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1. Introduction

Preservice teachers (PSTs) often struggle with creating positive teacher-student relationships
through behavioural strategies, also known as PSTs' *interpersonal competence* (Veenman,
1984; Stough & Montague, 2015). For interpersonal competence it is important that PSTs are
able to notice and interpret relevant classroom events using *interpersonal knowledge* (van Es
& Sherin, 2002). In the present study, we define PSTs' interpersonal knowledge as their
knowledge to develop and sustain healthy relationships with students and a classroom
environment supporting these teacher-student relationships. Healthy teacher-student
interpersonal relationships combine high degrees of interpersonal control with relational
proximity, and can be typified by leadership, helpful/friendly, and understanding teacher
behaviour (Wubbels, Brekelmans, den Brok, & van Tartwijk, 2006). Furthermore, as part of
their interpersonal competence, PSTs need to be able to *apply* their interpersonal knowledge,
for example by classifying observed classroom situations (Stürmer, Könings, & Seidel, 2013).

Videos appear to be a useful method for stimulating PSTs' knowledge development
(e.g., Santagata & Guarino, 2011; Stürmer, Könings, & Seidel, 2013). Recent technological
developments make it possible to watch videos in 360-degree (Aguayo, Cochrane, &
Narayan, 2017). With 360-degree cameras videos can be captured with an all-around view,

enabling multiple angles or viewpoints. 360-Degree videos have shown their usefulness in improving PSTs' ability to notice relevant classroom events and in applying a more theory-based terminology, describing these events as part of PSTs' interpersonal competence (Theelen, van den Beemt, & den Brok, 2019). However, to our knowledge, little is known about the effect of 360-degree videos in teacher education, and specifically with respect to their effect on PSTs' interpersonal knowledge development.

The development of interpersonal knowledge using videos starts by observing new events or objects and linking or adjusting these observations to the theoretical concepts within a knowledge structure one already possesses (Ausubel, 2000; Novak & Gowin, 1984). In other words: new concepts are connected to familiar concepts. In this study, we define PSTs' *interpersonal knowledge development* as the changes in PSTs' knowledge structures and application to situations in terms of teacher-student interpersonal relationships as the result of an intervention in teacher education. Concept maps can be used to visualize knowledge structures and analysed using social network analysis (McLinden, 2013), thereby looking at measures of structural complexity, and comparisons with expert concept maps (Winitzky, Kauchak, & Kelly, 1994).

This paper presents a mixed-method study that investigated the development of PSTs' interpersonal knowledge structures and the content of PSTs' interpersonal knowledge after watching 360-degree videos combined with theoretical lectures. Concept maps were used to organize and represent PSTs' knowledge structures and these concept maps were analysed with social network analysis, also providing measures of structural complexity, and comparisons with expert maps. Furthermore, we were interested to see if PSTs could apply their interpersonal knowledge within descriptions of authentic classroom situations (vignettes).

The theoretical background of this paper firstly describes the nature of PSTs'
interpersonal knowledge (section 1.1) and the content of interpersonal knowledge (section
1.2). Secondly, the use of traditional and 360-degree videos in teacher education will be
explained (section 1.3). Lastly, we describe the use of concept maps for interpersonal
knowledge (section 1.4). Figure 1 shows an overview of the above-mentioned concepts, their
assumed underlying concepts, and their mutual relations. The bottom half of Figure 1 explains
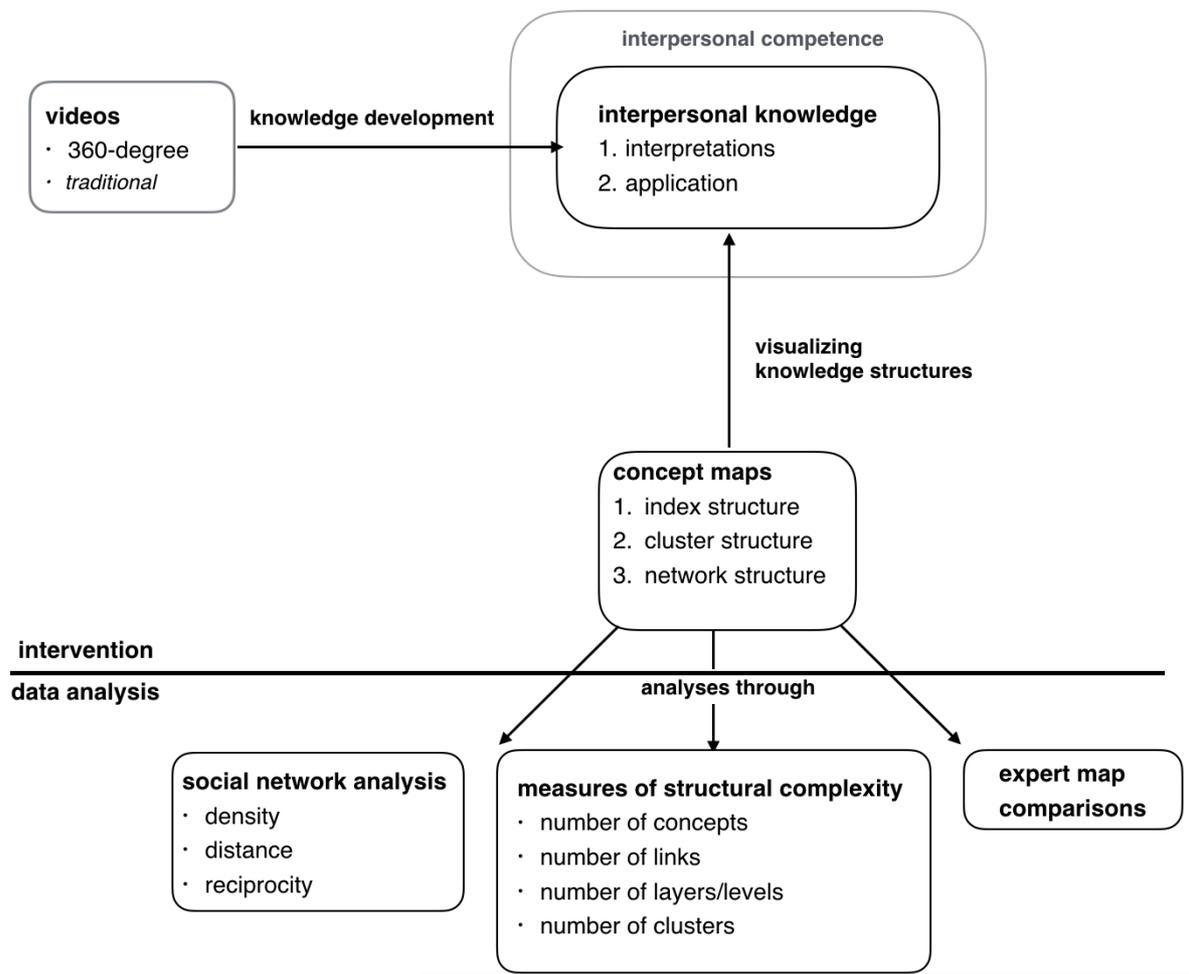data analysis and is therefore explained in the method section.

Figure 1 Main concepts and their assumed interrelations

1.1 PSTs' interpersonal knowledge

For interpersonal competence it is important that PSTs are *aware* of relevant classroom events that require action (van Es & Sherin, 2002). When becoming aware of relevant classroom events, PSTs require *interpersonal knowledge* to give meaning to their observations by connecting theories about interpersonal teaching behaviour to their interpretations (van Es & Sherin, 2002). PSTs can acquire interpersonal knowledge at both the teacher education institute and the workplace (van Tartwijk, den Brok, Veldman, & Wubbels, 2009).

First, knowledge acquired at the teacher education institute is based on the idea that teaching practice can be improved by knowing more about, amongst others pedagogy, and learning theories. This type of knowledge is also known as "formal knowledge," "theory-based knowledge," or "knowledge-for-practice", which is based on empirical evidence and forms the foundation of the knowledge base of teacher education institutes (van Tartwijk, den Brok, Veldman, & Wubbels,, 2009; Cochran-Smith & Lytle, 1999). Second, knowledge can be obtained at the workplace through experiences and reflecting on these experiences. This type of knowledge is also known as "practical knowledge" or "knowledge-in-practice", which can be defined as PSTs' knowledge and beliefs related to their own teaching practices, for example about interpersonal behaviour strategies. Thus, the acquisition of practical knowledge takes place in the classroom and is a result of teachers' reflections on their own classroom experiences (Cochran-Smith & Lytle, 1999; van Tartwijk, den Brok, Veldman, & Wubbels,, 2009).

Because the present study takes place at a teacher education institute, we focus on this first type of knowledge: *theory-based interpersonal knowledge.* Developing theory-based knowledge is an important element in teacher education institutes (Darling-Hammond, 2006). Contrary to expert teachers who already possess a certain knowledge base through experience, PSTs' knowledge is often insufficiently developed (Meijer, Zanting, & Verloop, 2002). Furthermore, differences between expert teachers and PSTs in applying theory-based

knowledge when interpreting noticed relevant classroom events has also been shown in different studies (e.g., van den Bogert, 2016; Wolff, 2015).

After being aware of relevant classroom events and interpreting these events, PSTs can make pedagogical decisions about actions to undertake for creating a positive learning environment (van Es & Sherin, 2002). In other words, they can apply their knowledge in authentic classroom situations (Stürmer, Könings, & Seidel, 2013). This *knowledge application* includes, amongst others, the ability to *explain* classroom situations. This explanation contains the classification of observed situations based on their theory-based interpersonal knowledge (Stürmer, Könings, & Seidel, 2013).

1.2 Interpersonal behaviour theory

Theory-based interpersonal knowledge consists of knowledge about interpersonal processes and knowledge about the nature of interpersonal relationships and behavioural indicators that determine this nature (van Tartwijk, den Brok, Veldman, & Wubbels,, 2009). The systems approach to communication (Watzlawick, Beavin, & Jackson, 1967) was used in the present study as starting point for the knowledge on interpersonal processes. One assumption of the dynamic systems approach (Watzlawick et al., 1967), is that classes can be considered as social systems in which teachers and students interact via every behaviour they display (Wubbels, Brekelmans, den Brok, & van Tartwijk,, 2006), and that they influence each other mutually (Horowitz & Strack, 2011). Knowledge on the interpersonal nature of relationships can be described in terms of the Teacher Interpersonal Circle. The Teacher Interpersonal Circle (Figure 2) describes this mutual influence (Pennings et al., 2018) by means of two independent dimensions: communion and agency. Communion is referred to as the extent of warmth in the teacher-student relationship. Influence of communication with students is the agency dimension (Horowitz & Strack, 2011). Teachers vary in the combination of

communion and agency they use in the classroom, resulting in eight types of interpersonal teacher behaviour: directing, helpful, understanding, compliant, dissatisfied, uncertain, imposing, and confrontational (den Brok & van Tartwijk, 2015). Commonly, these eight types of interpersonal teacher behaviour are represented into four quadrants, each combining two types of teacher behaviour: (1) directing-helpful, (2) understanding-compliant, (3) dissatisfied-uncertain, and (4) imposing-confrontational (Pennings et al., 2018). For example, teacher behaviour within the directing-helpful quadrant is characterised by high levels of communion and agency. For teachers who tend to the directing type of behaviour the agency dimension dominates and vice versa for helpful teacher behaviour in which the communion dimension dominates (Wubbels & Brekelmans, 2005).
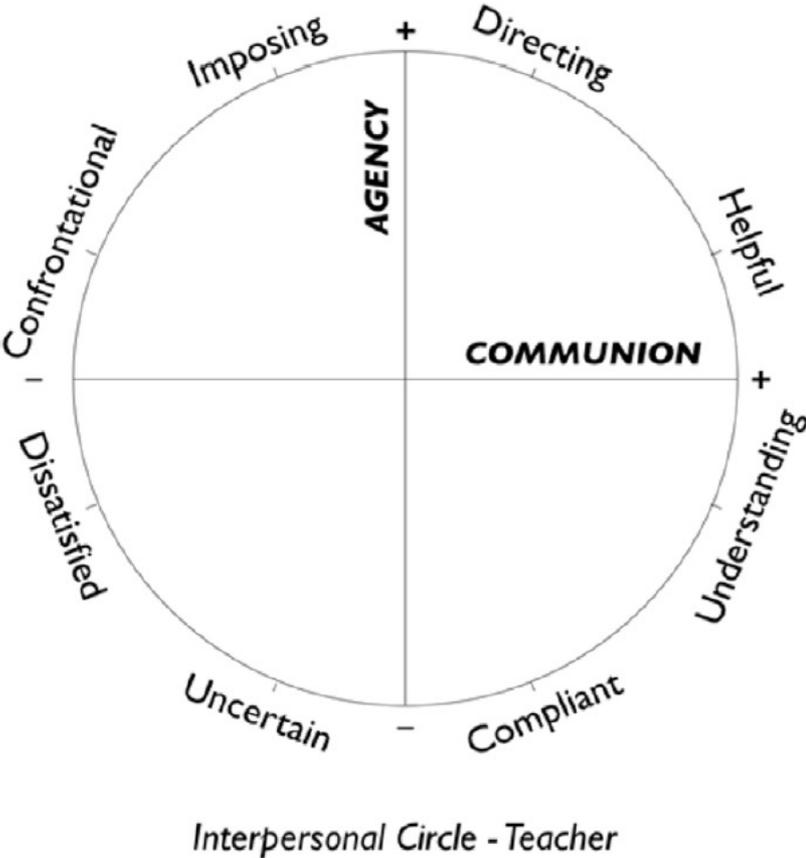

Figure 2 Teacher Interpersonal Circle (Pennings et al., 2018)

According to the systems approach of communication (Watzlawick et al., 1967), interactions between teachers and students always carry a content and a relational aspect (Wubbels, Brekelmans, den Brok, & van Tartwijk,, 2006). The relational aspect influences the interpretation of content and the perceptions of students about their teacher. For students' perception of the relational aspect of communication by the teacher (i.e., What type of interpersonal teacher behaviour does the teacher show in the student's perception?), non-verbal behaviour plays an important part (Wubbels, Brekelmans, den Brok, & van Tartwijk,, 2006). For example, students experience a smiling teacher with high communion and a teacher with an angry facial expression with low communion (van Tartwijk, 1993). Five channels of non-verbal behaviour influence students' perceptions of their teacher's interpersonal behaviour: *(1)* the way teachers use space in their classroom, *(2)* the body (position, and movements of the trunk, arms, and head), *(3)* facial expressions, *(4)* visual behaviour (e.g., how long a teacher looks at students), and *(5)* the non-content aspects of the voice (van Tartwijk, 1993). However, the use of voice and facial expressions are the most important non-verbal behaviour influencing the teacher-student relationship. In the lectures as part of the intervention of the present study, all aforementioned elements and concepts were addressed.

1.3 Theory-based interpersonal knowledge and concept mapping
Concepts maps can be used as a graphical tool to map the structure of PSTs' theory-based interpersonal knowledge (Novak & Cañas, 2008). Concept maps consist of concepts and their interrelations linked to each other with lines (Novak & Cañas, 2008). Within a concept map, interrelated concepts form a meaningful statement together (Ruiz-Primo, Schultz, Li, & Shavelson, 2001; Novak & Cañas, 2008). For example, "a bird can fly" is a meaningful statement. The two concepts "bird" and "fly" are connected to each other because the ability

to fly is a characteristic of birds. However, a bird is also feathered and eats worms. In this example, the concept "bird" is involved in more meaningful statements than one. These meaningful statements together around the concept "bird" form a framework defined as a concept map (Novak & Gowin, 1984). Figure 3 shows an example of a concept map.
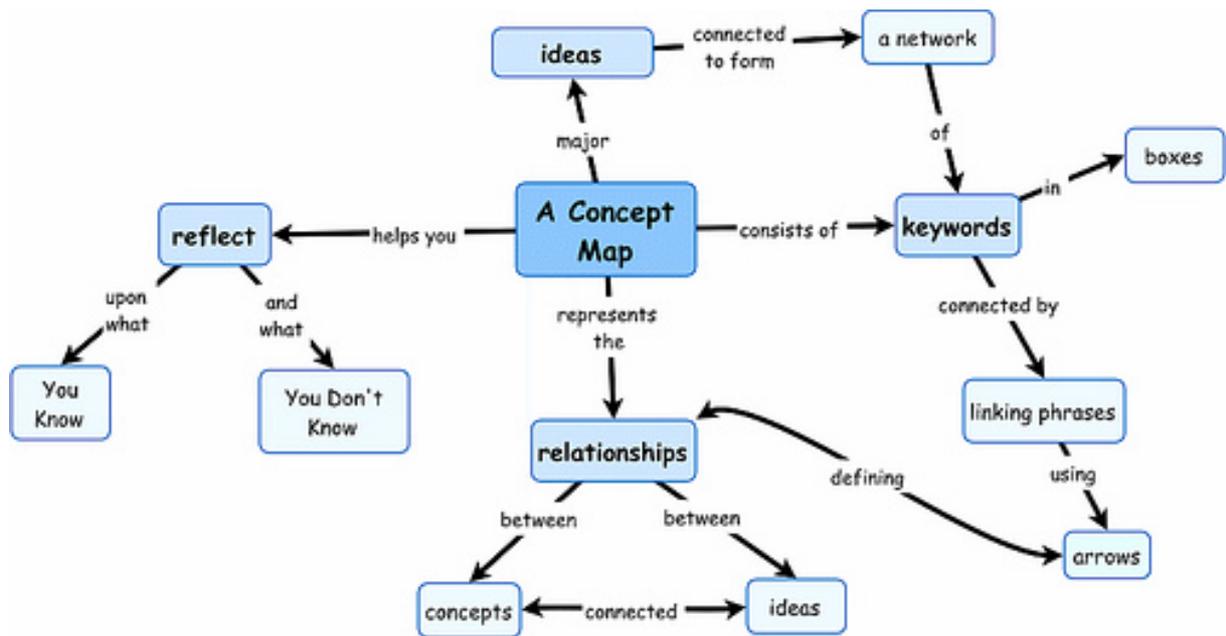
Figure 3 Example of a concept map about concept mapping (Morgan State University, 2019)

Since concepts and their interrelations concerning a subject domain are associated with an understanding of this domain (Novak & Gowin, 1984; Novak, Gowin, & Johansen, 1983), concept maps appear to be a good tool to assess students' *knowledge structure* (Novak, 1990). Buitink (2009) argues that there are three types of knowledge structures of concept maps based on the degree of clustering and the interconnections between clusters within the concept map: *(1)* index structure, *(2)* cluster structure, and *(3)* network structure (see Figure 4).
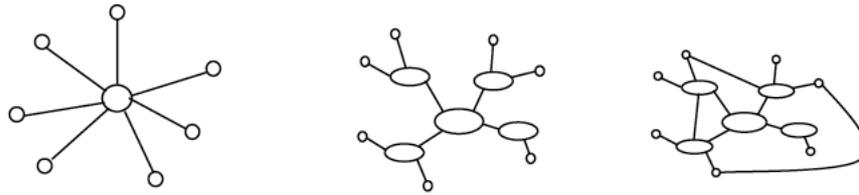
(1) index structure   (2) cluster structure   (3) network structure

Figure 4 Structure of concept maps (Buitink, 2009, p. 122)

An index structure has a central concept with all other concepts directly linked to it. A cluster structure has one central concept with connected concepts each having one or more concepts connected to itself, creating clear clusters of concepts. The network structure is similar to the cluster structure, only it has (some) concepts interlinked across the whole structure, connecting concepts from the same or different clusters together (Buitink, 2009). Buitink (2009) argues that the structure of concept maps shows how well developed a knowledge structure is and that theoretical knowledge is more developed when the concept map is clearer and more coherent, as is the case for the network structure. In other words, learners with index structured concept maps have a less developed knowledge structure than learners with a cluster structure or network structure. Thus, the increasing complexity of interpersonal knowledge development can be visualised in the concept map structure.

1.4 Videos in teacher education

One way to stimulate theory-based knowledge development are videos (e.g., Santagata & Guarino, 2011; Stürmer, Könings, & Seidel, 2013). The use of videos in teacher education has already proven useful for preparing PSTs for the teaching context (e.g., Asan, 2003; Blomberg, Sherin, Renkl, Glogger, & Seidel, 2014). For example, previous studies (e.g., Theelen, van den Beemt, & den Brok, 2019; Star & Strickland, 2008) focused on videos containing classroom management issues (e.g., disruptive students, classroom discipline,

motivating students) to improve PSTs' ability to notice relevant classroom events. Within the study of Star and Strickland (2008) preservice mathematics teachers improved their observational skills significantly after a teaching methods course that contained videos.

Videos can provide real-life authentic cases (Beck, King, & Marschall, 2002) featuring the richness and complexity of classrooms (Gomez, Sherin, Griesdorn, & Finn, 2008). For example, in the study of Beck and colleagues (2002), PSTs videotaped the lessons of their mentor teachers containing teacher strategies, student learning or understanding, teacher-student interactions, student-student interactions, and professional standards for teaching. Utilising videos, PSTs can watch experienced teachers teach, and discuss their observations grounded by teaching and learning theories (Star & Strickland, 2008). Furthermore, through videos PSTs can learn, analyse, and reason about teacher and student behaviour, and reflect on classroom interactions (Sherin & van Es, 2005; Santagata & Guarino, 2011).

As a result of recent technological developments, 360-degree cameras are increasingly less expensive and enable enrichment of videos (Aguayo, Cochrane, & Narayan, 2017). Mobile devices (e.g., smartphone, tablet) are currently also powerful enough to play 360-degree videos (Martín-Gutiérrez, Mora, & Añorbe-Díaz, 2016). PSTs can see classroom interactions between teachers and students when they view experienced teachers with 360-degree videos. Furthermore, PSTs can choose their own perspective when observing classroom interactions rather than viewing from a fixed perspective. As such, 360-degree videos provide a more *immersive* experience giving PSTs the feeling of presence in the actual classroom (Martín-Gutiérrez et al., 2016; Yoh, 2001). We therefore assume that in teacher education 360-degree videos are more useful than traditional videos.

Figure 5 VR-headset

360-degree videos can be watched using virtual reality (VR) headsets (Figure 5), which are becoming more affordable (Olmos, Cavalcanti, Soler, Contero, & Alcñiz, 2018). Online platforms such as YouTube offer easy playback and sharing of 360-degree videos (Aguayo et al., 2017). 360-degree videos can be used to display real-life classroom events to provide learners sensory and imaginary experiences resembling real-life (Yoh, 2001). The immersive user experience of watching 360-degree videos using VR-headsets appears to be more attractive to learners (Martín-Gutiérrez et al., 2016), because it disconnects them from their surroundings (Olmos-Raya et al., 2018). VR's immersiveness provides a feeling of presence (Yoh, 2001) and embodiment (Kilteni, Groten, & Slater, 2012), offering users a realistic and authentic situation (Martín-Gutiérrez et al., 2016). However, applying VR into education is also accompanied with some difficulties, for example experiencing dizziness, nausea, disorientation, the quality of mobile virtual reality can be low, and teachers have to be properly trained to use VR in their classrooms (Olmos et al., 2018).

1.5 Research questions

In the present study 360-degree videos are combined with theoretical lectures. We label this combination the Virtual Classroom. The Virtual Classroom is used to strengthen PSTs' theory-based interpersonal knowledge. The research questions addressed in this paper are:

1. *What is the effect of the Virtual Classroom on PSTs' theory-based interpersonal knowledge <u>structures</u>?*

2. *What is the effect of the Virtual Classroom on PSTs' theory-based interpersonal knowledge <u>development</u>?*

3. *How do PSTs <u>apply</u> their theory-based interpersonal knowledge after the Virtual Classroom?*

For the first research question we focus on the differences between PSTs' theory-based interpersonal knowledge structures before (pre-test) and after (post-test) the intervention. These structures are visualised using concept maps and analysed with measurements of structural complexity and social network analysis (see section 3.3 and 3.5). For the second research question we are interested to see if what the effect is of the Virtual Classroom on PSTs' theory-based interpersonal knowledge development. For this, we will investigate if PSTs use more relevant concept after the intervention (post-test only) when comparing their concept maps with an expert concept map (see section 3.6). For the third research question we are interested to see if PSTs can apply their theory-based interpersonal knowledge within descriptions of authentic classroom situations by scoring vignettes on the Teacher Interpersonal Circle and comparing these scores with experts (see section 3.5 and 3.6).

2. Design of the Virtual Classroom

The Virtual Classroom consisted of three two-hour sessions combining watching 360-degree videos of experienced teachers within secondary education and theoretical lectures. For watching the 360-degree videos, PSTs used YouTube on their mobile phones and a VR-headset. Every session consisted of a lecture about interpersonal behaviour theory as described in section 1.2 and five 360-degree video fragments. The theoretical lectures guided watching the videos, varying in length from 47 seconds to four minutes and 48 seconds, with an average time of three minutes and 8 seconds. For example, when the theoretical lectures were about a teacher's posture, PSTs were asked to pay specific attention to this aspect in the video. After every video, PSTs' interpretations were discussed, first within small groups then later with the entire class. This way, learning from examples of different teachers, students, settings and pedagogies was stimulated (Star & Strickland, 2008). By analysing and reasoning

about teacher and student behaviour (Santagata & Guarino, 2011), PSTs could reflect on classroom interactions (Sherin & van Es, 2005).

Session 1 included the first introduction with the VR-headsets. PSTs received instruction about how to watch a 360-degree video on their mobile phone using a VR-headset. PSTs could practice with a non-related video to get familiar with the technological features. The goal of this introduction was to avoid technological difficulties during the Virtual Classroom, rendering the learning experience. The theoretical lectures of this session included an introduction into the systems approach to communication (e.g., the content and relational aspect of communication; interpersonal perception, levels of communication) (Watzlawick, Beavin, & Jackson, 1967; Wubbels, Brekelmans, den Brok, & van Tartwijk,, 2006), teachers' verbal and non-verbal behaviour (van Tartwijk, 1993), and handling whole-class moments in the classroom where the teacher is talking and all students have to pay attention (Wubbels, Brekelmans, den Brok, & van Tartwijk,, 2006). The videos of session 1 contained one or more of the following classroom events, which are important for the teacher-student relationship: *(1)* the beginning of a lesson, *(2)* stimulating students to work behaviour, and *(3)* disruptive behaviour (Admiraal, 1994; Admiraal et al., 1996; Wubbels, Brekelmans, den Brok, & van Tartwijk, 2006).

Session 2 introduced the Teacher Interpersonal Circle (Wubbels, Brekelmans, den Brok, & van Tartwijk, 2006; den Brok & van Tartwijk, 2015; Pennings et al., 2018) with emphasis on the two concepts communion and agency and the five channels of non-verbal behaviour influencing the teacher-student relationship (van Tartwijk, 1993). Videos in this session displayed fragments about: *(1)* a moment of instruction, *(2)* questions or feedback from students behaviour, *(3)* the transition between two different phases of the lesson, *(4)* disappointed students' performances, *(5)* comments of students, and *(6)* stimulating students

to work behaviour (Admiraal, 1994; Admiraal et al., 1996; Wubbels, Brekelmans, den Brok, & van Tartwijk, 2006).

Session 3 focused on teachers' verbal behaviour and steering interactions (van Tartwijk, 1993). Furthermore, this session was about punishing and rewarding student behaviour, the beginning of a lesson (Wubbels, Brekelmans, den Brok, & van Tartwijk, 2006), and the Teacher Interpersonal Circle (Wubbels, Brekelmans, den Brok, & van Tartwijk, 2006; den Brok & van Tartwijk, 2015; Pennings et al., 2018). Video fragments in this session were about: *(1)* disruptive behaviour, *(2)* a moment of instruction, *(3)* stimulating students to work behaviour, *(4)* the transition between two different phases of the lesson, and *(5)* questions or feedback from students' behaviour (Admiraal, 1994; Admiraal et al., 1996; Wubbels, Brekelmans, den Brok, & van Tartwijk, 2006).

3. Method

3.1 Participants

Participants came from a teacher education program in the Netherlands counting 141 first year PSTs (81 female), covering all first-year students of this teacher education program. These PSTs were being prepared for the secondary education context and teach within eight different domains (see Table 1). Of these PSTs, 27 had little teaching experience consisting of one to two months experience at previous education programs other than the teacher education program. The remaining 114 PSTs had no teaching experience at all. This study followed the 2014 Association of Universities in the Netherlands' research guidelines for social scientific studies. All participants participated voluntarily 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♀

3.2 Procedure

A mixed-methods design was used within this study with a pre-test, an intervention (the Virtual Classroom), and a post-test. To bias the results of this study as less as possible, PSTs received no theoretical instruction about interpersonal behaviour during other courses at the teacher education program during the intervention, nor were they engaged in real-life internships. This way, other factors that could influence PSTs' interpersonal knowledge were ruled out as much as possible.

For the pre- and post-test, the method of concept mapping (see section 3.2.1) was applied to measure PSTs' conceptual interpersonal knowledge development regarding the teacher-student relationship. After the post-test, individual interviews (see section 3.2.2) were conducted (N=12; 7♀), to obtain more insight into PSTs' interpersonal knowledge structures and development. Meeting the minimal requirement for theoretical saturation (Guest, Bunce, & Johnson, 2006), 12 interview participants were selected with convenience sampling. All PSTs came from the full range of teaching disciplines and their interviews were audio-recorded. Used instruments are described in more detail in the following sections. To measure PSTs' theory-based knowledge application, teacher behaviour vignettes (den Brok & van Tartwijk, 2015) on the communion and agency dimension of the Teacher Interpersonal Circle were used in the post-test (see section 3.2.3).

3.2.1 Concept maps

Both at the pre- and post-test, PSTs created a free recall concept map about the teacher-student relationship. Given a general topic, PSTs were asked to brainstorm about terms and organize these into a concept map (Winitzky, Kauchak & Kelly, 1994). PSTs were given 50 minutes to develop their concept map on paper with the following instruction based on Koopman (2010):

1. *Make a list of concepts:*

   - Write down all concepts that come to your mind about the teacher-student relationship.

   - If you have an idea, ask yourself questions: Why? How? What? Where? Who? When? When you do so, you will probably get new ideas.

   - Read your list of concepts and think about which concepts are related.

   - Underline about 3 to 5 concepts that are, according to you, most important.

2. *Put the concepts in the concept map:*

   - In the middle of the concept map you see the teacher-student relationship.

   - Around the teacher-student relationship other concepts that are related to the teacher-student relationship should be filled out.

   - Concepts that belong to each other should be put near each other.

   - The most important concepts should be close to the centre, the less important concepts should be more to the outside.

3. *Make connections:*

   - Link the concepts that are related to each other by means of lines or arrows.

   - Put a short explanation next to the links, in which you describe the relation between the two concepts that you connected to each other.

Before using the concept maps as a measurement for this study, 6 first year PSTs (3♀) from another cohort of a teacher education program in the Netherlands piloted the use of concept maps to refine the method. After this, the method underwent one minor revision. PSTs preferred that their list of concepts was on the same page as the concept map itself, instead of on the back of the same paper.

3.2.2 Interviews

For the interviews, the phenomenographic method was used to understand the interpretations PSTs gave to concepts (Mavers, Somekh & Restorick, 2002). These structured interviews were designed to get a complete and open response as possible, consisting of a small number of open-ended questions. This study used the following interview questions, adapted from Mavers and colleagues (2002).

- *I found your concept map really interesting. Please could you tell me about it?*
- *Is any part of your map especially important? Why?*
- *Can you tell me how you know all of these things?*
- *Are there differences between your concept maps of the pre- and post-test? If so, what are the differences?*

The interview data contained no disconfirming evidence.

3.2.3 Teacher behaviour vignettes

At the post-test, PSTs were asked to score 20 teacher behaviour vignettes (see Appendix A) on the communion and agency dimension of the Teacher Interpersonal Circle as described in section 1.2 (Pennings et al., 2018) in order to measure PSTs' *theory-based knowledge application.* The vignettes contained descriptions of classroom situations with teacher behaviour and were developed with teachers and teacher educators (de Jong, van Tartwijk, Verloop, Veldman, & Wubbels, 2012). In our study, PSTs were asked to score a vignette on the communion and agency dimension both between a range of -4 and +4. PSTs got an exemplary situation to get familiar with the vignette method: *You want to start the lesson, but a few students keep calling through the classroom. You don't dare to intervene so well.* Figure 6 shows the scoring corresponding with the exemplary situation.
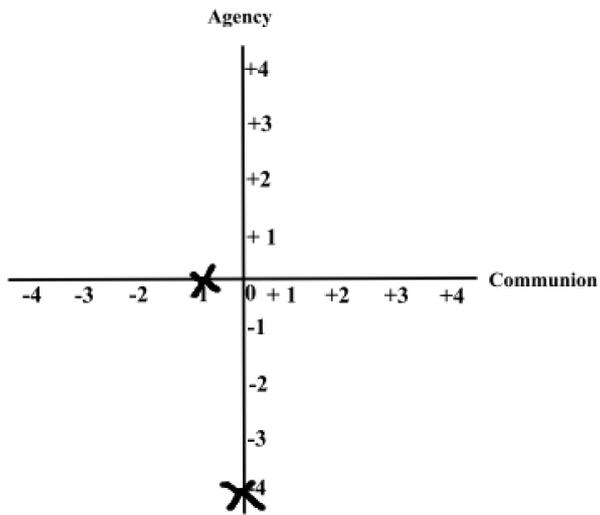
Figure 6 Example of scoring on the agency and communion dimension

3.3 Data-analysis

Concept maps are a network of ideas and are therefore suitable to apply social network analysis to (SNA), for a nuanced understanding of the concept map (McLinden, 2013). With SNA one can analyse networks based on visual representations of data. Using a graphical representation of concepts and how they are interlinked, SNA relies on mathematical models describing and explaining patterns (Freeman, 2004).

To further describe the social network, quantitative analyses are needed (McLinden, 2013). The quantitative measurements in SNA used in this study are density, distance, and reciprocity calculated in UCINET (Borgatti, Everett, & Freeman, 2002). *Density* is the statistic to quantify the number of links in the network, based on the maximum possible links between concepts in the network. The value varies between 0 (no links) and 1 (all concepts are connected) (Borgatti, Everett, & Johnson, 2013; Moolenaar, Sleegers, & Daly, 2011). Multiple concepts connected in a sequence form a path. The paths' complete length is defined as a walk and is numerically defined by edges, which are the number of connections within a path. Concepts can be connected following multiple paths. The shortest path connecting two concepts is the geodesic *distance* (Borgatti, Everett, & Johnson, 2013). If links are directed, one can calculate the *reciprocity*. This is the number of reciprocated relationships relative to the total number of meaningful statements (Moolenaar, Sleegers, & Daly, 2011).

Additional to SNA, other strategies to analyse concept maps can be used. In this study we conducted commonly used strategies when analysing concept maps: *(1)* measures of structural complexity and *(2)* comparing the concept maps of beginners with an expert on level of agreement (Winitzky, Kauchak & Kelly, 1994). Measures of *structural complexity* contain the number of concepts, the number of links between concepts, the depth of the network by stratify the number of layers, the number of clusters, which are clusters with

different topics distinguished in the concept map (Winitzky, Kauchak, & Kelly, 1994), and the network's structure (Buitink, 2009).

Regarding agreement with the expert map, the expert concept map functions as target of standards for scoring the beginner's concept map. PSTs' concepts maps were compared with an expert concept map made by the third author, who is an acknowledged expert in the research field of interpersonal teacher behaviour. To compare, PSTs' concepts were given a score between 1 and 3: concepts were not relevant (1), concepts were not in the expert map; however, they were relevant (2), and there was full agreement between the PST's concept and the expert's concept (3). To establish the inter-rater reliability of the agreement with the expert map, the first author (assessor 1) and a teacher educator (assessor 2) coded 10% of the total amount of concept maps as a sample survey (consisting of 28 concept maps with a total of 445 concepts), by calculating the linear weighted Cohen's Kappa. This resulted in a value of 0.72.

For analysing the above-mentioned aspects, the coding scheme (Table 2) adapted from Koopman, Teune, and Beijaard (2011) was used.

Table 2

Coding scheme for the analysis of the concept maps

Points of interest	Indicators	Analysis
Network cohesion	Density	UCINET
	Distance	UCINET
	Reciprocity	UCINET
Structural complexity	Number of concepts	Counts
	Number of links	Counts

	Number of layers	Maximum number of layers counts from core concept
	Clusters of concepts	Counts
	Structure of the concept maps	Rating (1= index structure; 2= cluster structure, 3= network structure)
Comparison with expert map	Agreement with expert map	Rating (3= full agreement; 2 = concepts are not in the expert map; however, they are relevant; 1= concepts are not relevant)

For analysing the teacher behaviour vignettes, firstly PSTs ratings were used to determine in which quadrant of the Teacher Interpersonal Circle PSTs scored each vignette. The model distinguishes four quadrants: (1) directing-helpful, (2) understanding-compliant, (3) dissatisfied-uncertain, and (4) imposing-confrontational (Pennings et al., 2018). Secondly, all authors of this article scored as experts on interpersonal teacher behaviour each vignette in the quadrants. Thirdly, the authors discussed their scores with each other until they reached full consensus. Fourthly, PSTs ratings correspondence with the experts' ratings were checked using IBM SPSS Statistics 22. Lastly, because PSTs' scores in an adjacent quadrant to those from experts could be closer to the experts' scores than PSTs' scores in the same quadrant, the absolute distance between PSTs' scores and the experts' scores were also calculated, using IBM SPSS Statistics 22.

Because some mobile phones were not equipped with a gyroscope necessary for watching videos in 360-degrees, and some PSTs felt nausea using the VR-headset, not all 141 PSTs used the VR-headset when watching the 360-degree videos. This created an extra condition to take into account when interpreting results of this study: the level of immersiveness. 60 PSTs used the VR-headset every session and 81 PSTs used the VR-headset very briefly or never. To determine if the level of immersiveness influenced PSTs' theory-based interpersonal knowledge structures, PSTs' theory-based interpersonal knowledge development, and the scoring of the vignettes, analysis of variances (one-way ANOVAs) were used.

4. Results

4.1 PSTs' theory-based interpersonal knowledge structures

For the first research question of this study, we were interested in the effect of the Virtual Classroom on PSTs' interpersonal theory-based knowledge structures by using concept maps for organizing and representing PSTs' knowledge structures, analysed using social network analysis and measurements of structural complexity.

Table 3

Mean scores and standard deviations on number of links, layers, clusters, network cohesion, and structure

	pre-test		*post-test*				
	M	*SD*	*M*	*SD*	*t(df)*	*d*	*p*
Links							
number of links (n=140)	16.99	7.35	19.91	7.46	-3.912*(139)*	0.3	<.01*
Depth							
number of layers (n=140)	3.29	1.63	3.07	1.36	1.426*(139)*	0.1	.16
Content							
number of clusters (n=140)	3.23	2.60	4.06	2.93	-3.217*(139)*	0.3	<.01*
Network cohesion							
density (n=140)	0.081	0.043	0.068	0.066	2.193*(139)*	0.2	.03**
distance (n=140)	1.78	0.89	1.63	0.46	1.934*(139)*	0.2	.05
reciprocity (n=140)	0.069	0.16	0.039	0.11	2.301*(139)*	0.2	.02**
Structure							
structure of the concept map (n=140)	2.22	.588	2.34	.570	-1.960*(139)*	0.2	.05

* $p < 0.01$, ** $p < 0.05$

Table 3 shows positive and statistically significant differences in the number of links and number of clusters, and negative statistically significant differences for density and reciprocity between the pre- and post-test, with small effect sizes (respectively $d=0.3$, $d=0.3$, $d=0.2$, and $d=0.2$) (Cohen, 1988). There were no statistically significant differences found in the number of layers, distance, and structure of the concept map between the pre-and post-test. These data imply that PSTs had more organised concept maps, while using more links and clusters after watching the videos and lectures. To illustrate, Figure 7 presents an exemplary concept map from the pre-test and Figure 8 from the post-test of the same PST (PST-a), using Netdraw in UCINET (Borgatti, 2002). As these Figures show, PST-a used more links (pre-test: 9, post-test: 35), more clusters (pre-test: 2, post-test: 4), had a decreasing density (pre-test: 0.19, post-test: 0.03), and reciprocity disappeared at the post-test (pre-test: 0.27, post-test: 0). Both concept maps had a cluster structure. However, within the first concept map it was difficult to distinguish clusters, while at the post-test clusters were clearly organized and graphically visualized. The colours and shapes accompanying the concepts refer to the relevance of the concepts. Concepts in full agreement with the expert map are coloured green and have a square shape; concepts that were not in the expert map but appear relevant are coloured orange and have the shape of a circle; and concepts that were irrelevant were coloured red and have the shape of an up-triangle.
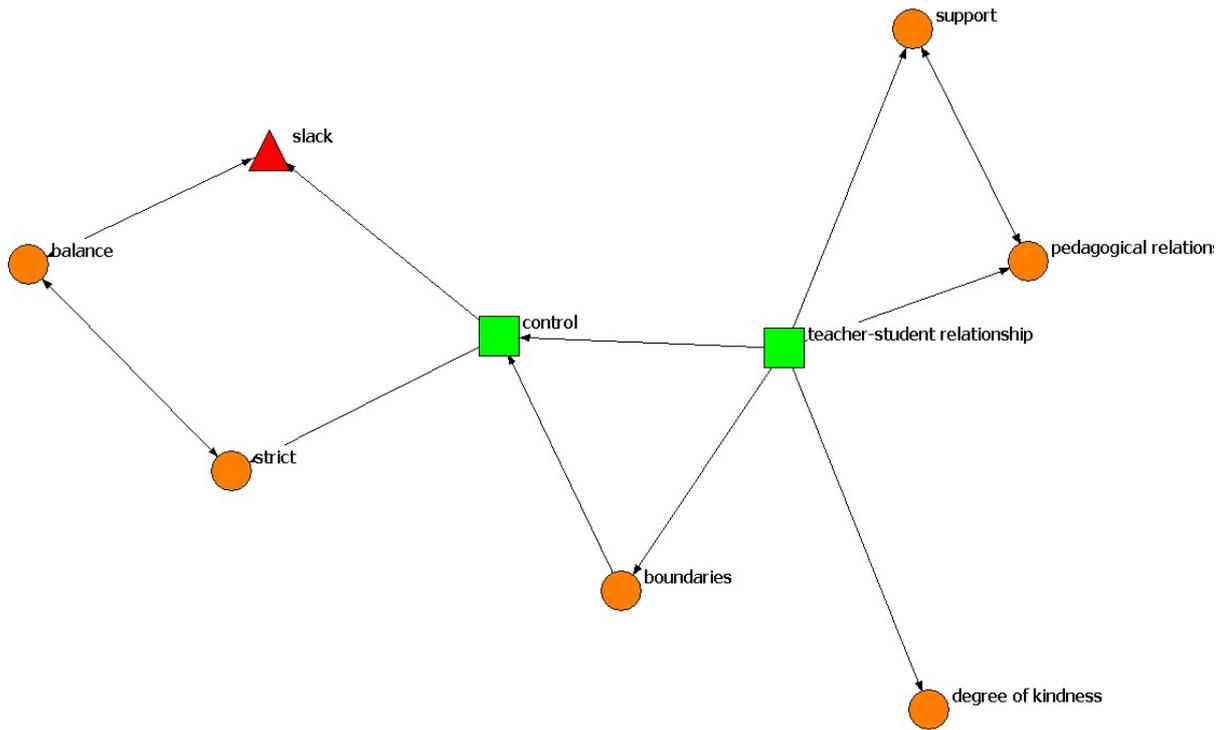
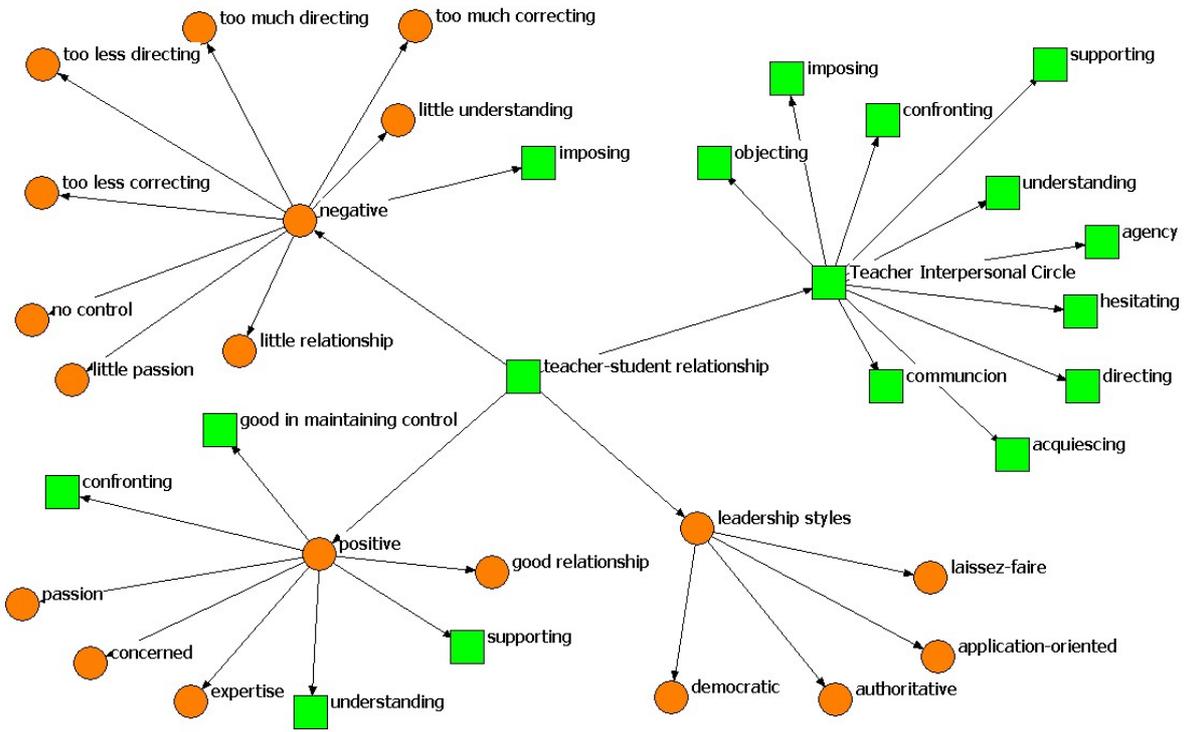*Figure 7* Exemplary concept map from the pre-test of PST-a

Figure 8 Exemplary concept map from the post-test of PST-a

To determine whether the variable 'immersiveness' influenced PSTs' theory-based interpersonal knowledge structures, an analysis of variance (one-way ANOVA) was conducted. Only a significant difference was found between immersiveness and differences between number of clusters at the pre- and post-test as part of PSTs' PSTs' theory-based interpersonal knowledge development (F(1,139)= 9.112, p < .01). The mean scores revealed that PSTs who watched all video fragments with a VR-headset outperformed the PSTs who used the VR-headset sometimes or never to watch videos by showing relatively more clusters in their concept maps at the post-test.

4.2 PSTs' theory-based interpersonal knowledge development

The second research question of this study investigated the effect of the Virtual Classroom on PSTs' theory-based interpersonal knowledge development.

Table 4

Mean scores and standard deviations on number of concepts and relevant concepts

	pre-test		*post-test*				
	M	*SD*	*M*	*SD*	*t(df)*	*d*	*p*
Concepts							
Total number of concepts (n=140)	16.50	6.05	19.46	6.66	-4.713*(139)*	0.4	<.001
Number of relevant concepts (n=140)	2.17	0.20	2.43	0.25	-10.968*(139)*	0.9	<.001

Table 4 shows statistically significant differences in the total number of concepts between the pre- and post-test with a small effect size (*d*=0.4) (Cohen, 1988) and in the number of relevant concepts between the pre- and post-test with a large effect size (*d*=0.9) (Cohen, 1988). In order to provide insight into the growth of relevant concepts, as an example, Figure 9 shows a PSTs' concept map at the pre-test, and Figure 10 shows a concept map of the same PST (PST-b) at the post-test using Netdraw in UCINET. As Figures 9 and 10 indicate, there are more green and square-shaped concepts (full agreement with the expert map) at the post-test. Figure 10 also illustrates that the less important concepts at the post-test were on the borders of the concept map.
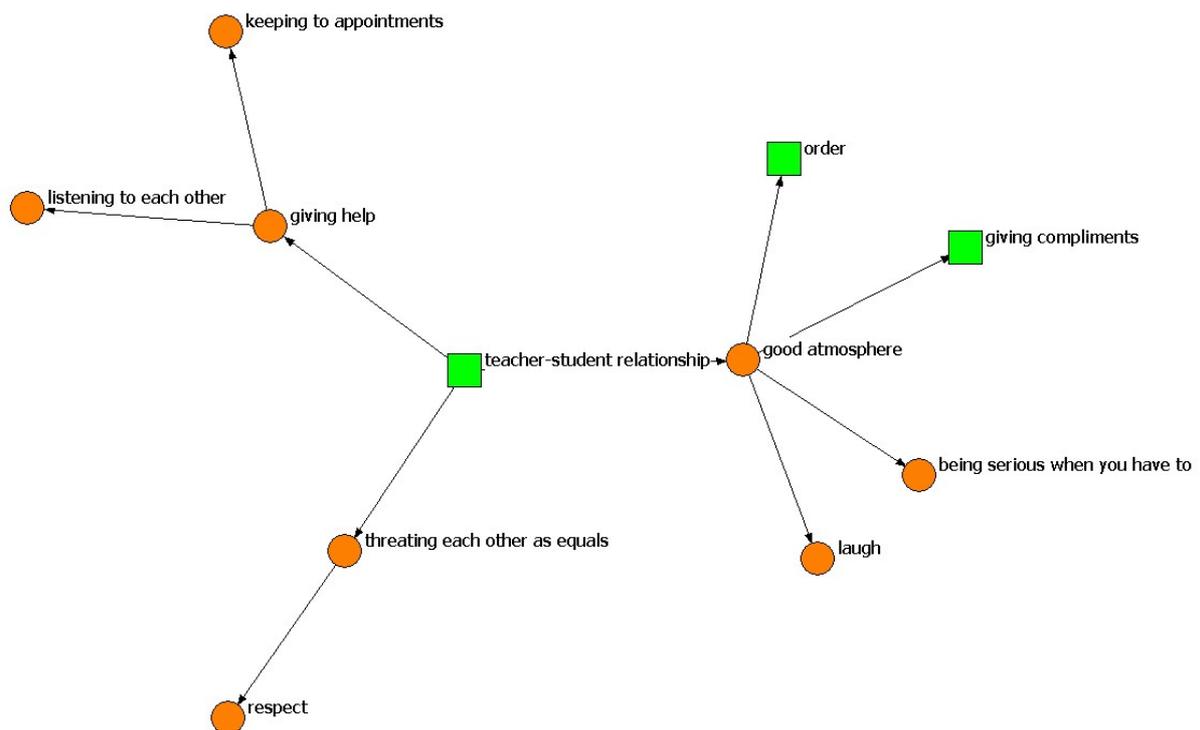

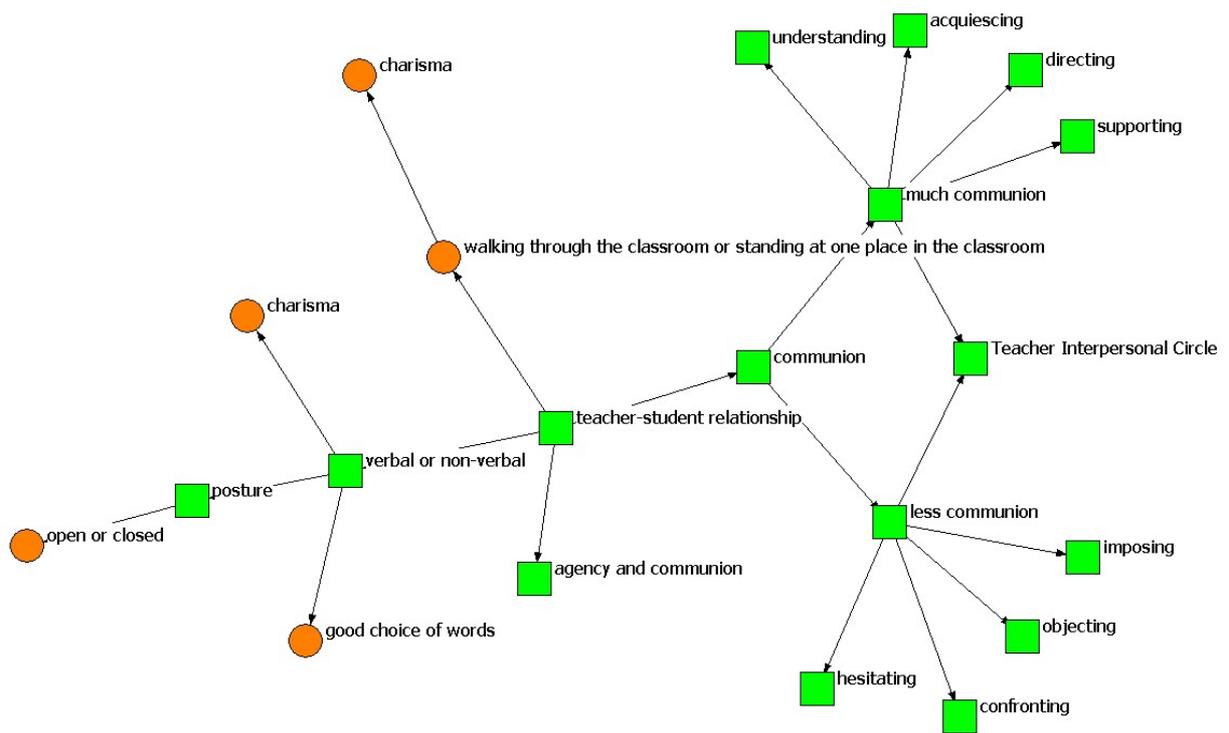*Figure 9* Exemplary concept map from the pre-test of PST-b

Figure 10 Exemplary concept map of the post-test of PST-b

To determine whether the variable 'immersiveness' influenced PSTs' theory-based interpersonal knowledge development, an analysis of variance (one-way ANOVA) was conducted. No significant differences were found between immersiveness and PSTs' theory-based interpersonal knowledge structures.

Concerning the question if PSTs' theory-based interpersonal knowledge was developed by the Virtual Classroom, the interview data revealed that all interviewed PSTs reported that for their pre-test concept map, they placed everything they knew about the teacher-student relationship in the concept map. For the post-test concept map nine PSTs stated in their interviews that they relied more on the theory they learned during the Virtual Classroom. These PSTs referred to the 'Teacher Interpersonal Circle,' verbal and non-verbal behaviour, communion, agency, and different teaching styles. After they described the main concepts that were discussed during the Virtual Classroom, they described concepts that were interrelated in their opinion (e.g., positive feedback, respect, trust). Three of these nine PSTs noted that they mainly learned from connecting the theory of the lectures to classroom events in the video fragments. They had never observed other teachers teach from an interpersonal perspective, for example, by studying the non-verbal behaviour of a teacher in the video. What is his position in the classroom? What does he do with his arms? What are his facial expressions? How do students react to this non-verbal behaviour? Two PSTs added that after the Virtual Classroom they gained terminology to describe the teacher-student relationship in the concept map.

Three PSTs did not base their concept maps at the post-test on the interpersonal theory from the Virtual Classroom in the first place. One PST described the kind of teacher she wanted to be in the future. In her description she used concepts related to the teacher-student relationship, like humour, respect, and patience. Another PSTs based his concepts on his own

limited teaching experience, which concepts were less related to the interpersonal theory as lectured within the Virtual Classroom. Furthermore, one PST reported that students' trust in the teacher is the most important aspect of the teacher-student relationship. From this, he described related concepts to trust. For example, not being too strict, easy to talk to.

Regarding the question which parts of the concept maps were especially important to PSTs, nine interviewed PSTs reported concepts related to the interpersonal behaviour theory, which were the same PSTs that stated they relied more on the theory they learned during the Virtual Classroom at the post-test. Three PSTs reported the 'Teacher Interpersonal Circle' as the most important part of their concept maps. Especially, being a teacher with high levels of communion and agency was important in their opinion. To them, this led to a good atmosphere in the classroom with positive teacher-student relationships. Regarding a high level of communion and agency two PSTs referred to the videos, these were the same PSTs that indicated to have never observed other teachers teach from an interpersonal perspective. One of these PSTs referred to a teacher in the video with lot of humour, but also to a teacher that was very strict. Another PST also referred to the videos of a very authoritarian teacher as an example of a teacher with less communion. Furthermore, this PST described a teacher from the videos that was very calm and had lots of agency. Two PSTs described that teachers' personal attention towards students as the most important concept of their concept map. In their opinion, this way students have trust in the teacher and possibly put more effort in the classroom. Related to this, one PST thought that feeling safe is the most important aspect for building a relationship between a teacher and students. Furthermore, according to one PST, teaching norms and values to students is important for treating each other respectfully. Finally, talking about hobbies with students was the most important aspect in one PST's concept map. He thought that finding common ground with students based on mutual hobbies

was very positive for building on a teacher-student relationship. Four PSTs stated that all concepts were equally important, and each concept was followed by another concept.

The same nine PSTs who reported they relied more on the theory they learned, gained this theory about the teacher-student relationship (partly) through the lectures within the Virtual Classroom and four of these PSTs learned especially from applying theory when watching the videos within the Virtual Classroom. Six PSTs also learned about the teacher-student relationship within other educational sciences courses at the teacher training institute that were conducted at the same time as the Virtual Classroom. Five PSTs indicated to have made the concept maps purely based on their own experiences as a student.

Finally, PSTs were asked if there were differences between their concept maps at the pre- and post-test. All 12 PSTs reported that for the post-test concept map they used more interpersonal behaviour terminology derived from the theoretical lectures within the Virtual Classroom. For example, they used terms as communion, agency, Teacher Interpersonal Circle, verbal and non-verbal communication, posture, imposing, directing, helpful, compliant, dissatisfied, uncertain, imposing, and confrontational (see for an example of PST-c, Figures 11 and 12). For two PSTs, the post-test concept map was more concrete, and four PSTs stated their post-test concept map was more structured. Finally, two PSTs focused at the pre-test concept map more on the content of their discipline, while they focused their post-test concept map more on teacher behaviour in general.
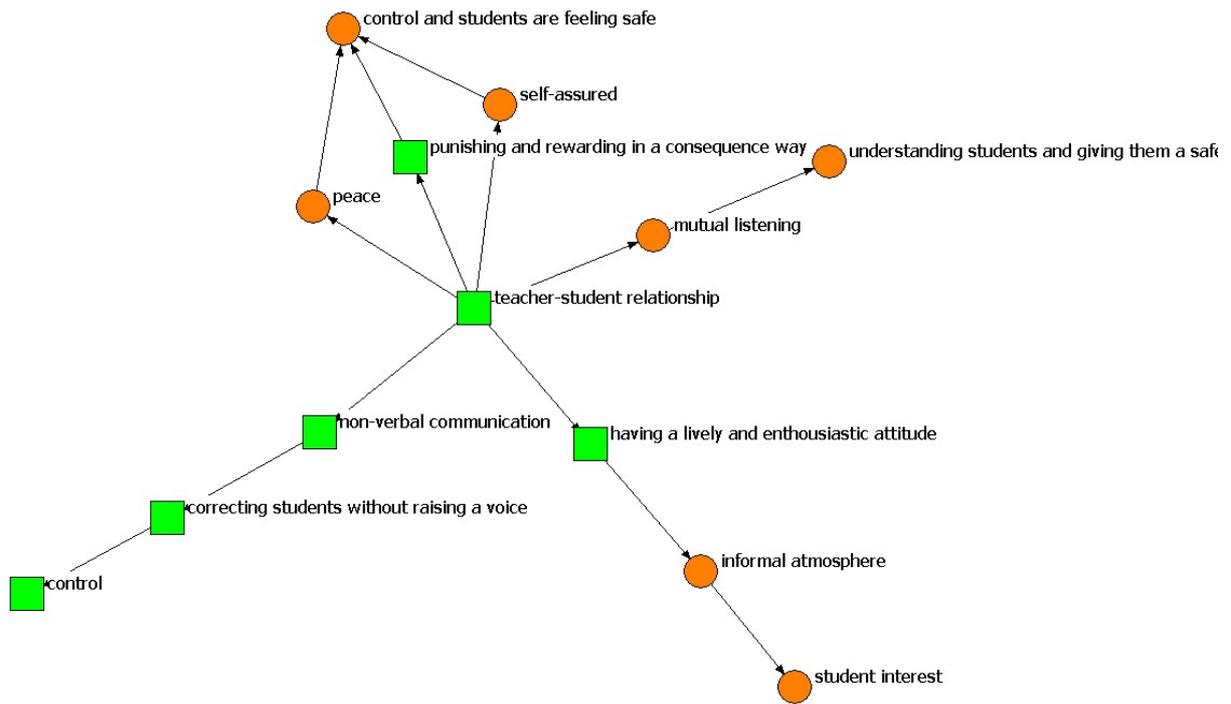
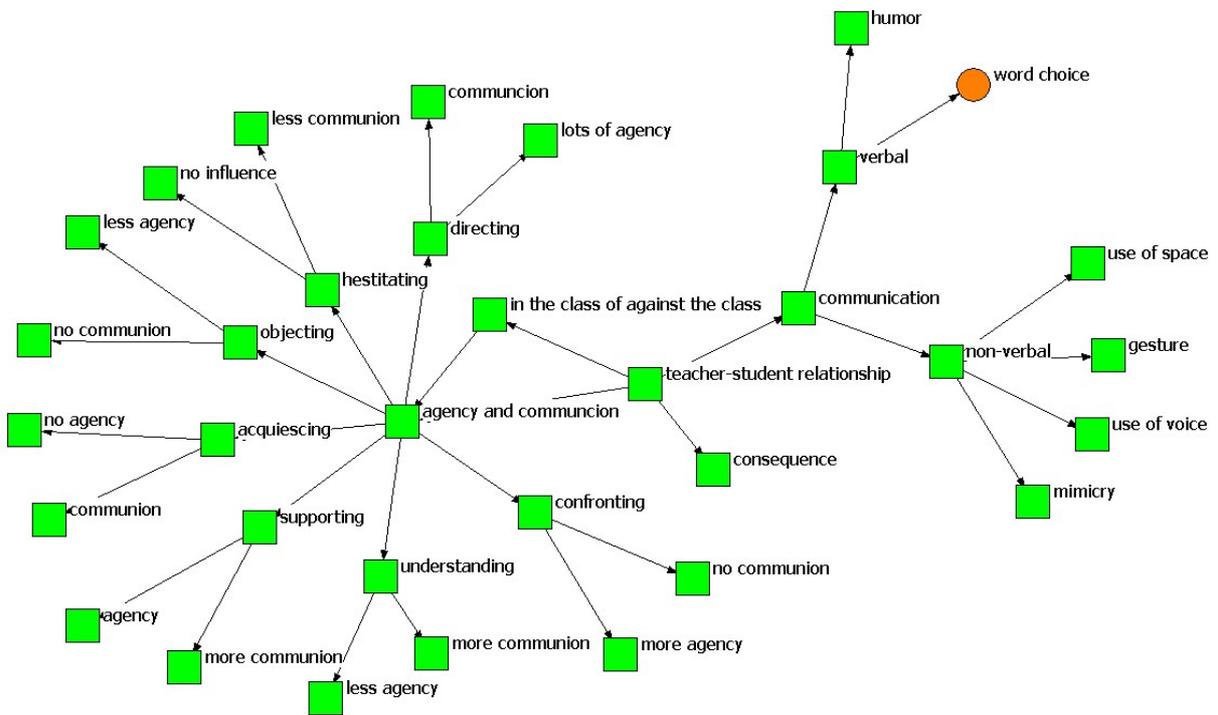*Figure 11* Exemplary concept map from the post-test of PST-c

Figure 12 Exemplary concept map from the post-test of PST-c

4.3 PSTs' theory-based interpersonal knowledge application

For the third research question, we were interested to see if PSTs could apply their theory-based interpersonal knowledge within descriptions of authentic classroom situations.

Table 5

Percentage agreement PSTs and experts in scoring vignettes in quadrants

Vignette	Quadrant expert	Percentage agreement PSTs - experts	N
1	1	62.4%	140
2	4	34%	138
3	1	92.2%	139
4	2	17.7%	138
5	2	7.8%	140
6	4	72.3%	141
7	1	95%	141
8	1	92.2%	141
9	1	96.4%	139
10	3	41.1%	141
11	3	60.3%	140
12	4	50.4%	140
13	2	24.1%	140
14	4	60.3%	139
15	1	97.9%	140
16	1	83.7%	139
17	1	47.5%	140
18	3	63.8%	140
19	4	64.5%	140
20	3	45.4%	140

Note: quadrant 1= directing-helpful, quadrant 2= understanding-compliant, quadrant 3= dissatisfied-uncertain, quadrant 4= imposing-confrontational

Table 5 shows the percentage of agreement between PSTs and the experts when scoring the teacher behaviour vignettes in the quadrants of the Teacher Interpersonal Circle. There is a reasonable percentage of agreement for the vignettes 1, 6, 14, 18, and 19 (between 60,3 % and 72,3%), and a high percentage of agreement for the vignettes 3, 7, 8, 9, 15, and 16 (between

83,7% and 97,9%). Six of the eleven above-mentioned concepts were vignettes situated in quadrant 1, three vignettes were situated in quadrant 4 and one vignette was situated in quadrant 3. This indicates that PSTs were mainly capable in applying their theory-based interpersonal knowledge for recognizing teacher behaviour situations in quadrants 1 directing-helpful and 4 imposing-confrontational, which are both quadrants were teachers showed a high level of agency. There was a relatively low percentage of agreement for the vignettes 4, 5, and 13 (between 7,8% and 24,1%). These three vignettes were the only three vignettes with situations situated in quadrant 2 understanding-compliant. This indicates that PSTs struggled the most with applying theory-based interpersonal knowledge for recognizing teacher behaviour with higher communion and lower agency.

Table 6

Descriptive statistics mean absolute distance between PSTs and experts on vignette scores

Vignette	N	Minimum	Maximum	Mean	Std. deviation
1	140	.00	4.47	2.09	.89
2	138	.00	8.54	3.60	1.63
3	140	.00	7.00	1.52	1.13
4	140	.00	9.43	6.94	1.66
5	140	.00	5.10	3.25	1.43
6	141	.00	7.07	2.43	1.71
7	141	.00	5.39	1.51	.85
8	141	1.00	7.07	3.13	.93
9	139	.00	5.00	1.48	.80
10	141	.00	9.43	3.49	2.07
11	140	.00	9.43	2.80	1.48
12	140	.00	8.54	3.62	2.15
13	140	1.00	8.25	5.26	1.91
14	139	.00	7.28	3.19	1.63
15	140	.00	4.47	2.62	.72
16	139	.00	6.40	2.13	1.32
17	140	.00	7.21	2.57	1.31
18	140	.00	7.21	2.62	1.25
19	140	.00	8.54	3.14	1.81
20	140	.00	8.06	3.01	1.64

Table 6 shows that the absolute distance between PSTs and the experts was relatively low for vignettes 3, 7, and 9, which is congruent with the comparisons of PSTs and the experts on the quadrant level. These results confirm that PSTs were especially capable in scoring vignettes within quadrant 1 directing-helpful. Contrary to the findings of the comparisons of PSTs and the experts on the quadrant level, the absolute distance between PSTs and the experts was relatively high for the vignettes 8, 14, and 19. This were three vignettes in which the experts scored close to the border of a quadrant.

To determine whether the variable 'immersiveness' influenced the scoring of the vignettes, an analysis of variance (one-way ANOVA) was conducted. A significant difference was found between immersiveness for scoring the vignettes ($F(1,139)= 10.420$, $p < .01$). The mean scores revealed that PSTs that watched all video fragments with a VR-headset outperformed the PSTs that watched the videos sometimes or never with the VR-headset, the absolute distance between their scores and the experts' score was lower (respectively 2.88 and 3.12). This indicates that the level of immersiveness positively influenced PSTs' theory-based interpersonal knowledge application when scoring teacher behaviour vignettes.

5. Discussion and conclusion

In this study we were interested to see if PSTs' theory-based interpersonal knowledge structures and the content of PSTs' theory-based interpersonal knowledge developed after theoretical lectures with videos (the Virtual Classroom). Furthermore, we were interested to see if PSTs could apply their theory-based interpersonal knowledge within descriptions of authentic classroom situations.

With respect to the first research question, it was found that PSTs showed more organised concept maps after the intervention. This was reflected in the statistically significant increase of links and clusters and the statistically significant decrease of density

and reciprocity. Especially in concept maps of PSTs who used the VR-headset throughout the whole intervention the number of clusters increased. Therefore, it seemed that providing PSTs with theoretical lectures added with observing immersive video fragments led to an increased structured concept map. Following Buitink (2009), a more structured concept map is associated with a better developed interpersonal knowledge structure. For teacher education, this implies that concept maps are a useful tool to assess PSTs' knowledge development as they can be analysed and compared for the knowledge structure before and after a course. These more organised concept maps after the intervention also imply that the combination of theoretical lectures and watching 360-degree videos can be an asset for teacher education to improve PSTs' knowledge structures about a certain topic, such as interpersonal teacher behaviour.

With respect to the second research question, it was found that PSTs used statistically significantly more concepts at the post-test compared to the pre-test. Moreover, these concepts were also more relevant after the intervention, when compared with the expert map. This indicates that PSTs' theory-based interpersonal knowledge also developed in the desired direction after the Virtual Classroom. By having a closer look at the concepts of the post-test, the qualitative data revealed that PSTs at the post-test relied more on the theory they learned partly during the Virtual Classroom. This was reflected in mentioning concepts about the systems approach to communication (Watzlawick, Beavin, & Jackson, 1967; Wubbels, Brekelmans, den Brok, & van Tartwijk, 2006), the Teacher Interpersonal Circle (Wubbels, Brekelmans, den Brok, & van Tartwijk, 2006; den Brok & van Tartwijk, 2015; Pennings et al., 2018), and teachers' verbal and non-verbal behaviour (van Tartwijk, 1993). It was surprising that only four PSTs referred to the videos within the Virtual Classroom. This implies that especially the theoretical lectures seemed to contribute to PSTs' improved theory-based interpersonal knowledge, while the actual addition of 360-degree videos to this remains

limited. Overall, these data suggest that the use of theoretical lectures, in combination with 360-degree videos, develops PSTs' theory-based interpersonal knowledge and is, therefore, a useful method for teacher education.

With respect to the third research question, it appeared that PSTs were mainly capable in applying their theory-based interpersonal knowledge on vignettes from quadrants 1 directing-helpful and 4 imposing-confrontational. A high level of agency is a characteristic of behaviour within these both quadrants. PSTs struggled with scoring classroom situations from quadrant 2 understanding-compliant, which is associated with a low level of agency. There are three possible explanations for these results: *(1)* Most experienced teachers have higher scores on the agency dimension than beginning teachers (Brekelmans, 2010). Within their own experiences as a student, PSTs were confronted with these experienced teachers, who possibly formed their perception on teacher behaviour. *(2)* Within the Virtual Classroom the focus of the theoretical lectures was on quadrant 1 which can be seen as ideal interpersonal teacher behaviour (Brekelmans, 2010). *(3)* The majority of the vignettes corresponded with quadrant 1.

Although the interviews and the concept maps suggested that PSTs especially developed their interpersonal knowledge through the theoretical lectures, it was shown that the use of a VR-headset positively influenced PSTs' theory-based knowledge development and application. Firstly, the number of clusters in PSTs' concept maps increased statistically significantly when all videos were watched using a VR-headset which suggests more organized interpersonal knowledge. Secondly, PSTs interpersonal knowledge application was closer to that of experts after using a VR-headset all the time, outperforming PSTs that used a VR-headset less often. This implies that a higher level of immersiveness is a positive influence for interpersonal knowledge development. This is possibly due to VR's immersive

ability to offer realistic and authentic situations (Martín-Gutiérrez et al., 2016) and its ability to disconnect PSTs from their surroundings (Olmos-Raya et al., 2018).

A first limitation of this study was that only 60 PSTs used the VR-headset throughout all the sessions. This was because some mobile phones were not equipped with a gyroscope necessary for watching videos in 360-degrees, and some PSTs felt nausea. It would be interesting for further research to investigate which conditions contribute to and hinder the use of a VR-headset. A second limitation was that the nature of the interrelations between concepts were underexposed. This study only investigated if PSTs used more relevant concepts and links and the structure involved. However, it is still unknown if PSTs made correct connections between concepts. Further research into the interrelations between concepts would be recommended. A third limitation was that during the interviews there was a lack of mentioning interpersonal theory while watching 360-degree videos. It would be interesting to see what the specific influence of watching videos with a VR-headset is for knowledge development in relation to the theoretical lectures. Future research could examine this. Thirdly, PSTs' vignettes were compared with the experts at the quadrant level. However, the Teacher Interpersonal Circle can also be divided on a more precise level in eight segments (den Brok & van Tartwijk, 2015). Further research regarding comparisons at the segment level would be worthwhile. Lastly, differences in PSTs' network structures at the pre- and post-test approached significance. Buitink (2009) argued that the network structure is an indicator for the complexity of a person's knowledge structure. For this reason, future research could provide a deeper understanding about the influence of a combination of 360-degree videos and theoretical lectures on PSTs' theory-based interpersonal knowledge structures.

Despite these limitations, this study has certainly added to our understanding of

(1) PSTs' knowledge development by assessing PSTs' knowledge structures with concept maps, *(2)* the developing of the content of PSTs' theory-based interpersonal knowledge, and *(3)* PSTs' theory-based interpersonal knowledge application through theoretical lectures combined with 360-degree videos. This study has shown that PSTs' theory-based interpersonal knowledge structure can be visualised using concept maps and interpreted by using social network analysis, by analysing measurements of structural complexity, and via comparisons with expert maps. Therefore, concept maps appear a useful method for teacher education institutes to assess PSTs' knowledge development. Finally, PSTs used more irrelevant concepts at the pre-test, while at the post-test they improved their concept maps with more relevant concepts due to the combination of theoretical lectures and watching 360-degree videos (the Virtual Classroom). This led to more precise concept maps with more relevant concepts and possibly a decreased the network cohesion. This implies that the Virtual Classroom is a valuable method for teacher education institutes to improve PSTs' theory-based interpersonal knowledge. To conclude, PSTs' theory-based interpersonal knowledge structures, development, and application can benefit from using VR-headsets in combination with theoretical lectures. Possibly this is true for more sorts of theory-based knowledge, which offers an interesting angle for future research.

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Appendix A Teacher behaviour vignettes

1. directing-helpful	V1	You position yourself in front of the classroom and indicate you would like to start the lesson.
	V3	To make something clearer, you tell the students about your own experiences.
	V7	The last couple of lessons you taught some difficult topics. At the end of the final lesson, you ask the students if there is anything they still need regarding these topics.
	V8	You gave your students a difficult and demanding task. While distributing the task, you also said you were fully confident in them.
	V9	Students have been working well. You show your appreciation.
	V15	This lesson is about a particular topic. You enthusiastically explain a particular part of it.
	V16	Students are allowed to work for themselves. You remain present so they can ask for help whenever they have any questions or problems.
	V17	You explain an assignment that has to be carried out in the lesson. While distributing it, you tell the students they have to work individually and in silence.
2. understanding-compliant	V4	In the previous lesson, you made a mistake in your explanation of a particular topic. In this lesson you again pay attention to this explanation, and you have just admitted that you have made this mistake.
	V5	It is the beginning of the lesson, the students are all seated and getting ready. You ask how they are doing.
	V13	The lesson is almost finished, you have told the students they may do something for themselves for the last ten minutes.
3. dissatisfied-uncertain	V10	In your view, students have shown a lack of effort. In the lesson you show them your dissatisfaction.
	V11	Three students are not paying attention. You react in an irritated way.
	V18	You are a bit ill-tempered today. A student makes the wrong remark at the wrong time. You react somewhat snappily.
	V20	Students' results are disappointing. You are quite certain they did not work hard enough and you show you are displeased.
4. imposing-confrontational	V2	A student did not perform well. You tell him/her that you expect him/her to try harder next time.
	V6	A couple of students arrive in class late. You resolutely confront them with the rules regarding attendance.
	V12	Two students are playing with a mobile phone or something, and because of that are not paying attention to the lesson. You give them both a straight look, without saying anything.
	V14	You tell students the consequences of not abiding by the rules.
	V19	A group of girls is talking and giggling. You look sternly in their direction and call out their names one by one.