedagogy than subject specific issues; much of the data returned from this research corresponds. For example, when looking at the findings produced by the TEN regarding what was noticed by category (see figure 3), it is evident that the trainees seem occupied with elements pertaining to pedagogy, these issues accounting for the top four measures of what trainees noticed most often (questioning, communication, activity structure, and how they communicate initial learning outcomes). It is with less prevalence that the PT concentrate on their students' progress and needs with group dynamics and key skill development returning the 5th and 6th most prevalent occurrence noticed. However, the trainees' attention soon returns to an inward gaze with pedagogical issues of positioning, learning outcome review, observation and body language being noticed most often thereafter. Consequently, teacher trainers should look to reiterate the necessity for their trainees to think more about their student's needs where possible to do so, particularly in the early stages of their development as they will no doubt be preoccupied with just getting through it.

5.2. Implications, Significance and Future Research

Van Es and Sherin (2021) remind us that for the last twenty years the research community has deemed teacher noticing as a key component of teacher expertise. Similarly, the results emerging from this study add clear support for that position and teacher education practice and policy can benefit from the insights gained here. Moreover, this study does agree that there is more that supports the development of teaching expertise in this context, that noticing should be seen to encompass three connected elements, the conceptual framework more expansive than previously conceived.

Regardless of the type of response made in the noticing process, the scaffolded noticing workshops, and the creation and implementation of the Initial Teacher Education Noticing Continuum (TEN) have provided a platform from which a clear understanding has been gained of how novice teachers select, reason, and 'respond' to the nuances of classroom practice via video viewing. Significant also was the element of the TEN that allowed for the determination of what was noticed by category, and prevalence of mentoring and coaching occurrences, and future research is warranted, using the TEN or other suitable proforma, to investigate if teachers on preparatory programmes of study notice similar noteworthy classroom incidents to attend do, and by what prevalence. Consequently, the generalizability of the Initial Teacher Education Noticing Continuum (TEN) across diverse educational and cultural contexts warrants further investigation.

Research has previously applied innovative methodologies to the study of noticing as a means to capture teacher noticing 'in-the-moment', as well as identifying the relationship between teacher noticing and teachers' instructional practices (Van Es & Sherin, 2021). However, the longitudinal application of the methodology in this study provides fresh insights into how noticing develops over an extended duration, and crucially, how that development impacts teaching practice. Subsequently, an important direction for future research involves the deployment of more studies that look to understand the nuances of noticing over more extended time frames and to further explore the explicit correlation between noticing and teacher competence.

When considering both the TEN and the NOF, and how they might be applied to preparatory teacher training programmes, across all sectors, there is initial evidence here from the data, and convincing support from the participants, that teacher noticing should become part of future

teacher training programmes' curricula. However, there appears to be some concern regarding how already extremely busy trainee teachers can be supported in these ways. Consequently, if noticing is to be advocated for inclusion on preparatory teacher programmes, then time will need to be built into their syllabi accordingly. That said, the potential for AI-based feedback to enhance the process of teacher noticing warrants exploration in light of these time pressures and the now ubiquitous take up such generative platforms.

More broadly, all teachers across all subjects, regardless of sector and subject specialism may well benefit from continued professional development in how they notice using these methods, this may be in 121 settings with advanced practitioners, or perhaps in communities of practice. Furthermore, future research would be welcomed that considers noticing via data-led video viewing in socio-cultural settings that extends to a broader demographic (i.e., nurse practitioners and sports coaches who regularly use video as a platform to reflect on their professional development).

5.3. Limitations of the Study

In interpreting the results presented here, several factors merit consideration. For example, the data presented here have emerged from social constructions from which I cannot claim a 'value-neutral' (Malaurent & Avison, 2017) position. As Crabtree (2019) postulates, this is 'insider research' my unique characteristics and education to date have no doubt contributed to this research process, and outwards to critical reflection on relationships with others involved in this investigation. A limitation to video is acknowledged in that the viewers' gaze are essentially fixed, with no control over the camera. Consequently, cautious assessment when making judgments via video viewing is required. Mann et al. (2019) agree and note another concern towards issues pertaining to audio quality. Mann et al's. (2019) report signposts a useful guide to making videos effectively (Hottmann, 2016 cited in Man et al., 2019) and care should be taken to ensure that such steps are adhered to ensure images and audio are of sufficiently good quality to aid reflection and noticing practices. An interesting idea may be to utilise technology such as Swivl's dual or multi-camera feature which may arguably capture a more comprehensive view of the classroom, with the potential to possibly help create a more holistic view of each pupil. McCoy and Lynam (2021) used such technology effectively in their study, with results indicating that the platform provided an effective means for self-reflection and for the emergence of 'embodied' introspection, with trainees reflecting on their gestures, facial expressions, tone of voice and such like.

Furthermore, the implementation of Initial Teacher Education Noticing Continuum (TEN), and the Noticing Observation Framework (NOF) require familiarisation and orientation with their operating procedures, a lack of clarity in this regard may distort any emergent data. Similarly, the TEN will require an advanced practitioner to use it effectively, to be able to work along the mentoring and coaching continuum and to be able to make effective judgments around how sophisticated trainees' levels of noticing are; this then comes with subjective judgments and this too needs be acknowledged and minimised where possible. In this way, Miller and Carney's (2009) findings indicate that supervisors can indeed find it difficult to interpret rubric criteria, that they [the assessors] can make tenuous claims about performance, and that these are likely caused by inadequate professional development regarding the use of the instruments used to assess performance. It may be prudent then, to minimise the potential of individual assessment and guidance error, if two advanced practitioners facilitate the TEN, and as a means to inter-rater reliability. Consequently, any judgments made would be less prone to subjective error. However, how realistic this is in an already time impaired vocation is admittedly questionable. As a minimum then, there needs to be sufficient professional development provided for those

making such assessments via rubrics that have potential for interpretive error, and wherein those making such judgments become conversant with how best to make those decisions in light of those criteria.

Moreover, whilst this paper highlights significant improvements in noticing skills and teaching practice attributable to the implemented noticing interventions, it is reasonable to consider alternative explanations that might account for these observed changes. One potential factor is general maturation effects; as teachers gain more experience over time, they may naturally develop enhanced observational skills and teaching efficacy (Eraut, 2004). This maturation can result from ongoing classroom interactions, increased familiarity with pedagogical strategies, and evolving student dynamics, which may lead to improved teaching outcomes (Veenman, 1984) independent of the specific interventions deployed here. Additionally, other components of the teacher education programme may have played a role in shaping these skills. For instance, exposure to diverse teaching methodologies, collaborative learning experiences with peers, and reflective practices integrated into the curriculum could have concurrently nurtured growth in noticing skills. These elements might enhance teachers' overall pedagogical knowledge and awareness, thereby contributing to their observed improvements in the study. Moreover, external factors such as professional development workshops and peer observations may have also influenced teaching practice (Timperley et al., 2007) and thus, the data yielded by the NOF. Therefore, while the noticing interventions likely contributed to the improvements evident on the data returned from this investigation, attributing these changes solely to the study's interventions overlooks the complex interplay of such potential contributors as highlighted above. Thus, future studies may be well positioned to consider these alternative explanations to strengthen the argument for the specific impact of the noticing interventions, ensuring a more nuanced understanding of how teachers develop their [noticing] skills within the multifaceted context of their professional environment.

6. Conclusion

The creation and implementation of the TEN expanded our understanding of how trainees' professional vision develops over time. Evidence indicates that trainee teachers need more support to notice noteworthy events in their classrooms when compared to reasoning what was happening and how they might effectively respond to those incidents. Furthermore, when referring to this key element of 'support', this investigation has shown the importance of the capacity of those scaffolding it to novice practitioners in this co-constructed and socio-cultural setting. Moreover, if noticing and the development of novice practitioners' professional vision via video viewing is to be facilitated effectively, then experienced educators who can discern between and deploy effective strategies of mentoring and coaching opportunity should be considered an appropriate person to take on such a role when co-constructing discourse in these ways (Mann et al., 2020). Moreover, data emerging from the Noticing Observation Framework indicate teaching practice improved over time with trainees showing significant improvements in their classroom practice. Consequently, it does appear that noticing is a central concept of teacher competency and effective instructional practice but more research is needed to better understand the longitudinal relationship of noticing to instructional expertise.

References

Amador, J. M., Gillespie, R., & Carson, C. (2023). Coaches and teachers shift noticing across coaching cycles: Analysis of video-based annotations. *Research in Mathematics Education,* 1-22. https://doi.org/10.1080/14794802.2023.2212258

Amador, J. M., Bragelman, J., & Superfine, A. C. (2021). Prospective teachers' noticing: A literature review of methodological approaches to support and analyze noticing. *Teaching and Teacher Education, 99.* https://doi.org/10.1016/j.tate.2020.103256

Atal, D., Admiraal, W., & Saab, N. (2023). 360° video in teacher education: A systematic review of why and how it is used in teacher education. *Teaching and Teacher Education, 135*, 104349. https://doi.org/10.1016/j.tate.2023.104349

Austin, D., Gilkison, A., & Clemons, J. (2020). Turning reflection into learning: A practice development tool for midwifery students. *Reflective Practice, 21*(3), 301-315. https://doi.org/10.1080/14623943.2020.1738370

Bacova, D., Telfer, S., & Griffiths, D. (2019) Video for (micro) teaching, an opportunity or a challenge ? (A mixed methods case study). *Educationalfutures, [Online] 10(2), pp. 66 – 85.*

Barnhart, T., & Van Es, E. (2015). Studying teacher noticing: Examining the relationship among pre-service science teachers' ability to attend, analyse and respond to student thinking. *Teaching and Teacher Education* 45, 83-93. https://doi.org/10.1016/j.tate.2014.09.005

Benedict-Chambers, A., & Aram, R. (2017). Tools for teacher noticing: Helping preservice teachers notice and analyse student thinking and scientific practice use. *Journal of Science Teacher Education*, 28(3), 294–318**.** https://doi.org/10.1080/1046560X.2017.1302730

Benedict-Chambers, A. (2016). Using tools to promote novice teacher noticing of science teaching practices in post-rehearsal discussions. *Teaching and Teacher Education*, 59, 28–44. https://doi.org/10.1016/j.tate.2016.05.009

Bergman, E., Hurst, A., & Martinez, S. (2023). Data Analysis Strategies for Mixed-Method Evaluation Designs. *Educational Evaluation and Policy Analysis*.

Blömeke, S., Gustafsson, J., & Shavelson, R. (2015). Beyond dichotomies: Competence viewed as a continuum. *Zeitschrift für Psy chologie*, 223(1), 3–13. https://doi.org/10.1027/2151-2604/a000194

Boud, D. (2010). *Relocating Reflection in the Context of Practice*. "In Beyond Reflective Practice: New Approaches to Professional Lifelong Learning, edited by H. Bradbury, N. Frost, S. Kilminster, and M. Zucas, 25–36. London: Routledge.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology,* 3, 77-101. https://doi.org/10.1191/1478088706qp063oa

Bruster, B. G., & Peterson, B.R. (2013). Using Critical Incidents in Teaching to Promote Reflective Practice. *Reflective Practice: International and Multidisciplinary Perspectives,* 14(2), 170–182. https://doi.org/10.1080/14623943.2012.732945

Castro Superfine, A., Amador, J., & Bragelman, J. (2019). Facilitating video-based discussions to support prospective teacher noticing. *The Journal of Mathematical Behaviour, 54*, 100681. https://doi.org/10.1016/j.jmathb.2018.10.001

Castanelli, D. (2023). Sociocultural learning theory and assessment for learning. *Medical Education, 57*(5), 382-384. https://doi.org/10.1111/medu.14901

Chan, K. K. H. (2023). Using classroom video-based instruments to characterise pre-service science teachers' incoming usable knowledge for teaching science. *Research in Science & Technological Education, 41*(1), 147-169. https://doi.org/10.1080/03057267.2020.1755803

Chan, K. K. H., Xu, L., Cooper, R., Berry, A., & van Driel, J. H. (2021). Teacher noticing in science education: Do you see what I see? *Studies in Science Education*, 57(1), 1-44. https://doi.org/10.1080/03057267.2020.1755803

Chan, K.K.H., He, C., Ng, R. C. K., & Leung, J.S.C. (2018). Student teachers' emotions when watching their own videos and those of their peers. *Journal of Professional Capital and Community*, 3(3), 192-211. https://doi.org/10.1108/JPCC-12-2017-0031

Christ, T., Arya, P., & Chiu, M. M. (2017). Video use in teacher education: An international survey of practices. *Teaching and Teacher Education, 63*, 22-35. https://doi.org/10.1016/j.tate.2016.12.005

Chung, E. (2023). Eleven factors contributing to the effectiveness of dialogic reflection: Understanding professional development from the teacher's perspective. *Pedagogies (Mahwah, N.J.), 18*(2), 268-288. https://doi.org/10.1080/1554480X.2021.2013234

Collin, S., Karsenti, T., & Komis, V. (2013). Reflective Practice in Initial Teacher Education: Critiques and Perspectives. *Reflective Practice*, 14(1), 104–117. https://doi.org/10.1080/14623943.2012.732935

Crabtree, S. M. (2019). Reflecting on reflexivity in development studies research. *Development in Practice, 29*(7), 927-935. https://doi.org/10.1080/09614524.2019.1593319

Creswell, J. W., & Plano Clark, V. L. (2021). *Designing and Conducting Mixed Methods Research* (3rd ed.). SAGE Publications.

Cubero-Pérez, R., Cubero, M., & Bascón, M. J. (2019). The reflective practicum in the process of becoming a teacher: The Tutor's discursive support. *Education Sciences, 9*(2), 96. https://doi.org/10.3390/educsci9020096

Education and Training Foundation. (2022). *Professional Standards Framework for Teachers and Trainers in Education and Training*. [online]. Available at https://www.et-foundation.co.uk/professional-standards/teachers/ [Accessed 04 April. 2023].

Eraut, M. (2004). Informal Learning in the Workplace. *Studies in Continuing Education, 26*(2), 247-273. https://doi.org/10.1080/158037042000225245

Estapa, A. T., Estapa, A. T., Amador, J., Amador, J., Kosko, K. W., Kosko, K. W., & Aming-Attai, R. (2018). Preservice teachers' articulated noticing through pedagogies of practice. *Journal of Mathematics Teacher Education, 21*(4), 387-415. https://doi.org/10.1007/s10857-017-9367-1

Faldet, A., Skrefsrud, T., Somby, H. M., Bredikyte, M., Ola Engen, T., Filipiak, E., Hakkarainen, P., Igland, M., Tveito Johnsen, E., Nes, K., Skodvin, A., Stalheim, O., & Vik, S. (2023). In Faldet A., Skrefsrud T., & Somby H. M.(Eds.), *Læring i et vygotsky-perspektiv: Muligheter og konsekvenser for opplæringen*. Cappelen Damm Akademisk/NOASP (Nordic Open Access Scholarly Publishing).

Farrell, T. S., & Ives, J. (2015). Exploring teacher beliefs and classroom practices through reflective practice: A case study. *Language Teaching Research: LTR, 19*(5), 594-610. https://doi.org/10.1177/1362168814541722

Fatiha, S., Razak, Z.A., Ahmad, S., & Sharatol, S. (2013). Novice teachers' challenges and survival: where do Malaysian ESL teachers stand? *American Journal of Educational Research*, 1(4). pp. 119-125. https://doi.org/10.12691/education-1-4-2

Fisher, M. H., Thomas, J., Jong, C., Schack, E. O., & Dueber, D. (2019). Comparing preservice teachers' professional noticing skills in elementary mathematics classrooms. *School Science and Mathematics, 119*(3), 142-149. https://doi.org/10.1111/ssm.12324

Fleming, J., Baird, D., & Choi, Y. (2018). Going beyond structured observations: Looking at classroom practice through a mixed-method lens. *ZDM – Mathematics Education*, 50(2), 235-248. https://doi.org/10.1007/s11858-018-0915-7

Floro, B., & Bostic, J. D. (2017). A case study of middle school teachers' noticing during modelling with mathematics tasks. In E. O. Schack, M. H. https://doi.org/10.1007/978-3-319-46753-5_5

Gaudin, C., & Chaliès, S. (2015). Video viewing in teacher education and professional development: A literature review. *Educational Research Review, 16*(16), 41-67. https://doi.org/10.1016/j.edurev.2015.06.001

General Teaching Council for Scotland (GTC). (2020). *Coaching and Mentoring*. [online]. Available at Coaching and Mentoring | General Teaching Council for Scotland (gtcs.org.uk) [Accessed 11 Dec. 2020].

Goeze, A., Zottmann, J. M., Vogel, F., Fischer, F., & Schrader, J. (2014). Getting immersed in teacher and student perspectives? Facilitating analytical competence using video cases in teacher education. *Instructional Science*, *42*(1), 91–114. https://doi.org/10.1007/s11251-013-9304-3

Goodwin, C. (1994). Professional vision. *American Anthropologist, 96*(3), 606-633. https://doi.org/10.1525/aa.1994.96.3.02a00100

Gotwalt, E. S. (2023). Noticing structural inequities in classroom discussions: The relationship between teacher educator pedagogies and teachers' noticing. *Teaching and Teacher Education,* 131, 104202. https://doi.org/10.1016/j.tate.2023.104202

Gröschner, A. (2023). Promoting video-based research in teacher education and professional development: A commentary on ontological, methodological and epistemological advances. *Learning, Culture and Social Interaction, 39*, 100701. https://doi.org/10.1016/j.lcsi.2023.100701

Hickson, H. (2011). Critical Reflection: Reflecting on Learning to Be Reflective. *Reflective Practice: International and Multidisciplinary Perspectives*, 12 (6), 829–839. https://doi.org/10.1080/14623943.2011.616687

Iqbal, M. Z. (2017). Reflection-in-action: A stimulus reflective practice for professional development of student teachers. *Bulletin of Education and Research, 39*(2), 65.

Jacobs, V. R., Lamb, L. L. C., & Philipp, R. A. (2010). Professional noticing of children's mathematical thinking. *Journal of Research in Mathematics Education*, 41(2), 169–202. https://doi.org/10.5951/jresematheduc.41.2.0169

Krupa, E. E., Huey, M., Leisseg, K., Casey, S., & Monson, D. (2017). Investigating secondary preservice teacher noticing of students' mathematical thinking. In E. O. Schack, M. H. Fisher., & J. Wilhelm (Eds.), *Teacher noticing—bridging and broadening perspectives, contexts, and frameworks* (pp. 49– 72). New York, NY: Springer. https://doi.org/10.1007/978-3-319-46753-5_4

Lienhardt, G., Putnam, R.T., Stein, M., & Baxter, J. (1991). Where subject knowledge matters. In P. Peterson, E. Fennema, & T. Carpenter (Eds.), *Advances in research on teaching* (pp. 87-113). Greenwich, CT: JAI Press.

Lepp, L., Leijen, Ä., Küüsvek, A., & Kalk, K. (2023). Teacher education students' first-time experiences of video-recording their teaching and analyzing it. *SAGE Open, 13*(3). https://doi.org/10.1177/21582440231196746

Leung, J. S. C., Chan, K. K. H., & He, T. C. (2021). Student teachers' metaphorical conceptualisations of the experience of watching themselves and their peers on video. *Educational Studies, 47*(3), 257-274. https://doi.org/10.1080/03055698.2019.1691505

Li, Y., & Walsh, S. (2023). Technology-enhanced reflection and teacher development: A student teacher's journey. *RELC Journal, 54*(2), 356-375. https://doi.org/10.1177/00336882231161153

Luna, M. J., Bernstein, M., & Walkoe, J. D. K. (2023). Intersections of teacher noticing and culturally sustaining pedagogy: A conceptual framework to inform the design of teacher learning. School Science and Mathematics, https://doi.org/10.1111/ssm.12611

Luna, M. J. (2018). What does it mean to notice my students' ideas in science today?: An investigation of elementary teachers' practice of noticing their students' thinking in science. *Cognition and Instruction*, 36(4), 297–329. https://doi.org/10.1080/07370008.2018.1496919

Major, L., & Watson, S. (2018). Using video to support in-service teacher professional development: The state of the field, limitations and possibilities. *Technology, Pedagogy and Education, 27*(1), 49-68. https://doi.org/10.1080/1475939X.2017.1400173

Mann, K. V., Gordon, J., & MacLeod, A. (2009). Reflection and reflective practice in health professions education: A systematic review. *Advances in Health Sciences Education*, 14(4), pp. 595–621. https://doi.org/10.1007/s10459-007-9090-2

Mann, S., Davidson, A., Gakonga, J., Harrison, T., Mossavian, P., & Richards, L. (2019). *Video in language teacher education*. London: British Council (ELTRA Research Report).

Mann, S., Crichton, R., & Edmett, A. (2020). Evaluating the role of video in supporting reflection beyond INSET, *System*, Volume 90, pp.1-24. https://doi.org/10.1016/j.system.2019.102195

Mann, S., & Walsh, S. (2017*). Reflective practice in ELT: Research-based principles and practices.* London: Routledge. https://doi.org/10.4324/9781315733395-2

Mann, S., & Walsh, S. (2013). "RP or 'RIP': A critical perspective on reflective practice" *Applied Linguistics Review*, vol. 4, no. 2, pp. 291-315. https://doi.org/10.1515/applirev-2013-0013

McCoy, S., & Lynam, A. M. (2021). Video-based self-reflection among pre-service teachers in Ireland: A qualitative study. *Education and Information Technologies, 26*(1), 921-944. https://doi.org/10.1007/s10639-020-10299-w

McCullagh, J. (2021). *Using Digital Video in Initial Teacher Education*. St Albans UK: Critical Publishing.

McKenzie. L. (2015). Trainee teachers' experience of reflection, *Journal of Further and Higher Education*, 39(5), 645-664. 10.1080/0309877X.2014.971103

McLeod, S. (2023). *Vygotsky's Zone Of Proximal Development and Scaffolding Theory*. Simple Psychology. [online]. Available at https://www.simplypsychology.org/zone-of-proximal-development.html [Accessed 15 Dec. 2023].

Miller, M. J., & Carney, J. (2009). lost in translation: Using video annotation software to examine how a clinical supervisor interprets and applies a state-mandated teacher

assessment instrument. *The Teacher Educator, 44*(4), 217-231. https://doi.org/10.1080/08878730903180200

Pérez, E. M., & Huerta, J. (2022). Teacher noticing in a mixed methods framework: Implications for practice and research. *Journal of Teacher Education*, 73(3), 260-275.

Qian, J., Shang, J., & Qin, L. (2023). A systematic scoping review of 360-degree videos in teacher education. *Journal of Research in Innovative Teaching & Learning,* https://doi.org/10.1108/JRIT-03-2023-0029

Rodgers, C. R. (2020). *The art of reflective teaching: Practicing presence*. Teachers College Press.

Rodgers, C. (2002). Defining Reflection: Another Look at John Dewey and Reflective Thinking. *Teachers College Record, 1*(4), 842-866. https://doi.org/10.1177/016146810210400402

Rosebery, A. S., Warren, B., &Tucker-Raymond, E. (2016). Developing interpretive power in science teaching. *Journal of Research in Science Teaching,* 53(10), 1571–1600. https://doi.org/10.1002/tea.21267

Sarmiento-Campos, N., Lázaro-Guillermo, J. C., Silvera-Alarcón, E., Cuellar-Quispe, S., Huamán-Romaní, Y., Apaza, O. A., & Sorkheh, A. (2022). A look at Vygotsky's sociocultural theory (SCT): The effectiveness of scaffolding method on EFL learners' speaking achievement. *Education Research International, 2022*, 1-12. https://doi.org/10.1155/2022/3514892

Sawada, D., Piburn, M. D., Judson, E., Turley, J., Falconer, K., Benford, R., & Bloom, I. (2002). Measuring reform practices in science and mathematics classrooms: The reformed teaching observation protocol. *School Science and Mathematics, 102*(6), 245-253. https://doi.org/10.1111/j.1949-8594.2002.tb17883.x

Sert, O. (2023). "It helped me grow and develop": Video-enhanced reflection and feedback in a Swedish teacher education context*. TESOL Journal*, https://doi.org/10.1002/tesj.771

Sherin, M. G. (2001). Developing a professional vision of classroom events. In T. Wood, B. S. Nelson, and J. Warfield (Eds.), *Beyond classical pedagogy: Teaching elementary school mathematics* (pp. 75-93). Hillsdale, NJ: Lawrence Erlbaum.

Sherin, M. G. (2007). The development of teachers' professional vision in video clubs. In R. Goldman, R. Pea, B. Barron, and S. Derry (Eds.), *Video research in the learning sciences*(pp. 383-395). Hillsdale, NJ: Lawrence Erlbaum.

Sherin, M. G., & Han, S. Y. (2004). Teacher learning in the context of a video club. *Teaching and Teacher Education*, 20, 163–183. https://doi.org/10.1016/j.tate.2003.08.001

Sherin, M.G., & Russ, R.S. (2015). Teacher Noticing Via Video: The Role of Interpretive Frames. In: Calandra, B. and Rich, P.J, ed., *Digital Video for Teacher Education: Research and Practice*, 1st edn. Abingdon: Routledge, part 1.

Sherin, B. L., & Star, J. (2011). Reflections on the study of teacher noticing. In: Sherin, M.G., Jacobs, V.R. and Philipp, R.A, ed., *Mathematics teacher noticing: Seeing through teachers' eyes*. New York: Routledge, pp. 66–78. https://doi.org/10.4324/9780203832714

Sherin, M. G., & Van Es, E. A. (2005). Using video to support teachers' ability to notice classroom interactions. *Journal of Technology and Teacher Education, 13*(3), 475.

Sherin, M., & Van Es, E. A. (2008/2009). Effects of video club participation on teachers' professional vision. *Journal of Teacher Education, 60*(1), 20-37. https://doi.org/10.1177/0022487108328155

Simpson, A., & Vondrová, N. (2019). Developing pre-service teachers' professional vision with video interventions: A divergent replication. *Journal of Education for Teaching, 45*(5), 567-584. https://doi.org/10.1080/02607476.2019.1674563

Slade, M. L., Burnham, T., Catalana, S. M., & Waters, T. (2019). The impact of reflective practice on teacher candidates' learning. *International Journal for the Scholarship of Teaching and Learning, 13*(2). https://doi.org/10.20429/ijsotl.2019.130215

Smith, B., & Sparkes, A. C. (2008). Contrasting perspectives on narrating selves and identities: An invitation to dialogue. *Qualitative Research: QR, 8*(1), 5-35. https://doi.org/10.1177/1468794107085221

Sparkes, A. C., & Smith, B. (2009). Judging the quality of qualitative inquiry: Criteriology and relativism in action. *Psychology of Sport and Exercise*, 10(5), 491-497. https://doi.org/10.1016/j.psychsport.2009.02.006

Stockero, S. L., & Rupnow, R. L. (2017). Measuring noticing within complex mathematics classroom interactions. In E. O. Schack, M. H. Fisher, & J. Wilhelm (Eds.), *Teacher noticing—Bridging and broadening perspectives, contexts, and frameworks* (pp. 281– 301). New York, NY: Springer. https://doi.org/10.1007/978-3-319-46753-5_17

Stokes, P., Fatien Diochon, P., & Otter, K. (2020). Two sides of the same coin?. Coaching and mentoring and the agentic role of context. *Annals of the New York Academy of Sciences*. https://doi.org/10.1111/nyas.14316

Strøm, K., & Fagermoen, M. S. (2012). Teacher noticing: The importance of teachers' reflections on their practices. *Teaching and Teacher Education*, 28(6), 894-905. https://doi.org/10.1016/j.tate.2012.07.001

Sun, J., & van Es, E. A. (2015). An exploratory study of the influence that analyzing teaching has on preservice teachers' classroom practice. *Journal of Teacher Education, 66*(3), 201-214. https://doi.org/10.1177/0022487115574103

Theelen, H., Beemt, A., & Brok, P. (2019). Using 360-degree videos in teacher education to improve preservice teachers' professional interpersonal vision. *Journal of Computer Assisted Learning, 35*(5), 582-594. https://doi.org/10.1111/jcal.12361

Timperley, H., Wilson, A., Barrar, H., & Fung, I. (2007). *Teacher Professional Learning and Development: Best Evidence Synthesis*. Ministry of Education, New Zealand.

Tomczyk, Ł., Mascia, M. L., & Guillen-Gamez, F. D. (2023). Video tutorials in teacher education: Benefits, difficulties, and key knowledge and skills. *Education Sciences, 13*(9), 951. https://doi.org/10.3390/educsci13090951

Tripp, T., & Rich, P. (2012). Using video to analyse one's own teaching. *British Journal of Educational Technology, 43*(4), 678-704. https://doi.org/10.1111/j.1467-8535.2011.01234.x

Tummons, J. (2007*). Becoming a Professional Tutor in the Lifelong Learning Sector*. Exeter: Learning Matters.

van Es, E. A., Cashen, M., Barnhart, T., & Auger, A. (2017). Learning to notice mathematics instruction: Using video to develop preservice teachers' vision of ambitious pedagogy. *Cognition and Instruction, 35*(3), 165-187. https://doi.org/10.1080/07370008.2017.1317125

van Es, E.A., & Sherin, M.G. (2002). Learning to Notice: Scaffolding New Teachers' Interpretations of Classroom Interactions. *Journal of Technology and Teacher Education*, 10(4), 571-596.

van Es, E. A., & Sherin, M. G. (2006). How different video club designs support teachers in "learning to notice." *Journal of Computing in Teacher Education*, 22, 125–135.

van Es, E. A., & Sherin, M. G. (2008). Mathematics teachers' "learning to notice" in the context of a video club. *Teaching and Teacher Education*, 24, 244–276. https://doi.org/10.1016/j.tate.2006.11.005

van Es, E. A., & Sherin, M.G. (2010). The Influence of Video Clubs on Teachers' Thinking and Practice. *Journal of Mathematics Teacher Education, 13* (2),155–176. https://doi.org/10.1007/s10857-009-9130-3

van Es, E. A., & Sherin, M. G. (2021). Expanding on prior conceptualizations of teacher noticing. *ZDM - Mathematics Education*. https://doi.org/10.1007/s11858-020-01211-4

van Es, E. A., Tunney, J., Goldsmith, L. T., & Seago, N. (2014). A framework for the facilitation of teachers' analysis of video. *Journal of Teacher Education, 65*(4), 340-356. https://doi.org/10.1177/0022487114534266

Veenman, S. (1984). Perceived Problems of Beginning Teachers. *Review of Educational Research,* 54(2), 143-178. https://doi.org/10.3102/00346543054002143

Vondrová, N., Novotná, M., Pavlasová, L., Robová, J., Stará, J., & Uličná, K. (2023). Pre-service teachers' noticing: On the way to expert target. *Scientia in Educatione,* 14(1), 27-39. https://doi.org/10.14712/18047106.2774

Walkoe, J., Sherin, M., & Elby, A. (2020). Video tagging as a window into teacher noticing. *Journal of Mathematics Teacher Education*, 23(4). https://doi.org/10.1007/s10857-019-09429-0

Wang, L., & Oliver, J. S. (2023). Prospective science teachers' noticing: An exploration in an authentic practical context. *School Science and Mathematics,* https://doi.org/10.1111/ssm.12616

Walsh, N., & Driver, P. (2019). Developing reflective trainee teacher practice with 360-degree video. *Teaching and Teacher Education, 78,* 97-105. https://doi.org/10.1016/j.tate.2018.11.009

Weiland, I. S., Hudson, R. A., & Amador, J. M. (2014). Preservice formative assessment interviews: The development of competent questioning. *International Journal of Science and Mathematics Education*, 12(2), 329–352. https://doi.org/10.1007/s10763-013-9402-3

Xu, L., Widjaja, W., & Ferguson, J. (2019). Seeing through the eyes of the teacher? investigating primary school teachers' professional noticing through a video-based research methodology. *International Journal of Research & Method in Education, 42*(5), 470-484. https://doi.org/10.1080/1743727X.2018.1499016

Yousef, N. T., & Mahameed, M. I. (2022). Reading Yeats's 'A prayer for my daughter' in light of lev Vygotsky's sociocultural theory of learning. *Theory and Practice in Language Studies, 12*(2), 241-247. https://doi.org/10.17507/tpls.1202.04

Zugelder, B. S. (2019). Beyond new teacher mentoring: The role of instructional coaching. https://doi.org/10.1080/00228958.2019.1659074