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Classroom simulations in teacher education to support preservice teachers' interpersonal competence: A systematic literature review

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ABSTRACT

Computer-based classroom simulations have been argued to be a promising way to practice preservice teachers' (PSTs') interpersonal competence and to ease the gap between teacher education and educational practice. The systematic literature review presented in this paper examined existing research on the links between PSTs' interpersonal competence, well-being, and simulations. Furthermore, this review mapped learning experiences, affordances, and hindrances of simulations. Fifteen studies were found eligible for inclusion. Most of these studies reported positive effects of simulations on PSTs' classroom management and teaching skills in general, rather than specifically on interpersonal competence (e.g., professional interpersonal vision, professional interpersonal knowledge, professional interpersonal repertoire). Concerning PSTs' well-being, four studies did show positive effects of simulations on PSTs' self-efficacy. However, none of the studies reported PSTs' anxiety. Reported affordances were mostly educational (e.g., receiving teacher feedback, available resources) or social (e.g., peer observation, discussions), while the reported hindrances were mainly of a technical nature (e.g., lack of a user-friendly interface, malfunctioning audio or video). Positive learning experiences depended on the degree of realism and authenticity within the simulation. The results of this study provide suggestions for future research on how computer-based simulations in teacher education could contribute to PSTs' interpersonal competence and well-being.

1. Introduction

Preservice teachers' (PSTs) ability to create positive teacher-student relationships via behavioural strategies is referred to as PSTs' *interpersonal competence,* which is an important element in classroom management (Stough & Montague, 2015) and a major concern for PSTs (Friedman, 1995). Difficulties with classroom management and teacher-student interpersonal relationships are among the main reasons for PSTs to leave teacher education (Evertson & Weinstein, 2006). Computer-based classroom simulations are considered a safe way to practice and improve PSTs' interpersonal competence (Dalgarno, Gregory, Knox, & Reiners, 2016; Rayner & Fluck, 2014), which in turn contributes to preservice teachers' well-being (Wubbels et al., 2015).

A recent literature review found promising learning outcomes in the cognitive, intrapersonal, and interpersonal domains for games and simulations in education (Clark, Tanner-Smith, & Killingsworth, 2016). For instance, digital games were found to be more effective for learning outcomes than non-game instructional conditions. However, this review focused primarily on games rather than

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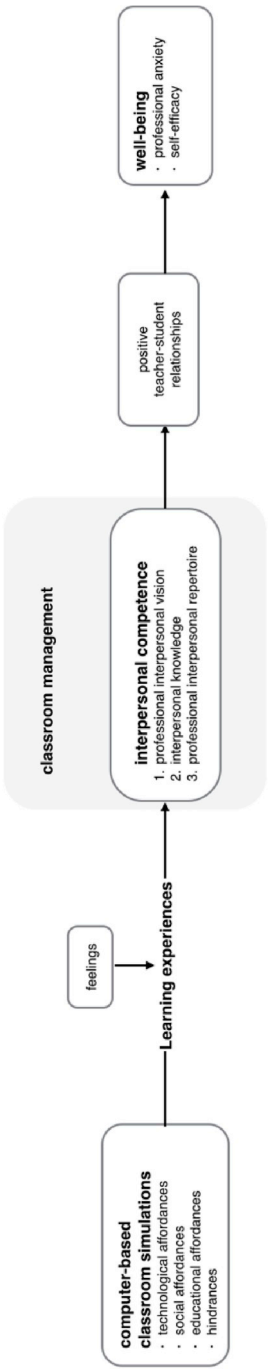

Fig. 1. Main concepts and their assumed interrelations.

simulations, and on K-16 students, rather than PSTs. Moreover, prior reviews on simulations in education (e.g., Vogel, et al., 2006; Wouters, Van Nimwegen, Van Oostendorp, Van der Spek, 2013) refrained from addressing aspects that afforded or hindered the effective use in teacher education. Furthermore, PSTs' feelings that arise through simulations were unaddressed, while these feelings can determine the quality of the learning experience (Sansone & Thoman, 2005).

This paper offers a systematic review to map all relevant literature about computer-based classroom simulations, PSTs' interpersonal competence, and important indicators of PSTs' well-being. Additionally, our review explores learning experiences, affordances, and hindrances of simulations. It serves as a starting point for more in-depth research about simulations and PSTs' interpersonal competence. Below, we first operationalize the main concepts of this review: Fig. 1 shows an overview of these concepts and their assumed underlying concepts and their mutual relations.

1.1. Preservice teachers' well-being

Well-being encompasses, among other things, how PSTs feel at school, and whether they are free of school related psychological or psychosomatic problems (Van der Want, 2015). Following Van der Want (2015) we distinguish two central aspects of PSTs' well-being: professional anxiety and self-efficacy. Teachers often experience emotions such as anxiety, as teaching is characterized by intensive social relations, fast decision making, unmotivated students, and constant change (Alontaga & Durban, 2013). When anxiety of teachers relates to their professional actions, it is considered *professional anxiety*. PSTs experience anxieties from (minor) disruptions within their daily classroom routine, such as students' off and on task behaviour (Admiraal, Wubbels, & Korthagen, 1996). Likewise, 'classroom discipline' and 'motivating students' are reported as the two most important problems that PSTs and beginner teachers face (Veenman, 1984).

PSTs have a lower chance of experiencing professional anxiety caused by disruptions in their daily classroom routine, if they have a strong sense of self-efficacy (Friedman, 2003). *Self-efficacy* is known as teachers' belief that they can influence student behaviour and achievements (Friedman, 2003). Three subcomponents of self-efficacy can be distinguished: self-efficacy for classroom management, for instructional strategies, and for student engagement (Tschannen-Morran & Woolfolk Hoy, 2001).

1.2. Preservice teachers' interpersonal competence

The actions teachers undertake to create positive learning environments, and the meaning students and teachers give to their interactions can be defined as interpersonal competence (Wubbels et al., 2015; Wubbels, Créton, & Hooymayers, 1985). We perceive interpersonal competence as the combined set of abilities to notice, interpret and anticipate on classroom events, aiming to influence the teacher-student relationship. We distinguish three important components of interpersonal competence: *professional interpersonal vision*, *professional interpersonal knowledge,* and *professional interpersonal repertoire*.

Teachers' professional interpersonal vision consists of the combination of *noticing* and *interpreting* classroom events from an interpersonal perspective (Goodwin, 1994; Van Es & Sherin, 2002). The 'Learning to Notice Framework' (Van Es & Sherin, 2002), distinguishes three key aspects of PSTs professional interpersonal vision. The first aspect in professional interpersonal vision is to notice a relevant classroom event. Second, after PSTs notice a relevant classroom event, they should interpret this event by connecting it to theories about interpersonal teaching behaviour. Through interpreting noticed interpersonal events, PSTs develop insight in interpersonal classroom events. Lastly, PSTs have to apply knowledge about the specific teaching context to the noticed event.

The second component of interpersonal competence involves interpreting classroom events, where interpretation depends on PSTs' knowledge about interpersonal behaviour. We refer to this as *professional interpersonal knowledge*. We define professional interpersonal knowledge as practical knowledge about how to develop and support a healthy teacher-student relationship. This knowledge includes the roles students and teachers have, as well as the larger classroom system that they are a part of. Practical knowledge is defined as PSTs' knowledge and beliefs related to their own teaching practices, for instance about classroom management strategies (Van Tartwijk, Den Brok, Veldman, & Wubbels, 2009). Knowledge of strategies before starting a lesson, such as shaking hands to create positive and trustful teacher-student relationships, is an example of professional interpersonal knowledge.

The third component of interpersonal competence involves anticipating on classroom events. This consist of the range of possible actions PSTs undertake to create positive teacher-student relationships, which we define as PSTs' *professional interpersonal repertoire*. This repertoire is influenced by professional interpersonal knowledge (Verloop, Van Driel, & Meijer, 2001; Wubbels et al., 2015). A relation exists between preservice teachers' professional interpersonal knowledge on teacher-student relationships, and the quality of these relationships (Wubbels et al., 2015). This quality increases when PSTs are more knowledgeable of factors that improve teacher-student relationships, and when they can apply this knowledge into practice.

1.3. Computer-based classroom simulations

Since PSTs practice their interpersonal competence mainly in the classroom, this may restrict their teacher education (Brekelmans, 2010). Computer-based classroom simulations offer the opportunity to improve teacher education and educational practice as it can smoothen the transition from teacher education to practice. This way, before they assume full responsibility over a real classroom, PSTs can experience rich learning opportunities by engaging in a safe environment (Rayner & Fluck, 2014). Classroom simulations in teacher education are intended as an *additional* resource for developing interpersonal competence, rather than a *replacement* of the teacher educator. Simulations offer dynamic, rule-based and often simplified imitations of classroom events. They

give teachers (educators) control of content, training structure and timing of classroom events (Clark & Mayer, 2011). Simulations differ from games, since games result in a quantifiable outcome (Salen & Zimmerman, 2004). In other words, contrary to simulations, players can either win or lose a game or receive a numerical score.

A common way of simulating classrooms is *role playing* (Clapper, 2010): simulating realistic classroom events and confronting PSTs with realistic problems in their role as teachers. By taking part in role plays, PSTs are able to actively develop new skills. The focus in this literature review is on classroom simulations that use role play enhanced by technology. Role play simulations can be enhanced by technology in two ways via non-immersive simulations and immersive simulations (Dalgarno et al., 2016). Non-immersive simulations represent classroom scenarios through text and static graphical output. Examples of this kind of simulations include: ClassSim (Ferry, Kervin, Cambourne, Turbill, & Hedberg, 2005), the Cook District School (Girod & Girod, 2006), and simSchool (Gibson, 2007). Immersive simulations are designed with visual representations of realistic classroom events (Dalgarno et al., 2016). Avatars are used to represent students and teachers. Examples of these kind of simulations are Second Life (Cheong, 2010; Mahon, Bryant, Brown, & Kim, 2010), or The VirtualPREX Classroom Simulation (Dalgarno et al., 2016).

A recent literature review (Clark et al., 2016) demonstrated that cognitive, intrapersonal and interpersonal learning outcomes from students in grade K-16 increased after applying simulations. However, not all learners were motivated by simulations (Van den Beemt, Akkerman, & Simons, 2010). Learners who were unfamiliar with simulations were demotivated by the complexity of these applications. Additionally, it has been argued that elements of simulations can be so motivating that they distract from learning goals (Clark & Mayer, 2011). Hence, it is important to investigate how simulations contribute to learning and how a balance can be achieved between learning and maintaining student motivation (Clark et al., 2016). Therefore, this review also focuses on affordances and hindrances for simulations in teacher education.

Affordances are the perceived and actual properties of objects that determine how they could possibly be used (Salomon, 1993; as cited in Conole & Dyke, 2004). For example, a potential affordance of ICT is the exposure to experiences of others (Conole & Dyke, 2004). Three types of affordances can be distinguished: *technological*, *social,* and *educational* (Kirschner, Strijbos, Kreijns, & Beers, 2004). Technological affordances relate to system usability, social affordances give the opportunity for social interaction, and educational affordances determine how learning takes place using ICT. Hindrances are the counterpart of technological affordances. Not being able to see facial expressions of avatars is an example of a hindrance when focusing on interpersonal competence (Kim & Blankenship, 2013).

1.4. Learning experiences from simulations

While PSTs are engaged in learning experiences using computer-based classroom simulations, they experience different types of feelings (Sansone & Thoman, 2005). Feelings of engagement and motivation, as well as feelings of uncertainty and stress were reported to be caused by classroom simulations (Stavroulia, Makri-Botsari, Psycharis, & Kekkeris, 2016). Particularly for classroom simulations PSTs reported negative feelings including anxiety, embarrassment, nervousness, disappointment, insecurity, inability to deal with the various classroom management issues, feeling dissatisfied about oneself during the simulated activities, fatigue, fear, stress, and confusion (Stavroulia et al., 2016). Feelings such as embarrassment, insecurity and stress were found to be similar to feelings novice teachers experience in classrooms (Stavroulia et al., 2016).

Van den Beemt and Diepstraten (2016) argued that besides feelings, attitudes towards ICT are based on a relation between teachers' self-efficacy, learning experiences, relevant others, beliefs, and their adoption of ICT. In this context, the concept of ICT minded teachers and non-ICT minded teachers is introduced. ICT minded teachers are able to set limitations of new technologies aside whereas non-ICT minded teachers experience these limitations as a foundation for their aversion towards technology.

1.5. Aim and research questions

This paper presents a systematic literature review in an effort to gather and analyse existing research about interrelations between computer-based classroom simulations, learning experiences, interpersonal competence, and well-being as discussed above in our theoretical model (Fig. 1). Simulations serve to increase interpersonal competence, which is speculated to increase PSTs' well-being through decreasing their professional anxiety and increasing PSTs' self-efficacy.

Furthermore, this review aims to understand learning experiences, affordances, and hindrances of computer-based classroom simulations when applied to enhance PSTs' interpersonal competence. The main research question that guides this review is: what main issues regarding computer-based classroom simulations, affordances, hindrances, learning experiences, interpersonal competence, and well-being have emerged in the field of empirical research on teacher education?

2. Method

2.1. Search process

A systematic review was conducted to answer the research question. Studies were found in the databases Scopus, ERIC, PsycINFO, and Web of Science. Studies had to be peer reviewed to be included. Table 1 provides an overview of keywords and corresponding synonyms that were used to select relevant studies. These keywords were based on relevant literature about interpersonal competence, well-being, and simulations. Based on the argued increase in digital games for learning from 2000 and later (Clark et al., 2016), the search period of this systematic review was limited to 2000 until 2016.

Table 1
Keywords and synonyms used in the query.

Keywords	Synonyms
simulation	"virtual reality", "game[a]", "role play[a]", "virtual internship[a]", "simulated environment[a]", "virtual environment[a]"
interpersonal competence	"classroom management", "teacher-student relationship[a]", "teacher beliefs", "teacher cognition[a]", "interpersonal communication[a]", "teacher-student interaction[a]"
professional interpersonal vision	"withitness","awareness", "visual perception[a]", "learning to notice", "cognitive representation[a]"
professional interpersonal repertoire	"teacher attitude[a]", "teacher skill[a]", "teacher value[a]", "interpersonal knowledge", "teacher knowledge", "pedagogical knowledge"
self-efficacy	"teacher concerns", "work engagement"
teachers' well-being	"teacher's well-being", "teachers' wellbeing", "teacher's well-being"
teacher education	"teacher training"

[a] After a key word denotes that variations of the keyword, such as plurals, were also included as search terms.

2.2. Screening articles

Fig. 2 shows the selection process of this literature review. The first search resulted in 594 hits in Scopus, 11 hits in ERIC, four hits in PsycINFO and 19 hits in Web of Science. Twenty articles appeared to be duplicates.

Initially, the abstracts were screened by applying the following inclusion criteria:

1. The study investigated the use of computer-based classroom simulations;
2. The study discussed one of the following terms: interpersonal competence, professional interpersonal vision, professional interpersonal repertoire, professional interpersonal knowledge, well-being, professional anxiety, and professional efficacy;
3. Participants in the study were PSTs;
4. Studies could be qualitative or quantitative;
5. The article was written in English with an available full-text version.

After reading the abstracts, thirty-eight studies remained for full reading. Studies that did not met one or more of the above criteria were excluded for analysis.

2.3. Reading full articles

In the next phase, full texts were analysed using the above-mentioned inclusion criteria. However, one full text could not be retrieved, even after contacting the authors, and was therefore excluded. Ten studies were eventually included. Snowballing the references of included articles yielded another twelve studies. After reading the abstracts and full texts of these twelve studies, five studies remained. Eventually, fifteen studies met the inclusion criteria. Main reasons to exclude articles during the selection process were that they were conducted in contexts other than teacher education (such as nursery), they were not about computer-based simulations, or no reference was made to one of the keywords in the abstract.

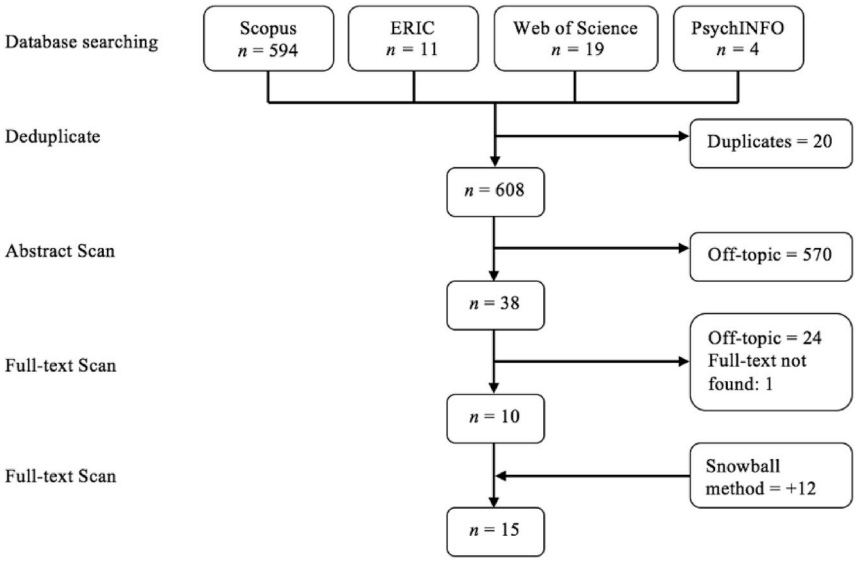

Fig. 2. Flowchart selection process.

Table 2
Criteria for quality appraisal.

	0	1	2	3
	no mention	some mention	good mention	Extensive mention
Criteria for qualitative studies Study methodologically is clear		6	1	
Study theoretically substantiated		2	2	3
Ethical process transparent	3	2	2	
Researcher(s) relation to participants are clear	5	1	1	
Researchers(s) relation to the data are clear	7			
Researcher(s) take a critical stance towards own research	1	4	2	
Congruence between methodology and methods used for data collection, analysis, and interpretation	1	2	4	
Participant involvement in data interpretation	7			
Limitations voiced	1	3	3	
Criteria for quantitative studies				
Is the source population or source area well described?		3	6	3
Were interventions and comparisons) well described and appropriate?		3	6	3
Were outcome measures reliable?		4	6	2
Were outcomes relevant?		2	7	3
Were the analytical methods appropriate?		4	4	4
Are the study results internally valid (i.e. unbiased)?	2	4	5	1
Are the findings generalizable to the source population (i.e. externally valid)?	7	1	3	1

2.4. Process of analysis

The following theoretical coding scheme was applied to describe and categorise the included studies:

1. General information: authors, title, year of publication, database, journal, abstract, keywords, country;
2. Research design: aims and research questions, theoretical background, method, instruments, information about the participants, length of intervention;
3. Operationalisation concepts: definitions of the used computer-based classroom simulations and keywords;
4. Overall results: findings and conclusions related to research question of this review. Results were organized using keywords from the query, such as interpersonal competence, well-being, and affordances.

The coding scheme revealed similarities and dissimilarities between results of the included studies. During the process of analysis, the first author applied the coding scheme, the second and third authors monitored the process, and advised about the method.

2.5. Quality appraisal

Finally, quality appraisal was employed. Criteria for evaluating studies suitable for qualitative research synthesis (Table 2) were adapted from Savin-Baden and Major (2007, p. 838) and used for quality appraisal of included qualitative studies (N = 2). Criteria for quality appraisal of the quantitative studies (N = 8) were adapted from the checklist for quantitative intervention studies (NICE, 2012) as shown in Table 2. Mixed-method studies that were equally quantitative and qualitative (N = 5) were subjected to both quality appraisals. Two mixed-method studies were mostly quantitative and hence included in the quantitative quality appraisal. For each criteria studies received a score between 0 and 3. A score of 0 represents no mention of the topic, where 3 represents an excellent description of the criteria's topic. The scores 1 and 2 respectively represent touching the topic only briefly and substantial description of the topic.

A few studies scored high on multiple (e.g., most) quality aspects: Rayner and Fluck (2014), Mirliss, May, and Zedeck (2015), Girod and Girod (2006), and Christensen, Knezek, and Tyler-Wood (2011). For the mixed-method studies, one study scored low on the quality appraisal. Other studies scored across the remaining range of the quality appraisal scale. Because the research field of this literature review is in its nascent state, only a few (15) articles were found about this topic and was decided to include all studies to obtain a substantial body of literature. Because the found studies scored across the full range of the quality appraisal scale, conclusion will be drawn with caution.

3. Results

3.1. Characteristics

The search period for this systematic review was between 2000 and 2016. Distribution over years, countries, type of methodology, and discussed theoretical concepts of the included articles are presented in Table 3.

None of the included articles reported studies about the theoretical interrelation between concepts of the theoretical model

Table 3
Characteristics of included studies.

Authors	Simulation	Theoretical concepts	N	Method	Type of data collection	Country	Year
Bautista & Boone	TeachME™	Interpersonal competence Learning experiences	62	Mixed-method	Written journals	United States	2015
Cheong	Second Life	Self-efficacy	110 Condition 1: 59 Condition 2: 51	Quantitative	Questionnaire	Korea	2010
Christensen, Knezek, & Tyler-Wood	simSchool	Self-efficacy	Trial 1: 62 Trial 2: 104 (47 PSTs)	Quantitative	Questionnaires	United States	2011
Dalgarno et al.	VirtualPREX	Interpersonal competence Professional interpersonal vision Professional interpersonal repertoire Self-efficacy Hindrances Learning experiences	Phase 1: 72 Phase 2: 21	Mixed-method	Questionnaire	Australia	2016
Dawson & Lignugaris	TLE TeachLivE™	Interpersonal competence	4	Quantitative	Video Assessments Questionnaire	United States	2016
Deale & Pastore	simSchool	Professional interpersonal repertoire Learning experiences	13	Quantitative	Questionnaire	United States	2014
Ferry et al.	ClassSim	Professional interpersonal vision Affordances	Trial 1: 24 Trial 2: 24	Qualitative	Observations Interviews PSTS′ entries	Australia	2005
Girod & Girod	The Cook Simulation	Professional interpersonal repertoire	Experimental group: 33 Control group: 38	Quantitative	Questionnaire Teacher work sample scores Lesson evaluation scores	United States	2006
Hummel et al.	Mastership game (online and face-to-face version)	Interpersonal competence Affordances Learning experiences	19 Online version: 9 Face-to-face: 10	Mixed-method	Questionnaire Written reports	The Netherlands	2015
Kim & Blankenship	Second Life	Hindrances Learning experiences	12	Qualitative	Vignettes Reflective statements Observations Debriefings	United States	2013

(*continued on next page*)

Table 3 (*continued*)

Authors	Simulation	Theoretical concepts	N	Method	Type of data collection	Country	Year
Mahon et al.	Second Life and Role Play	Interpersonal competence Hindrances	20	Qualitative	Questionnaire Observation Written notes	United States	2010
Mirliss et al.	Seton Hall's Simulation	Interpersonal competence Professional interpersonal knowledge Hindrances Learning experiences	23	Mixed-method	Questionnaires	United States	2015
Quintana & Fernández	TYMMI (in Second Life and Open Sim virtual worlds)	Professional interpersonal repertoire Affordances Hindrances Learning experiences	18	Mixed-method	Log book Questionnaire Observation	Chile	2015
Rayner & Fluck	simSchool	Professional interpersonal knowledge Affordances Learning experiences	15	Mixed-method	Questionnaire	Australia	2014
Yeh	Computer Simulation for Teaching	Professional interpersonal knowledge	149	Quantitative	Questionnaire	Taiwan	2004

(Fig. 1) as discussed above in the theoretical background. The included studies focused only on individual interrelations of the theoretical model, for example simulations and self-efficacy. In the result section of this study, we describe these individual interrelations in the sequence of our theoretical background.

3.2. Well-being

None of the included studies reported effects of computer-based classroom simulations on PSTs' professional anxiety.

Concerning PSTs' self-efficacy, four studies showed that computer-based classroom simulations increased PSTs' self-efficacy, however, not specifically efficacy for classroom management. Cheong (2010), Bautista and Boone (2005), and Christensen et al. (2011) reported significant increase in teaching self-efficacy through using respectively Second Life, TeachME™, and simSchool. Studies conducted by Bautista and Boone (2005) and Cheong (2010) measured science teaching efficacy beliefs using two scales: personal science teaching efficacy and science teaching outcome expectancy. Both scales had increased in the study of Bautista and Boone (2005). In contrast, Cheong (2010) reported that only the personal science teaching efficacy had increased after using the simulation. Christensen et al. (2011) measured an increased instructional self-efficacy. Dalgarno et al. (2016) showed that after using a simulation PSTs reported increased self-confidence as a teacher, however, this study did not specifically mention self-efficacy.

Overall, the results of these studies suggest a positive contribution of computer-based classroom simulations to PSTs' self-efficacy.

3.3. Interpersonal competence

The conceptual framework of this article stated that interpersonal competence consists of PSTs' *professional interpersonal vision, repertoire, and knowledge*. None of the included studies focused specifically on interpersonal competence. However, we did find six studies looking at the broader concept of classroom management.

Bautista and Boone (2015) used an immersive classroom simulation (TeachME™) in which PSTs practiced instructional strategies. In this simulation, PSTs in science education entered a classroom with five students (avatars), which represented typical middle school students. Students or hired professionals controlled the five avatars. PSTs were standing in front of a screen facing the avatars and practice pedagogical skills and knowledge. The teacher educator first demonstrated classroom management strategies in the simulation. PSTs learned strategies for classroom management by mimicking the teacher educator. In another study, PSTs could make decisions about classroom management (Dalgarno et al., 2016). After using an immersive simulation (VirtualPREX) with Second Life as a virtual classroom environment, PSTs felt that they could better manage student behaviour. This study, however, did not investigate whether classroom management skills had actually improved.

In the immersive Seton Hall's Simulation, one group of PSTs practiced classroom management skills while another group functioned as the audience (Mirliss et al., 2015). This study showed a significant difference between the actors and the audience for PSTs' ability to formulate classroom rules. PSTs reported that concepts they learned were suitable to apply at the workplace. Hummel, Geerts, Slootmaker, Kuipers, and Westera (2015) used 'The Mastership Game', in our opinion a simulation because of missing a quantifiable outcome. Together with peers PSTs discussed classroom dilemmas (i.e. 'How to deal with a pupil that does not want to get coached?'). In the end, PSTs elaborated a solution for a problem in an advisory report. This study concluded that PSTs could learn classroom management in simulated environments, through collaboration and without support of a teacher.

Furthermore, PSTs who practiced classroom management in another Second Life environment reported learning classroom management through simulations to be creative and intriguing (Mahon et al., 2010). They also reported an increased understanding of classroom management skills. Finally, Dawson and Lignugaris (2016) reported that PSTs improved their delivery of specific praise, praise around (simultaneously ignoring misbehaviour and praising desired behaviour), and error correction after using the non-immersive TLE TeachLivE™. This simulation was projected on a big screen, using an Xbox Kinect system. An interactor manipulated virtual students and observed through a camera PSTs' actions.

Overall, these results indicate that computer-based classroom simulations contribute to PSTs' classroom management skills and therefore are assumed to enhance interpersonal competence. However, direct empirical evidence for the effect on interpersonal competence was absent in all of the mentioned studies.

3.3.1. Professional interpersonal vision

Although two studies studied simulations and awareness, which is only part of PSTs' professional interpersonal vision, none of the studies mentioned specific results about professional interpersonal vision. Ferry et al. (2005) used a non-immersive computer-based classroom simulation ClassSim. In this simulation, PSTs took on the role of kindergarten teacher. Participants were confronted with sets of authentic classroom teaching episodes in which PSTs took classroom management decisions. Afterwards, the participating PSTs reported increased awareness of the challenges they might face in an actual classroom. Dalgarno et al. (2016) reported that PSTs became more conscious about unexpected circumstances in classrooms after observing their peers.

3.3.2. Professional interpersonal knowledge

None of the included studies reported effects of simulations on professional interpersonal knowledge. However, three studies showed that computer-based simulations could increase PSTs' pedagogical knowledge about teaching in general.

Drawing from Shulman (1986), Yeh (2004) found that using the non-immersive Computer Simulation for Teaching General Critical-Thinking Skills caused a significant effect on content knowledge (PSTs' understanding of the concept critical thinking) about effective instruction of critical thinking. However, PSTs pedagogical content knowledge (PSTs' knowledge about designing a

curriculum to improve students' critical thinking) did not increase significantly. Mirliss et al. (2015) found a positive correlation between the immersive Seton Hall's Simulation and applying teaching knowledge and learning about characteristics of classrooms. Furthermore, PSTs reported to have gained more insight in special educational needs of students (Rayner & Fluck, 2014) after they were engaged in simSchool.

The results of these studies demonstrate inconsistent effects of computer-based classroom simulations on PSTs' pedagogical knowledge. All three studies found positive results on gaining knowledge after simulating, yet Yeh (2004) only found increased content knowledge rather than pedagogical content knowledge. Moreover, none focussed explicitly on professional interpersonal knowledge.

3.3.3. Professional interpersonal repertoire

The included articles did not specifically address professional interpersonal repertoire. However, four studies reported positive contributions of simulations on PSTs' teaching skills in general. Professional interpersonal repertoire can be seen as part of PSTs' teaching skills (Shagrir, 2010). Since the included studies did not define teaching skills, it is assumed that PSTs' professional interpersonal repertoire improved as part of more general improvement in teaching skills.

First, in the study of Dalgarno et al. (2016), PSTs reported an increased ability to handle unexpected occurrences in the classroom as result of to the simulation (Dalgarno et al., 2016). Second, Girod and Girod (2006) used the non-immersive Cook Simulation. In this simulation, students were simulated, and PSTs had the opportunity to control variables such as instructional strategy or curriculum area. Girod and Girod (2006) suggested that teaching skills increased after simulated classrooms. Third, Deale and Pastore (2014) used the non-immersive simulation simSchool. This simulation models learner behaviour and gives PSTs opportunities to practice their teaching skills, which increased after simulating. Finally, Quintana and Fernandez (2015) reported that PSTs believed that an immersive simulation supported them in their teaching practice as it increased their professional skills (Quintana & Fernandez, 2015). In this simulation, using an immersive computer-based classroom simulation, using Second Life, and the learning management system Open Sims virtual worlds, PSTs were confronted with classroom scenarios in which they acted like teachers.

Although definitions of teaching skills were sometimes unclear, and data were collected via PSTs' self-reports, overall these results suggest that computer-based classroom simulations have a positive influence on PSTs' teaching skills. Therefore, it stays unclear to what degree these skills encompass professional interpersonal repertoire.

3.4. Affordances and hindrances

Affordances and hindrances of computer-based classroom simulations mentioned by PSTs were derived from the included studies. In the study by Quintana and Fernandez (2015) PSTs reported the following educational affordances of the simulation: co-assessment, receiving teacher feedback, and available resources. These affordances helped PSTs to improve their teaching practice and to gain more insight into their strengths and weaknesses. PSTs using the simulation ClassSim experienced thinking spaces, which provided opportunities to reflect on occurrences as an educational affordance (Ferry et al., 2005). These thinking spaces allowed PSTs to reflect on and evaluate the decisions they made in the simulation. Furthermore, PSTs reported social affordances about working with simulations on the following characteristics: collaboration (Hummel et al., 2015), peer observation, and discussions (Rayner & Fluck, 2014). PSTs could learn from each other through these affordances.

PSTs also reported technical hindrances, such as malfunctioning audio and videos (Mahon et al., 2010; Mirliss et al., 2015; Quintana & Fernandez, 2015). These technology-related hindrances impacted their learning throughout the simulation. PSTs also experienced problems with chat/conversation functions. Furthermore, PSTs indicated that simultaneous reading and writing was not very convenient (Quintana & Fernandez, 2015), and that they perceived typing, instead of talking, as difficult (Dalgarno et al., 2016). As a consequence, PSTs were not always able to follow and contribute to the conversations in the simulation, which led to less lively conversations. PSTs using Second Life mentioned that it was difficult to see facial expressions of avatars, which made it difficult to interpret interactions (Kim & Blankenship, 2013).

3.5. Learning experiences

Learning experiences in terms of PSTs' feelings towards computer-based classroom simulations were examined. Five studies showed that PSTs found learning with simulations enjoyable (Bautista & Boone, 2015; Hummel et al., 2015; Kim & Blankenship, 2013; Mirliss et al., 2015; Quintana & Fernandez, 2015). Furthermore, PSTs felt engaged as they were psychologically involved and could enjoy the simulation's content. Providing that the simulation was realistic and authentic, PSTs were able to engage more efficiently with the content of the simulation. (Mirliss et al., 2015). This can be contrasted with two other studies in which PSTs were unable to engage with the content because the simulation was unrealistic due to the simulation being dissimilar to an actual classroom (Dalgarno et al., 2016; Rayner & Fluck, 2014).

The TeachME™ simulation and ClassSim were experienced as relatively safe learning environments (Bautista & Boone, 2015) as PSTs could explore interactions without damaging their relationship with students (Ferry et al., 2005). Since the simulation felt like a real classroom (Bautista & Boone, 2015), PSTs reported that these simulations helped prepare them for their work in actual classrooms (Bautista & Boone, 2015; Dalgarno et al., 2016; Deale & Pastore, 2014; Quintana & Fernandez, 2015; Rayner & Fluck, 2014). Finally, PSTs perceived the simulations as relevant (Quintana & Fernandez, 2015).

Alongside positive feelings and experiences with classroom simulation, PSTs of two studies also experienced negative feelings. Due to the unfamiliarity of the simulation as they did not know what to expect, as well as being evaluated by their peers, some PSTs

believed this contributed to their negative feelings (Bautista & Boone, 2015). Furthermore, they found the pupil behaviour in the simulation unrealistic and thought the pupils in the simulation were overreacting. PSTs also perceived the simulation to be difficult as there were too many activities happening at the same time. On the other hand, some PSTs even felt boredom because pupils' off-task behaviour was taking all playing time (Dalgarno et al., 2016). For these reasons, some PSTs did not appreciate the simulation at all.

4. Conclusion and discussion

This literature review aimed to map research about computer-based classroom simulations, PSTs' interpersonal competence, and aspects of PSTs' well-being. Furthermore, affordances and hindrances of simulations, and how PSTs experienced simulations aimed at their (interpersonal) teaching skills were explored.

It was found that simulations can contribute to PSTs' professional development and are a potential asset for teacher education by bridging the gap between teacher education and educational practice. However, our literature review did not found studies that directly and specifically investigated the interrelations between PSTs' well-being, interpersonal competence, learning experiences, and computer-based classroom simulations as visualized in Fig. 1. Although the theoretical background advocated the importance of studying these interrelations as a whole (increasing well-being via interpersonal competence through positive learning experiences with simulations), included studies only focused on individual interrelations of the model.

A closer look at the individual interrelations revealed little evidence about the contribution of computer-based classroom simulations on PSTs' professional anxiety and interpersonal competence. However, studies did report effects of simulations on the broader domain of classroom management skills, teaching skills and self-efficacy. We also found studies that reported about the specific aspect awareness as part of professional (interpersonal) vision.

Concerning PSTs' well-being, none of the included studies reported effects of computer-based classroom simulations on professional anxiety. Yet, included studies did show positive effects of simulations on PSTs' self-efficacy. These results are consistent with data obtained in a study of Knezek, Christensen, Tyler-Wood, Fisser, and Gibson (2012) who indicate that PSTs' self-efficacy improved significantly after using simSchool. Increased self-efficacy can be explained by Bandura's (1977) self-efficacy theory, which assumes that self-efficacy increases through vicarious experiences. The results of our literature review demonstrate that simulations can strengthen PSTs' beliefs in their teacher abilities and add value to teacher education.

None of the included studies focused specifically on interpersonal competence as element of classroom management, however, six studies investigated the influence of simulations on the broader concept of classroom management. Findings suggest that PSTs can learn classroom management through computer-based classroom simulations. These studies reported that PSTs' felt as though they were able to manage their classrooms better. However, whether they actually improved their classroom management skills, was not observed in the studies. Other studies focused only on an aspect of classroom management, such as formulating rules. The lack of attention to interpersonal competence is possibly a consequence of current teacher education programs. PSTs often experience a shortage in reality-based preparation on how to manage classrooms (Eisenman, Edwards, & Cushman, 2015). The attention teacher education gives to classroom management is mainly focused on how to manage misbehaviour, instead of on how to create positive teacher-student relationships (Van Tartwijk & Hammerness, 2011). However, research indicates that interpersonal competence is important for teachers as part of their classroom management skills (Wubbels et al., 2015). We argue that future research should focus on particular effects of classroom simulations on PSTs' interpersonal competence.

Furthermore, we examined PSTs professional interpersonal vision, as part of their interpersonal competence. Two studies demonstrated that after using a simulation, PSTs were more conscious and aware of the challenges that teachers face and the unexpected circumstances in classrooms. These studies concluded that noticing important classroom events can be improved with simulations. However, professional interpersonal vision includes not only awareness of important classroom events, but also interpreting these events based on professional interpersonal knowledge (Van Es & Sherin, 2002). Regarding professional interpersonal knowledge, three studies mentioned inconsistent results about increased (pedagogical) content knowledge. Consequently, we conclude that little is known about simulations and professional interpersonal knowledge. Studies argue that PSTs' professional vision is important for PSTs classroom management skills (Van den Bogert, 2016; Wolff, 2015). Therefore, it can be inferred that further research into whether classroom simulations could help PSTs develop their professional vision beyond the aspect of awareness and professional interpersonal knowledge, necessary for professional vision, would be considered as valuable and necessary.

Another part of PSTs' interpersonal competence distinguished in this review was professional interpersonal repertoire, which was not specifically mentioned in the included studies. Most of these studies mentioned improved general teaching skills caused by computer-based classroom simulations. However, the included studies did not operationalize the concept of teaching skills very clearly, and data were collected via PSTs' self-reports. The positive results of simulations on self-reported teaching skills are consistent with the study of Knezek et al. (2012), which showed that teachings skills improved significantly after using simSchool. However, several studies suggest that there may be differences between self-perceived behaviour and behaviour as observed by others, such as the students of a PST (Den Brok, Bergen, & Brekelmans, 2006). Thus, there is a clear need for more specific research on simulations and interpersonal repertoire, not only using self-reports, but also student perceptions or observations.

Overall, the results of this literature review strengthen the idea that simulations are promising tools to contribute to improving PSTs' teaching skills. However, we understand that simulations can never replace teacher educators to learn PSTs complex topics such as interpersonal competence. The interest of our study was to investigate whether simulations can additionally contribute to PSTs' development of interpersonal competence. Although the included studies mainly provided information about teaching skills in general, findings of these studies are promising, and in many cases interpersonal competence can be assumed to be part of these more general skills. As a result, it is relevant to assess the effects of simulations on PSTs professional interpersonal vision, professional

interpersonal knowledge, and professional interpersonal repertoire as part of PSTs' interpersonal competence. This assessment would offer more specific insights into how simulations can support interpersonal competence, and as a result, it would aid in the development of classroom management skills. In fact, studies have already demonstrated a positive influence of simulations on teaching and classroom management skills. In addition, it would be interesting to investigate if classroom simulations can also reduce PSTs' professional anxiety.

Furthermore, this study asked whether there are any affordances and hindrances when using computer-based classroom simulations for PSTs. The educational affordances of these simulations perceived by PSTs were co-assessment, receiving teacher feedback, available resources, thinking spaces, active learning, and the ability to take the role of a teacher. Reported social affordances were peer observation, discussions, and collaboration. Most reported affordances appeared to be educational, which can be explained by the limited possibilities to collaborate or play together in simulations. At the same time, reported hindrances were primarily technical. The lack of a user-friendly interface, malfunctioning audio or video, not being able to see facial expressions, lack of realism, and problems with chat/conversation functions were reported as a hindrance of simulations.

This review extends our knowledge about affordances and hindrances of computer-based classroom simulations and could contribute to further development of these kind of simulations. For simulations to be effective, a well-designed interface is necessary, as well as a high level of realism. Although this conclusion appears obvious, many included studies regarded this as an important aspect for using simulations.

Finally, this literature review investigated how learning experiences with computer-based classroom simulations are influenced by PSTs' feelings. Although some PSTs felt anxiety, were nervous, or did not appreciate simulations, in general, PSTs appreciated the simulations, felt engaged and enjoyed the experience. These feelings correspond with results found by Stavroulia et al. (2016), who conclude that feelings of both enjoyment or engagement, as well as anxiety and nervousness, are similar to emotions novice teachers experience in classrooms. The included studies did not mention whether participating PSTs were ICT minded or not. This is important for previous positive or negative experiences with ICT could influence future experiences with simulations (Van den Beemt & Diepstraten, 2016). As it was not investigated whether ICT mindedness contributed to these differences in the PSTs experience, it is not clear whether a lack of ICT mindedness had negatively influenced their experience with simulations. One possible explanation could be that non-ICT minded PSTs were nervous due to their unfamiliarity with the technology of simulations. Continuing, non-ICT minded PSTs could have perceived the simulations as less useful, because of the technical nature of the hindrances. Nevertheless, the majority of PSTs felt better prepared for jobs in education by using classroom simulating as they perceived simulations as a safe learning environment to practice in before they entered a real classroom. These findings support arguments by Rayner and Fluck (2014) who suggest that computer-based classroom simulations are a safe way to prepare PSTs for educational practice because PSTs are able to practice their role as a teacher without the fear of making mistakes in front of real students. Therefore, we argue that simulations improve PSTs' interpersonal competence and well-being as they are potential assets for teacher education, provided that simulations are realistic.

4.1. Limitations and future research

Findings of this review may be limited by the small number of included studies. Numerous studies used quantitative data gathering from self-reports and refrained from providing in-depth information about simulations in teacher education. Effects of computer-based classroom simulations were reported, such as positive effects on PSTs' teaching skills and self-efficacy. However, none of the studies reported which elements of simulations contributed to PSTs' professional development. Most results found in the studies only provided a limited insight. Moreover, ten of the included studies were case studies, and most of them were conducted locally. Most studies also had only a small number of participants, which further limited their results. For that reason, the results are less generalizable. Finally, it is important to bear in mind that the quality appraisal showed differences in quality of the included studies. To preserve a substantive body of literature we decided not to exclude studies from our literature review. Therefore, not all results appeared equally reliable which could lead to an overly positive bias. When analysed as a whole, we should be cautious with extrapolating our findings to the population at large.

By mapping existing research about computer-based classroom simulations in teacher education, this review study serves as a starting point for more in-depth research about classroom simulations and their effects on PSTs' interpersonal competence and well-being. Due to a limited number of studies on computer-based classroom simulations and professional anxiety, further research could usefully explore how these simulations contribute to PSTs' professional anxiety. To determine the interrelations between simulations, well-being, interpersonal competence, and learning experiences in relation to each other, further research is also required.

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