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Using 360-degree videos in teacher education to improve preservice teachers' professional interpersonal vision

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Abstract

Noticing and interpreting classroom events (professional vision) is an important element of preservice teachers' (PSTs) interpersonal competence. This paper presents a mixed-method study about a classroom simulation using 360-degree videos combined with theoretical lectures in teacher education, intended to improve PSTs' interpretations of noticed events. Furthermore, this study examined how PSTs evaluate technological and educational affordances of 360-degree videos. Results indicate that participating PSTs improved in noticing classroom events and in applying a more theory-based terminology to describe these events. PSTs perceived observing other teachers teach as an educational affordance for mastering theory and for developing insights about interpersonal teacher behaviour. Concerning technological affordances, mainly physical discomforts and technical hindrances, was reported by PSTs. The results of this study imply that 360-degree videos can be useful for teacher education to improve PSTs' interpretation of noticed events.

KEYWORDS

360-degree videos, affordances, computer-based classroom simulation, tags, teacher education

1 | INTRODUCTION

Preservice teachers (PSTs) need the ability to create positive teacher–student relationships to improve student achievement and attitudes (den Brok, Brekelmans, & Wubbels, 2004). Positive teacher–student relationships also contribute to PSTs' well-being (Wubbels et al., 2015). PSTs' actions to create positive teacher–student relationships is referred to as PSTs' interpersonal competence (Wubbels et al., 2015). Managing a positive relationship is a major concern for PSTs (Pillen, Beijaard, & den Brok, 2013), and an important reason for leaving the teaching profession (Evertson & Weinstein, 2006). Training interpersonal competence mainly takes place in the classroom during internships (Brekelmans, 2010) but can also be practiced in teacher education using computer-based classroom simulations (e.g., Dalgarno, Gregory, Knox, & Reiners, 2016; Rayner & Fluck, 2014). One way of simulating is using 360-degree videos of actual classes in order to familiarize PSTs with the professional teaching context (Beck, King, & Marshall, 2002).

This paper presents a mixed-method study about the use of 360-degree videos as an example of computer-based classroom simulations in teacher education to improve PSTs' professional interpersonal vision, and specifically the interpretations of noticed events. Interpersonal vision is an aspect of PSTs' interpersonal competence (see Section 1.1). Furthermore, this study examines how 360-degree

videos are evaluated by PSTs in terms of technological and educational affordances. In the introduction of this paper, we first operationalize the concept of professional interpersonal vision as part of PSTs' interpersonal competence. Second, we describe the use of 360-degree videos and virtual reality. Lastly, the importance of affordances of ICT will be explained.

1.1 | Preservice teachers' professional interpersonal vision

Classroom management is a major concern for PSTs (e.g., Friedman, 1995; Pillen et al., 2013) and can be one of the main reasons for PSTs to stop teaching (Evertson & Weinstein, 2006). Examples of PSTs' concerns include managing unmotivated students (Alontaga & Durban, 2013), or students' off and on task behaviour (Admiraal, Wubbels, & Korthagen, 1996). One of the goals of classroom management is to create positive teacher–student relationships (Stough & Montague, 2015). Teachers' actions to create a positive learning environment via teacher–student relationships and the meaning both students and teachers give to their relationships in the classroom are also known as teachers' interpersonal competence (Wubbels et al., 2015).

Noticing and interpreting what occurs in a classroom is an important skill for classroom management in general (Van Es & Sherin, 2002) and can be considered as an important element of PSTs' interpersonal competence. In this study, we refer to the combination of noticing and interpreting classroom events from an interpersonal perspective as PSTs' *professional interpersonal vision*. This study utilizes conceptually an adapted version of the "Learning to Notice Framework" (Van Es & Sherin, 2002), in which PSTs professional interpersonal vision consists of three key aspects, as visualized in Figure 1.

First, PSTs have to be *aware* of relevant interpersonal classroom events and maintain an ongoing awareness of what occurs in a classroom (Kounin, 1970 as cited in Wolff, 2015). Previous research has shown that experienced teachers, in contrast to PSTs, are continuously scanning the classroom, which gives them the opportunity to notice relevant classroom events at an early stage (Van den Bogert, 2016). This also gives experienced teachers the opportunity to intervene before events escalate. Furthermore, it is suggested that experienced teachers have a better overview of the classroom, which allows them to not only notice disruptive students but also to be aware of other students who are influenced by this disruption (Van den Bogert, 2016).

Second, to make sense of a noticed interpersonal classroom event, PSTs need to *interpret* a noticed event, which in turn requires *knowledge* (Van Es & Sherin, 2002). In other words, PSTs have to apply theory on interpersonal teacher behaviour to their observations. For example, when an experienced teacher notices a disruptive student, (s)he likely knows from interpersonal behaviour theory that teacher dominance evokes submissive student behaviour (Wubbels, Brekelmans, den Brok, & Van Tartwijk, 2006). Previous research has shown that experienced teachers mostly use theoretical teaching and learning principles when they interpret noticed classroom events, whereas PSTs mainly use literal descriptions to interpret an event
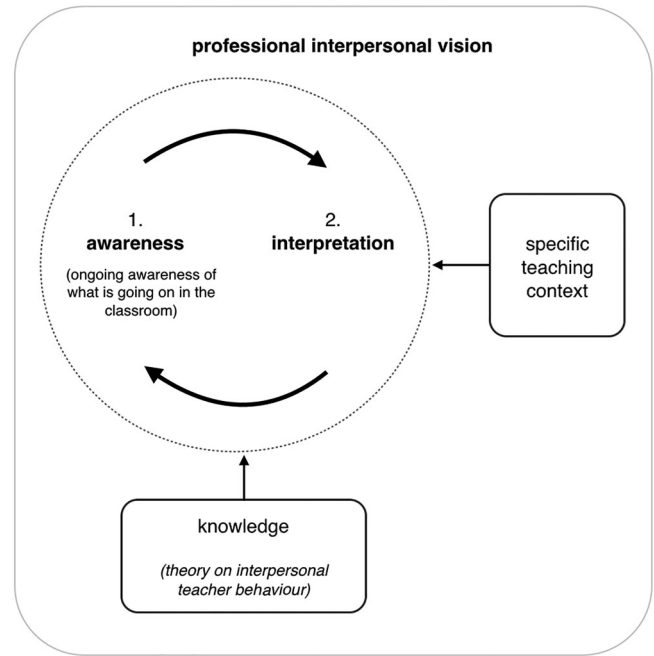

FIGURE 1 Aspects of professional interpersonal vision and their underlying relations

(Copeland, Birmingham, DeMeulle, D'Emidio-Caston, & Natal, 1994; Van Es & Sherin, 2002).

Third, noticing relevant classroom events takes place in a *specific teaching context*. For example, a history teacher makes more sense of events within a history lesson than a biology teacher (Van Es & Sherin, 2002).

Van Es and Sherin (2002) suggest that when interpretations of noticed events are on a higher level in the Learning to Notice Framework, meaning PSTs use more theory for their interpretations and being less judgmental, and PSTs have also learned to notice and discriminate relevant classroom events. Therefore, we argue there is an ongoing interaction between noticed classroom events and interpretations. After PSTs notice and interpret a relevant classroom event, they can use their interpretations to inform pedagogical decisions (Van Es & Sherin, 2002).

1.2 | Computer-based classroom simulations

Computer-based classroom simulations can be used to enable PSTs to become more aware of relevant classroom events (Dalgarno et al., 2016; Ferry, Kervin, Cambourne, Turbill, & Hedberg, 2005). However, awareness is only one aspect of professional interpersonal vision. It is yet to be determined whether computer-based classroom simulations can stimulate PSTs' application and retrieval of knowledge for interpretations of noticed classroom events as part of their professional interpersonal vision (Theelen, van den Beemt, & den Brok, 2019).

Computer-based classroom simulations provide representations of real classroom events in which PSTs and teacher educators have control over content, training structure, and timing of classroom events

(Clark & Mayer, 2011). Using classroom simulations, PSTs can learn safely from performing tasks within an authentic learning environment (Rayner & Fluck, 2014). These authentic tasks offer PSTs real-life experiences before entering a real classroom (Herrington & Oliver, 2000). Therefore, we argue that classroom simulations can ease the transition from teacher education to professional teaching contexts.

One type of content in simulations is video, which can provide PSTs with real-life authentic cases (Beck et al., 2002). Compared with traditional assignments in teacher education, videos can capture the richness and complexity of classrooms and appear to be useful in bridging the gap between teacher education and the professional teaching context (Gomez, Sherin, Griesdorn, & Finn, 2008). Previous studies have reported the usefulness of videos in teacher education to prepare PSTs for the professional teaching context (e.g., Asan, 2003; Blomberg, Sherin, Renkl, Glogger, & Seidel, 2014; Santagata & Guarino, 2011).

PSTs can use videos to reflect on their own teacher behaviour, using for example the video-stimulated recall method (e.g., Muir, 2010; Pirie, 1996; Powell, 2005). In this method, PSTs watch videotaped passages of their own lessons to reflect on in a dialogue between the PST and a researcher. These dialogues are focused on thinking about aspects of the teaching practice (Powell, 2005), which provides opportunities to relive the classroom event and to verbalize the original thought processes in retrospect (Pirie, 1996).

Besides being used as a reflective tool, videos also appear useful for watching other teachers teach (Star & Strickland, 2008). Videos provide illustrations of teaching and learning theories and provide PSTs the opportunity to watch videos together and discuss their observations (Star & Strickland, 2008). By watching videos, PSTs can learn from examples of different teachers, students, settings, and pedagogies (Star & Strickland, 2008). This way, PSTs can reflect on classroom interactions and learn about teacher behaviour (Sherin & Van Es, 2005). Videos appear to be useful to notice, analyse, and reason about teacher and student behaviour (Santagata & Guarino, 2011).

Regarding PSTs' professional vision, watching and discussing videos can influence which classroom events PSTs notice and how PSTs discuss these classroom events over time (Sherin & Van Es, 2005). For example, in one study (Sherin & Van Es, 2005), PSTs focused at the beginning of the study on every classroom event they noticed. Later on, they only focused on classroom events that were relevant to react on. Furthermore, PSTs' discussions became more interpretative instead of evaluative. Likewise, Star and Strickland (2008) found that PSTs significantly improved their ability to notice important classroom events. These PSTs specifically noticed classroom management events while watching videos, which is not surprising because problems related to classroom management are one of the most pressing concerns for PSTs (Pillen et al., 2013) and consequently attract PSTs attention.

1.3 | 360-Degree videos

Recent technological developments enable video simulations to be enriched using 360-degree cameras (Aguayo, Cochrane, & Narayan,

2017). 360-Degree cameras are becoming more affordable (Aguayo et al., 2017), and mobile devices (e.g., smartphone and tablet) have become powerful enough to play 360-degree videos (Martín-Gutiérrez, Mora, Añorbe-Díaz, & González-Marrero, 2016). We argue that 360-degree videos are more useful in teacher education than traditional video for watching experienced teachers teach, because 360-degree videos enable PSTs to continuously choose their own perspective when observing classroom interactions rather than viewing from a fixed perspective, which can help PSTs to understand classroom dynamics. Studies in other domains that compared 360-degree videos with traditional videos showed promising results in favour of 360-degree videos (e.g., Schöne, Wessels, & Gruber, 2017; Yoganathan, Finch, Parkin, & Pollard, 2018). Participants in the study of Schöne et al. (2017) watched either a 360-degree video with virtual reality (VR) or a traditional video of a motorcycle ride, followed by an unannounced recognition memory task 2 days later. VR-group participants experienced the video as more realistic and performed better in the memory task. Similarly, in the domain of surgery, doctors in the 360-degree VR condition outperformed doctors in the traditional video condition when learning surgical knot tying skills (Yoganathan et al., 2018).

PSTs can watch 360-degree videos with VR headsets (Figure 2). VR headsets are becoming reasonably priced (Martín-Gutiérrez et al., 2016; Olmos, Cavalcanti, Soler, Contero, & Alcañiz, 2018), and online platforms such as YouTube make it possible to share 360-degree videos (Aguayo et al., 2017).

Real-life classroom events can be displayed via VR and provide learners sensory and imaginary experiences similar to real-life experiences (Yoh, 2001). Watching 360-degree videos with VR headsets appear to be more attractive to learners because of the immersive user experience (Martín-Gutiérrez et al., 2016), which disconnects the user from (distracting factors of) the "real world" (Olmos-Raya et al., 2018). VR gives a feeling of presence (Yoh, 2001) and a sense of embodiment (Kilteni, Groten, & Slater, 2012) in a virtual environment. This way, the user is involved in a realistic and authentic situation without being physically present (Martín-Gutiérrez et al., 2016). VR experiences can help bridge the gap between theory and actual teaching practice (Dede, 2009).

FIGURE 2 VR headset [Colour figure can be viewed at wileyonlinelibrary.com]

1.4 | Information and communication technology affordances

When using technology to design simulations, information and communication technology (ICT) affordances play an important role. ICT affordances in the context of this study can be defined as the perceived and actual properties of technology that determine how the simulation possibly could be used (Salomon, 1993, as cited in Conole & Dyke, 2004). For example, simulations can provide an immersive experience (feeling of being present in an authentic situation) when watching 360-degree videos with a VR headset. Three types of affordances can be distinguished: technological, which relate to the technology itself; social, which offer opportunities for interaction; and educational, which determine how learning takes place (Kirschner, Strijbos, Kreijns, & Beers, 2004). When designing and evaluating simulations using advanced technology, it is important to take all types of affordances into account. However, the 360-degree videos do not provide opportunities for interaction, which excludes evaluation of social affordances in this study. Our focus lies, therefore, on the remaining technological and educational affordances, both of which are distinctly relevant because the technology is new and the effect on both affordances are not or only minimally researched.

1.5 | Aim and research questions

We are interested to see if PSTs' interpretations of noticed events as representations of their interpersonal knowledge, the *second* key aspect of professional vision, can be improved using a virtual classroom. A virtual classroom is defined in the present study as a computer-based classroom simulation containing videos.

The main research question of our study is: *How can the virtual classroom improve PSTs' level of interpretation of noticed classroom events as part of their professional interpersonal vision?* Because ICT affordances are important when evaluating 360-degree videos, we are also interested in how the videos are evaluated by PSTs in terms of technological and educational affordances. This leads to a second research question: *How is the virtual classroom evaluated by PSTs in terms of technological and educational affordances?*

2 | DESIGN OF THE VIRTUAL CLASSROOM

Three 2-hr sessions were created to combine theoretical lectures via a regular setting and watching 360-degree videos, which provides an addition to the regular teacher education setting. The combination of watching videos and theoretical lectures was made because it was found for simulation games that if these simulations were embedded in a program of instruction, learners had higher knowledge levels than learners involved in simulation game without additional instruction (Sitzmann, 2011). The composition of the three sessions was adapted from the Learning to Notice Framework (see Figure 1). Before watching a 360-degree video, PSTs received a theoretical lecture about interpersonal teacher behaviour, which guided the PSTs on how to watch 360-degree videos. These theoretical lectures included the systems approach to communication (Watzlawick, Beavin, & Jackson, 1967; Wubbels et al., 2006), the Teacher Interpersonal Circle (den Brok & Van Tartwijk, 2015; Wubbels et al., 2006), and teachers' verbal and non-verbal behaviour (Van Tartwijk, 1993). Guided whole class 360-degree video watching was conducted to encourage PSTs to observe systematically, to make PSTs *aware* of relevant classroom events and to activate their *knowledge* about interpersonal teacher behaviour. After watching a 360-degree video, PSTs discussed their *interpretations* of observed classroom events first in small groups, and later on with the entire class. These discussions provide PSTs with the opportunity to learn from examples of different teachers, students, settings, and pedagogies (Star & Strickland, 2008), to reflect on classroom interactions (Sherin & Van Es, 2005), and to analyse and reason about teacher and student behaviour (Santagata & Guarino, 2011).

During three sessions, PSTs watched fifteen 360-degree video fragments of 10 experienced teachers within secondary education, using YouTube on their mobile phones in a VR headset. The videos each contained one or more of the following classroom events, which are important for the teacher–student relationship: (a) the beginning of a lesson, (b) a moment of instruction, (c) stimulating students to work, (d) disruptive behaviour, (e) comments of students, (f) disappointed students' performances, (g) questions or feedback from students, and (h) the transition between two different phases of the lesson (e.g., from instruction to work independently on the teaching materials; Admiraal, 1994; Admiraal et al., 1996; Wubbels et al., 2006). The length of videos varied from 47 s to 4 min and 48 s, with an average time of 3 min and 8 s.

3 | METHOD

3.1 | Participants

All participants were 141 first year PSTs of a teacher education program in the Netherlands (81♀) aged between 16 and 28 years old, with little or no teaching experience. This teacher education program prepares PSTs for the secondary education context and is representative for teacher education institutes in the Netherlands. These PSTs were from eight different domains (Table 1). For the intervention, they were divided into nine classes. This distribution was made based on group sizes and class schedules. The domain of English was divided into three separate classes, History was divided into two separate classes, Dutch language and Physics were combined into one group, and Geography and Economy were combined into one group. The first author taught all groups. This study followed the research guidelines for social scientific studies from the Association of Universities in the Netherlands (2014). PSTs participated voluntarily in this study and gave their informed consent.

TABLE 1 Number of PSTs per domain

	Number of PSTs
History	22; 3♀
Geography	10; 5♀
Economy	8; 3♀
Dutch language	17; 16♀
German language	12; 7♀
English language	47; 34♀
Mathematics	19; 13♀
Physics	6; 0♀

Abbreviation: PSTs, preservice teachers.

3.2 | Procedure

This study used a mixed-methods design with a pretest, an intervention (the virtual classroom), and a posttest. The virtual classroom is a situation-based short-term classroom simulation using 360-degree videos. Because little is known about the effect of 360-degree videos in teacher education, in our study, *traditional* videos are used before and after the simulation as pretest and posttest to establish the level of interpretations of events. For the pretest and posttest, the method of tagging video fragments (see Section 3.3) was used (Van den Bogert, 2016) to measure the interpretation of noticed events.

After the pretest, PSTs participated in three 2-hr sessions as described in Section 2. During the intervention, no data were collected.

For the posttest, the method of tagging was used again. Furthermore, to gather insights in PSTs' perceived affordances of the virtual classroom, a questionnaire with six closed-ended questions and three open-ended questions was conducted and analysed.

To obtain more insight in the manner in which PSTs tagged the video fragments and PSTs' experiences with the virtual classroom, semistructured individual interviews were conducted after the virtual classroom (N = 12; 7♀). Respondents were selected with convenience sampling, and their number met the minimal requirement for theoretical saturation (Guest, Bunce, & Johnson, 2006). PSTs from all teaching disciplines were involved in the interviews, which were audio recorded. The next sections describe the instruments in detail.

3.3 | Tags

During the pretest and posttest, PSTs tagged three video fragments of secondary education teachers (teacher-1, teacher-2, and teacher-3) from the video database Didiclass (Firssova, 2009). The length of these video fragments varied from 3 min and 8 s to 4 min and 12 s. These video fragments consisted of authentic classroom situations showing teachers struggling with their interpersonal teacher behaviour (e.g., disruptive students and a teacher with a lack of influence). For a description of the three video fragments, see Appendix A. After watching a video fragment, PSTs were asked to note three to five

aspects related to the teacher–student relationship they considered to be important.

3.4 | ICT affordances

Six closed questions were analysed to gather insights in PSTs' perceived affordances.

The first five questions asked PSTs to rate the virtual classroom on the (a) quality of the content, (b) coherence between meetings, (c) added value of to the curriculum, (d) contribution to their teaching skills, and (e) technological aspects of the VR headset using a 5-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). Because not all mobile phones were equipped with a gyroscope necessary for watching videos in 360-degrees, and watching videos with a VR headset can cause nausea (Olmos et al., 2018), the sixth question asked about the device PSTs used to watch the videos fragments: (a) mobile phone in a VR headset, (b) mobile phone without VR headset, (c) laptop, (d) tablet, or (e) both mobile phone with and without a VR headset as well. With this information, it could be investigated if device use influenced the level of tagging (see Section 3.6).

Furthermore, three open-ended questions were used in which PSTs were asked to describe (a) what they liked and (b) disliked about the virtual classroom and (c) what they learned from the activities within the virtual classroom.

3.5 | Interviews

The interviews consisted of two questions (see Appendix B) about PSTs' professional interpersonal vision. The first question was adapted from Wolff (2015): "Can you describe what you saw and how that is relevant to interpersonal teacher behaviour?" The second question asked if PSTs could distinguish differences between their tags of the pretest and posttest.

Furthermore, the interviews consisted of six questions (see Appendix B) related to PSTs experiences with the virtual classroom. These questions were used to deepen the quantitative data about the topics of the six close-ended questions, as mentioned in Section 3.3. For example, "What are your experiences with technical aspects of your mobile phone in the VR-headset? Which parts worked well? Which parts didn't? How can this be improved?"

3.6 | Data analysis

Regarding professional vision, tags PSTs used to describe relevant interpersonal teacher behaviour when watching videos were first coded into four levels: (a) *descriptive tags* containing information about observable classroom events, (b) *evaluation tags* containing positive or negative appraisals about observations, (c) *analytic tags* containing information about underlying teaching and learning principles, and (d) *prescriptive tags* describing alternatives for teacher action (Van den Bogert, 2016). Van den Bogert (2016) based these codes on the Learning to Notice Framework of Van Es and Sherin (2002). The first

author (Assessor 1) and a teacher educator (Assessor 2) coded a sample survey of tags from 47 PSTs (total number was pretest 490 tags and posttest 544 tags) to establish the interrater reliability by calculating the linear weighted Cohen's Kappa. This resulted in a value of 0.67 for the pretest and 0.61 for the posttest. After consultation, two systematic errors were identified. First, tags related to teachers' non-verbal behaviour were coded by Assessor 1 as analytic tags and by Assessor 2 as evaluation tags. The assessors decided to code these as analytic tags, because literature distinguishes non-verbal behaviour as an important part of interpersonal teacher behaviour (Van Tartwijk, 1993). Second, Assessor 2 coded some tags with judgmental terminology (e.g., much, negative, and nice), as a descriptive tag. The assessors decided that tags with judgmental terminology had to be coded as evaluation tags because objective descriptions (Level 1) are free from judgements. After correcting the systematic errors, interrater reliability was established again, which resulted in a value of 0.96 for the pretest and 0.94 for the posttest.

Questionnaire data were entered in a database and were analysed with IBM SPSS Statistics 22. Regarding the tags, results of the pretest and posttest were compared using a paired samples t test. Descriptive statistics regarding the educational affordances and used devices were calculated for the six close-ended questions. A one-way analysis of variance (ANOVA) was used to determine if the variable "device" influenced the level of tagging for professional interpersonal vision.

With respect to the analysis of qualitative data, sensitizing concepts (Charmaz, 2006) were derived from the theoretical background and used to categorize answers from interviews, focusing group interviews and open-ended questions in an analysis matrix. The starting concepts were technical and educational affordances. The categorization was validated by the first author and a teacher educator, by discussing and evaluating the categorization. To increase the reliability of this qualitative analysis, the first author and the teacher educator collaborated closely in the process. Points of debate and uncertainty were discussed until consensus was reached.

4 | RESULTS

4.1 | Professional interpersonal vision

The first research question of this study was: *How can the virtual classroom improve PSTs' level of interpretation of noticed classroom events as part of their professional interpersonal vision?* To answer this question, tags, questionnaires, and interviews were used.

Table 2 shows statistically significant differences between the pretest and posttest on PSTs' interpretations for both the individual fragments and the total of all tags (Fragments 1, 2, 3, and all fragments together), which means that after the virtual classroom PSTs interpreted the video fragments on a higher level on the Learning to Notice Framework (e.g., "The teachers scored low on the communion dimension', 'The teacher had a closed posture"). This implies that PSTs likely used more knowledge about teaching and learning principles for

TABLE 2 Mean score and standard deviations of the level of interpretation on the tags

Tags	Pretest		Posttest		t (_df_)	d	p
	M	SD	M	SD			
Total (n = 140)	1.95	0.26	2.31	0.39	−10.368 (139)	0.8	<0.01
Fragment 1 (n = 141)	1.88	0.38	2.34	0.46	−10.092 (140)	0.8	<0.01
Fragment 2 (n = 141)	1.83	0.36	2.21	0.44	−8.335 (140)	0.7	<0.01
Fragment 3 (n = 140)	2.13	0.37	2.39	0.46	−6.028 (139)	0.5	<0.01

their interpretations. Table 2 shows medium up to large effect sizes between 0.5 and 0.8 (Cohen, 1988).

To validate the quantitative data related to PSTs' professional interpersonal vision, qualitative data were used to gather more insights in which classroom events attracts PSTs' attention when watching a video. PSTs (N = 12) were asked during the semistructured interviews to answer the following question for each video fragment of the posttest: "Can you describe what you saw and how that is relevant to interpersonal teacher behaviour?"

Fragment 1: All PSTs used Teacher Interpersonal Circle theory to report that there was less warmth in the teacher–student relationship, and for this, PSTs used words such as imposing, objecting, or nondirecting. As a consequence, two PSTs stated that the relationship of the teacher in the video (teacher-1, teacher of German language) with her students was poor. Six of the 12 PSTs used non-verbal behaviour theory: Two PSTs had the opinion that her gestures came on too strong (e.g., pointing at a student), two PSTs felt that teacher-1 showed a closed posture, and three PSTs considered here tone of voice too loud and strict. Regarding the system approach theory, seven PSTs reported that teacher-1 showed a lack of authority over her students: There was a lot of noise in the classroom, students had no respect for teacher-1, it took too much time to acquire silence, rules and consequences were unclear, and students were not allowed to ask questions. However, one PST stated that teacher-1 showed enough control and another PST viewed directing students individually as a positive aspect. Two PSTs gave suggestions for alternative teacher behaviour: For teacher–student relationships, it is important to start the lesson with a friendly attitude. And to gain a positive relationship with students, it would be better if the teacher moved around the classroom instead of being in front of the classroom for the entire time.

Fragment 2: For this fragment, PSTs reported different interpretations of the teachers' behaviour (teacher-2, geography teacher). Using Teacher Interpersonal Circle and non-verbal behaviour theories, five of the 12 PSTs situated teacher-2 with a high level of communion (supporting and understanding), whereas on the other hand two PSTs thought he was sometimes hesitating, objecting, too confronting, and missing agency. This is in contrast to the opinion of one PST, who thought teacher-2 had quite a lot of authority.

Three respondents confirmed this and argued that teacher-2 was in control (e.g., he gave consequences, gave warnings, used a punishment, utilized clear rules, and made eye contact), whereas seven respondents felt that teacher-2 was out of control (e.g., he gave too many warnings, students continued talking, and used bad language). One PST concluded: "Teacher-2 had a good relationship with his students in general, but not with all students."

Fragment 3: Interpretations of teacher-3's behaviour (history teacher) varied among PSTs, and even individual observations had changed during the lesson. Six of the 12 PSTs used Teacher Interpersonal Circle theory and reported that teacher-3 showed a lack of agency during (parts of) the lesson, was too soft for students, hesitated, did not give any resistance to ruling students' behaviour, and was acquiescing. Three PSTs suggested that it would be better if teacher-3 corrected misbehaviour, one PSTs stated that teacher-3 had to move more throughout the classroom instead of sitting behind his desk, and one PST emphasized that it is better to avoid discussions with students. In contrast, one PST thought he was imposing, whereas two other PSTs described him as directing, supporting, and friendly. Eight PSTs reported the use of stickers as a reward for students' good work as a positive teaching strategy, whereas one PSTs found this to be childish.

The second question regarding PSTs' professional interpersonal vision asked if PSTs could distinguish differences between their tags of the pretest and posttest. Except for one, all PSTs stated clearly that they used more of the interpersonal behaviour theory in terms of the Teacher Interpersonal Circle and teachers' non-verbal behaviour, which made their tags more precise. One PST reported to have developed a new way of observing teachers, another PST felt he had more focus on interpersonal behaviour while observing other teachers teaching, and two PSTs said they gained more terminology to describe observed behaviour.

Overall, the results of the tags and interviews indicate that PSTs, after the virtual classroom, developed terminology to describe teacher behaviour from an interpersonal perspective and they also used more interpersonal knowledge in their tags.

4.2 | Technological affordances

The second research question of this study was: *How is the virtual classroom evaluated by PSTs in terms of technological and educational affordances?* To answer this question, closed and open questions and interviews were used.

The descriptive statistics of the technical aspects of the VR headset (Table 3) show that PSTs had mixed opinions about these aspects.

Regarding the technological aspects of the virtual classroom, 47 PSTs reported that they were hindered (more or less) by the VR headset. For 12 PSTs, the VR headset caused physical discomfort, such as headache, dizziness, and nausea. Ten PSTs experienced technical hindrances relating to difficulties with an online platform (YouTube), mobile phones without a gyroscope, and poor video and audio quality.

TABLE 3 Descriptive statistics technological aspects of the VR headset

	1 Strongly disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly agree
Technological aspects of the VR headset	10	22	43	52	14

Furthermore, 24 PSTs reported they disliked the VR headsets, and 13 PSTs thought that the VR headsets were unnecessary. Two respondents also reported that some mobile phones appeared to be too big for the VR headset. What was noteworthy is that three respondents stated that the use of a VR headset over top of prescription glasses felt uncomfortable. However, one of these respondents had mixed feelings as she also liked the immersive experience.

In contrast, a minority of seven PSTs reported the VR headset as a positive learning experience. Five PSTs reported watching videos with a VR headset as fun, instructive, and an alternative to regular teacher education sessions. Furthermore, three PSTs felt as if they were present in a real classroom due to the immersive aspect of VR. The quantitative data revealed that seven PSTs were positive about the VR headset. These PSTs appreciated the immersive aspect and thought watching 360-degree videos provided them with a different perspective of the whole classroom instead of a fixed viewpoint. Three PSTs noticed that it was difficult to look around when seated behind a desk and therefore suggested to watch the videos standing up. In the interviews and open-ended questions, five PSTs reported that they stopped using the VR headset due to technological hindrances.

A substantial number of PSTs experienced technological hindrances using the VR headset. To check whether the variable "device" influenced the level of tagging (professional interpersonal vision), a one-way ANOVA was conducted. Table 4 shows the number of PSTs per device used. A significant difference was found between devices for the level of tagging, $F_{(4, 135)} = 2.527$, $p < .05$. We applied Fisher's Least Significant Difference post hoc test, because the overall ANOVA was significant. The post hoc test revealed that the device "laptop" outperformed all other devices, except for the device "tablet." All other differences between pairs of devices were not statistically significant. However, only four PSTs used the device "laptop." For this reason, we conclude that device did not significantly influence the level of tagging.

TABLE 4 Devices PSTs used to watch the video fragments

	Number of PSTs
Mobile phone in a VR headset	60
Mobile phone without VR headset	53
Laptop	4
Tablet	4
Mobile phone with and without a VR headset	20

Abbreviation: PSTs, preservice teachers.

Overall, these results indicate that PSTs had mixed opinions about the VR headset as a technological affordance. A fair number of PSTs were hindered by technological aspects of the VR headset, whereas others perceived watching videos with the VR headset as an immersive experience. The use of devices by PSTs did not influence the level of tagging.

4.3 | Educational affordances

Regarding the educational affordances of the virtual classroom, the descriptive statistics (Table 5) provide more insights in PSTs' ratings about the quality of the content, the coherence between meetings, the added value to the curriculum, and the contribution to their teaching skills. As Table 5 indicates, the majority of PSTs were positive about educational affordances.

In the open-ended questions, PSTs were asked what they had learned from the virtual classroom. The results showed that 100 PSTs reported that the 360-degree videos and the theoretical lectures taught interpersonal teacher behaviour in terms of how a teacher can influence the teacher–student relationship (36 PSTs), dos and don'ts regarding interpersonal teacher behaviour (17 PSTs), different teacher styles (42 PSTs), and the meaning of communion and agency (5 PSTs). Forty-two PSTs stated that it was a good learning experience to observe other teachers teach. Through observation, PSTs gained insights on different teaching styles that influence teacher–student relationships, which helped PSTs to reflect on their own teacher behaviour. Furthermore, 31 PSTs perceived they developed more insights into non-verbal behaviour. In their responses, they focused mostly on body language and facial expressions. None of the PSTs responded negatively concerning the educational affordances.

When asked about the content of the virtual classroom during the interviews, five PSTs reported that they learned from observing other teachers teach and their interactions with students. The variety of teacher examples was especially appreciated. Not all examples were good ones, which gave PSTs the opportunity to see different sides of the teaching profession. As one PST stated: "You learn that you can teach in different ways". For one PST, observing other teachers

teach decreased her anxiety for classroom management. Afterwards, she was able to understand better on how to handle classroom management issues. Furthermore, three PSTs said they gained knowledge and they learned different terminology to describe interpersonal teacher behaviour. These PSTs also appreciated the structure of the meetings and how theory was spread out over the meetings.

Concerning the coherence between meetings, all interviewed PSTs felt that the coherence was good as there was repetition between the meetings, and in the end, all theory was discussed in the videos. Two respondents reported that they made progress throughout the meetings and one PST liked the variation within a meeting.

There was a consensus between all PSTs that the virtual classroom added value to the curriculum. Five PSTs argued that the virtual classroom is especially interesting for PSTs without real-life internship experiences (which was the case for them). They perceived the virtual classroom as a safe learning environment where you can observe without any pressure or making damaging mistakes. Two issues were identified: Two PSTs said it would be better if there was less time between the meetings (as meetings were sometimes 2 weeks apart) and one PST suggested that the virtual classroom could gain more added value if it was completed with a formal test.

Ten PSTs felt that the virtual classroom added value to their teaching skills. They were able to learn by observing other teachers teach, or as one PST put it: "You notice more and more, for example facial expressions. As a beginner you do not notice these kinds of things. But now I am more aware of this." By watching other teachers, discussion, and personal reflection, six PSTs argued they extended their teaching repertoire. In contrary, two PSTs with already minor teaching experience indicated that the virtual classroom was less useful for their teaching skills. They argued this was due to the context differing from their previous teaching experience and a difference in character traits between their own and the observed teachers.Taken together, these results suggest that PSTs experienced positive educational affordances using the virtual classroom. The majority of PSTs were positive about the quality of the content, the coherence between meetings, the added value of to the curriculum, and the contribution to their teaching skills.

5 | CONCLUSION AND DISCUSSION

This study set out to gather insights into how a computer-based classroom simulation using videos (the virtual classroom) could support the development of PSTs' interpretations of noticed classroom events as part of their professional interpersonal vision. Furthermore, this study investigated how PSTs evaluated the virtual classroom in terms of technological and educational affordances.

The virtual classroom consisted of three meetings about interpersonal teacher behaviour in which PSTs watched 360-degree videos of experienced teachers with a VR headset in combination with theoretical lectures. This study showed that participating PSTs improved in noticing classroom events and in applying a theory-based terminology to describe these events. Furthermore, PSTs felt better prepared for

TABLE 5 Descriptive statistics educational affordances

	1 Strongly disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly agree
Content of the virtual classroom			12	111	18
Coherence between meetings		2	4	102	33
Added value virtual classroom to curriculum	2	6	38	80	15
Contribution to PSTs' teaching skills	1	5	29	79	27

Abbreviation: PSTs, preservice teachers.

teaching in practice by watching experienced teachers teach. Although some PSTs perceived watching 360-degree videos with a VR headset as an immersive learning experience, the majority of PSTs experienced physical discomfort and technical hindrances using the VR headset. These main findings will be further elaborated in detail.

Regarding PSTs interpretations of noticed classroom events, PSTs tagged three video fragments at the pretest and posttest. These tags were coded on four levels adapted from the Learning to Notice Framework: (a) descriptive tags events, (b) evaluation tags, (c) analytic tags, and (d) prescriptive tags (Van den Bogert, 2016; Van Es & Sherin, 2002). A significant increase was found in the level of tags at the pretest and posttest for all three video fragments (Table 2). Where PSTs at the pretest mainly noticed tags within the first and second level, they scored more on the second and third level during the posttest. Thus, the results suggest that the 360-degree videos, added with theoretical knowledge, increased PSTs' professional vision when noticing relevant classroom events. The qualitative data also revealed that PSTs used more theoretical terminology to describe teacher behaviour from an interpersonal perspective (e.g., the interpersonal circle, aspects of non-verbal behaviour). Connecting noticed classroom events with theory is important for interpreting as it can be used to make sense of what one noticed (Van Es & Sherin, 2002). Van den Bogert (2016) compared PSTs with experienced teachers in their level of tagging. This study identified that PSTs mainly use descriptive and evaluation tags, which was also the case for PSTs at our pretest and in line with Van Es and Sherin's (2002) research about the Learning to Notice Framework. However, experienced teachers also use analytic tags when noticing classroom events (Van den Bogert, 2016). PSTs' level of tagging at the posttest of our study corresponded with these experienced teachers. PSTs from our study and the experienced teachers of the study from Van den Bogert (2016) both did not use prescriptive tags. However, in the interviews, PSTs incidentally used a prescriptive tag (they proposed alternative teacher behaviour). This indicates that a computer-based classroom simulation using (360-degree) videos, together with theoretical knowledge provided, can influence and possibly increase PSTs' capability of learning to notice. As the differences between experienced teachers and PSTs point out that learning to notice takes time and can be developed over time, the results of our study show that teacher education institutes can accelerate this learning process using 360-degree videos within theoretical lectures. This is important, because noticing and interpreting relevant classroom events are important to inform pedagogical decisions (Van Es & Sherin, 2002). Therefore, this kind of simulations can be an asset for teacher education to prepare PSTs for teaching in practice. However, there are still unanswered questions about whether exclusively the 360-degree videos, the theoretical lectures, or the combination of both influenced PSTs' level of interpretations of noticed events. The study of Sitzmann (2011) already showed promising results for theoretical lectures as part of a simulation game, for 360-degree videos the influence of added theoretical lectures is still unknown.

The second aim of this study was to evaluate the technological and educational affordances by PSTs. Concerning the technological affordances, physical discomforts (headache, dizziness, and nausea) were reported by PSTs using the VR headset. Furthermore, PSTs experienced technical hindrances such as mobile phones without a gyroscope. Difficulties with an online platform (YouTube) and poor video and audio quality obstructed the immersive experience. Olmos et al. (2018) argue that these physical discomforts and low quality of VR-environments are reasons why the use of VR in education is complex, although technologies develop at fast pace. For good learning experiences with VR headsets, good usability, proper functionality, and aesthetics are necessary (Olmos et al., 2018). Due to the problems experienced with the VR headset, almost half of the participants watched the 360-degree videos without the VR headset. What is remarkable is that watching the 360-degree video with or without the VR headset did not influence the participants' level of tagging. Both conditions appeared useful to develop professional interpersonal vision. This could indicate that especially the theoretical lectures influenced PSTs' level of tagging. In conclusion, teacher educators do not have to be hindered by technical hindrances of VR, using 360-degree videos in teacher education. Solely, the use 360-degree videos in theoretical lectures is a promising combination for teacher educators to improve PSTs' interpretations of noticed classroom events and prepare them for their job as teachers.

Despite the negative experiences with the VR headset, there was also a minority of PSTs who reported that watching 360-degree videos with a VR headset was a positive learning experience. They perceived the VR headset as fun, instructive, another way of teaching, and immersive. As a result of the immersive experience, some PSTs felt like they were present in a real classroom without being actually there. Yoh (2001) refers to this as the sensory experience, which can be derived from VR. These findings suggest that, in general, good working VR-environments are required for an immersive learner experience.

PSTs believed that observing other teachers teach is a positive educational affordance. Through this observation, they were able to learn theories on interpersonal teacher behaviour, develop insights about different teaching styles that influence teacher–student relationships, and could reflect on classroom events. These outcomes are in line with studies about the use of video in teacher education, which found that videos provide opportunities to learn from examples of different teachers, students, settings, and pedagogies to reflect on classroom interactions and to analyse and reason about teacher and student behaviour (Santagata & Guarino, 2011; Sherin & Van Es, 2005; Star & Strickland, 2008). This implies for teacher educators that 360-degree videos are useful to bridge the gap between theory and practice by giving PSTs opportunities to learn from experienced teachers using authentic classroom situations. Furthermore, PSTs were positive about the quality of the content and the coherence between meetings, and they had the opinion that the virtual classroom contributed to their teaching skills and added value to the curriculum.

This study was, to our knowledge, the first study that investigated the use of computer-based classroom simulation using 360-degree videos to improve PSTs' professional interpersonal vision and evaluated the technological and educational affordances. Findings of this study, while preliminary, suggest that classroom simulations using 360-degree videos (with or without a VR headset) are useful for

improving PSTs' professional interpersonal vision and developing theory about interpersonal teacher behaviour. This is important because the professional interpersonal vision is part of PSTs' interpersonal competence, which is a major concern for PSTs (Pillen et al., 2013). It can, therefore, be assumed that the use of classroom simulations with 360-degree videos, and theoretical knowledge can be used to strengthen PSTs' interpersonal competence and ease the transition to teaching in practice. It is also evidentiary that the use of 360-degree videos is a beneficial educational tool in general as this theory resonates with studies in other domains (e.g., Harrington et al., 2018; Krokos, Plaisant, & Varshney, 2018; Schöne et al., 2017; Yoganathan et al., 2018). Furthermore, findings of this study emphasize the importance of good quality VR-environments to improve the immersive experience.

A limitation of this study was that only PSTs' self-perceptions of affordances and hindrances were investigated. We did not measure, for example, if the simulations did contribute to PSTs' teaching skills. Another limitation is that the professional interpersonal vision was measured with tags, but whether PSTs were more accurate in their interpretations of noticed events in their actual teaching practice is still unknown. Finally, the first author taught all the classes herself which possibly caused some degree of bias.

The question raised by this study was whether 360-degree videos, in combination with lectures, added value for improving professional interpersonal vision. This study found that the combination of 360-degree videos and lectures influenced PSTs' professional interpersonal vision positively, although the added value of a VR-glasses was not established. Furthermore, PSTs' perceived educational affordances, which are congruent with studies on the use of "traditional" videos in teacher education. The assumed added value of 360-degree videos is that PSTs could change their viewpoint when observing classroom interactions, instead of passively viewing situations from a predefined viewpoint when watching traditional videos. However, it is unclear if PSTs of this study changed perspective and if that was preferable over traditional videos. Although some PSTs reported that a benefit of 360-degree videos is that situations could be viewed from their own perspective, it remains a question whether 360-degree videos are more effective to improve professional interpersonal vision than traditional video or not. However, other studies have found that there is an added value of using 360-degree videos (e.g., Schöne et al., 2017; Yoganathan et al., 2018). It would be valuable to explore those findings specifically for the current topic.

Additional research is also required to determine if the use of better quality 360-degree videos could improve the immersive experience of VR and, consequently, if a good immersive experience will improve learning experiences. What would be additionally interesting is whether the effect of reduced physical discomforts have a positive influence on the learning experience. Furthermore, this study used traditional videos for the tagging instead of 360-degree videos. It would be interesting to investigate if PSTs tag differently if 360-degree videos are used at the pretest and posttest. Besides that, when using ICT, it is important to take PSTs' ICT mindedness into account. The level of ICT mindedness determines whether one can set aside limitations of new technological experiences for the benefit of the goal or to find a foundation for their aversion for new technological experiences in these limitations (Van den Beemt & Diepstraten, 2016). Further research is required to establish if PSTs' ICT mindedness influences learning outcomes using 360-degree videos with or without a VR headset. Lastly, professional interpersonal vision is only one aspect of PSTs' interpersonal competence. Further studies regarding the influence of computer-based classroom simulations, including VR classroom situations on other aspects of PSTs' interpersonal competence, would be worthwhile to investigate, especially regarding PSTs' professional interpersonal behaviour repertoire.

CONFLICT OF INTEREST

There were no conflicts of interest in this study.

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APPENDIX A

DESCRIPTIONS VIDEO FRAGMENTS USED AT THE PRETEST AND POSTTEST

Fragment 1 showed teacher-1 standing in front of a classroom. She promised this class to give them the results of a test in this lesson. However, she has not finished correcting the test and had to disappoint her students. She promised them to give the results in the next lesson and had a discussion with her students when this next lesson would be. After that, she started her lesson by asking student questions about the previous lesson. Not all students were paying attention and teacher-1 did not tolerate student questions in this stage of her lesson.

Fragment 2 showed teacher-2 sitting on a desk in front of the classroom. He wanted some students to read a text aloud. However, one group of three students were not paying attention to his lesson. They were laughing with each other and two students did not have a book on their desk. Teacher-2 demanded one girl to put a book in their desk and to read a text. However, she ripped a page out of the book that was not even hers. She and the boy next to her could not stop laughing. Teacher-2 gave the boy several warnings and finally removed him from the classroom.

Fragment 3 showed teacher-3 sitting behind his desk asking students one by one to show their homework. If the students did their homework, he gave them a sticker. One student did not deserve a sticker in the teacher's opinion. As a reaction, this student disagreed. Teacher-3 held onto his decision on not giving her a sticker.

APPENDIX B

INTERVIEW QUESTIONS

Question	Topic
Can you describe what you saw and how that is relevant to interpersonal teacher behaviour?	Professional interpersonal vision
Can you distinguish differences between your tags at the pretest and posttest?	Professional interpersonal vision
What did you think about the quality of the content of the virtual classroom? Could this be improved?	Quality of the content
What did you think about the coherence between meetings? Could this be improved?	Coherence between meetings
Do you think that the virtual classroom added value to the curriculum of the teacher education program? In which way?	Added value to the curriculum
Do you think that the virtual classroom contributed to you teaching skills? In which way?	Contribution to PSTs' teaching skills
What is your opinion about watching 360-degree videos with a VR headset?	VR headset
What are your experiences with the technical aspects of your mobile phone in the VR headset? Which parts worked well? Which parts did not? How can this be improved?	Technological aspects of the VR headset