International Educational Research; Vol. 8, No. 2; 2025
ISSN 2576-3059 E-ISSN 2576-3067
https://doi.org/10.30560/ier.v8n2p126

Using Virtual Simulations with Avatars to Train Preservice Special Educators' Relational Competence Toward Students with Neurodevelopmental Conditions

Sofia Lindberg[1], Jonas Aspelin[1], Daniel Östlund[1] & Anders Jönsson[1]

[1] Faculty of Teacher Education, Kristianstad University, Sweden

Correspondence: Sofia Lindberg, Department of Special Education, Faculty of Teacher Education, Kristianstad University, 291 88 Kristianstad, Sweden. Tel: 46-44-2503988. E-mail: sofia.lindberg@hkr.se

Received: March 20, 2025; Accepted: April 2, 2025; Published: April 3, 2025

Abstract

Teacher-student relationships (TSRs) involving students with neurodevelopmental conditions (NDCs) are challenging and tend to be of lower quality compared to those involving neurotypical students. The purpose of this study is to explore in what respects the use of avatar technology can support the development of preservice special educators'(PSEs) relational competence toward students with NDCs. We used two data sources: focus group interviews (n = 18) and screen observations of the interactions (n = 37). The findings show that PSEs perceive relational competence as situated competence, manifested in the teacher's ability to establish positive and supportive relationships through identification and management of emotions and active listening and validation. PSEs' relational competence is reflected in their capability to show patience, encouragement, empathy, sensitivity, involvement, understanding, validation, and interest in interactions with students. Overall, the findings suggest that avatar technology is a meaningful and relevant tool to support PSEs in developing relational competence with regard to students with NDCs.

Keywords: low case, neurodevelopmental conditions (NDCs), preservice special educator (PSE), relational competence, special education teacher training (SETT), virtual simulations

1. Introduction

A positive and supportive teacher-student relationship (TSR) is crucial for students' social, emotional, and academic development (Ansari et al., 2020; Ettekal & Shi, 2020). This is especially true for students who require special educational support (Feldman et al., 2019), who encounter heightened struggles and increased dropout rates (Claudia et al., 2021). TSRs involving students with special educational needs are often emotionally challenging for teachers (Koenen et al., 2021) and conflictual relationships may negatively impact both students and teachers (Evans et al., 2019; Koenen et al., 2021). For instance, students with neurodevelopmental conditions (NDCs) tend to develop low-quality TSRs (Losh et al., 2022; Staff et al., 2023). Teachers provide more negative feedback and corrections to these students than to neurotypical students. Moreover, teachers perceive less emotional closeness and more conflicts in their relationships with students with NDCs (Ewe, 2019; Staff et al., 2023).

Although TSR is important for students with NDCs, research on TSR has focused almost exclusively on neurotypical students. This is remarkable, as positive and supportive TSR is crucial for students who have difficulties initiating, maintaining, and developing relationships (Ewe, 2022; Prino et al., 2016). Thus, further research is needed to investigate TSRs of students with NDCs (Ewe et al., 2023), and how the relevant competence can be developed in pedagogical practice (Ewe, 2019, 2022).

According to researchers (Borremans et al., 2024; Koenen et al., 2021) teacher education programs should focus more on TSR and the development of teachers' relational competence (Borremans et al., 2024; Koenen et al., 2021). Pre-service special educators (PSEs) should have opportunities to reflect on interpersonal communication across various educational scenarios that encompass behavioural diversity (Aspelin et al., 2021a).

Virtual simulations have emerged as an innovative approach in this area, employing technology to replicate authentic situations and improve the educational process (Levin & Flavian, 2020). Several benefits of using virtual simulations have been proposed, including the facility of interacting in controlled and safe environments without affecting students (Dieker et al., 2014; Howell & Mikeska, 2021; McGarr, 2021). Virtual simulation can

significantly affect PSEs' preparedness for various classroom settings in special education by focusing on how they handle different situations (Peterson-Ahmad, 2018). It might be particularly relevant to use virtual simulations in special education teacher training (SETT), since it can prepare PSEs for varying student behaviors (Aspelin et al., 2024). Avatar technology has previously been used to support the development of various teacher competencies, primarily rule management competence; however, research on avatar technology for relational competence training is very limited, and more importantly, research on relational competence regarding students with NDCs is entirely lacking (Lindberg & Jönsson, 2023).

TSRs of students with NDCs tend to be challenging and of lower quality than TSRs involving neurotypical students. Hence, this research motivates teacher education programs to focus more on TSR and on how to support PSEs in developing relational competence, not least regarding students with NDCs. In special education, establishing a positive teacher–student relationship is challenging, especially when students exhibit neurodevelopmental conditions. Traditional teacher training often fails to equip educators with the necessary skills to manage these complex dynamics. Current teacher education often overlooks the nuanced interpersonal dynamics needed to support students with NDCs, and existing simulation technologies have rarely been tested in this context. This study investigates how avatar technology can be used in teacher education to support PSEs in developing relational competence with regard to students with NDCs. We expected that exposure to avatar-based simulations would enhance preservice special educators' ability to manage emotions and engage in effective communication. The study seeks answers to the research questions listed below (RQs):

RQ 1: How do PSEs perceive their relational competence, as manifested in their interactions with avatars exhibiting NDCs?

RQ 2: How does the relational competence of PSEs manifest in their interactions with avatars exhibiting NDCs?

1.1 Relational Competence in SETT

In the discourse on teacher education in Scandinavia, relational competence has become a well-established concept over the last decade (Jensen et al., 2015; Segerby, 2022; Skibsted & Matthiesen, 2016). According to Nordenbo et al. (2008) the ability to build respectful, tolerant, and empathetic TSRs is a core aspect of being a professional teacher. However, research on PSEs' relational competence remains highly inadequate (Aspelin et al., 2021b). In addition, an examination of curricula within SETT in Sweden showed that relational competence is largely neglected (Aspelin & Östlund, 2020).

An interview study (Aspelin et al., 2021a), investigating how special educators' understanding of relational competence can be developed, showed that experienced special educators perceive positive and supportive TSRs as fundamental in relation to students with special educational needs and they view relational competence as especially important in the special education profession (Aspelin et al., 2021a). A different study (Aspelin et al., 2021b) examined how video-based reflections could improve PSEs' understanding of relational competence. The findings show that the PSEs, through the intervention, shifted focus from teaching strategies and educational settings towards teacher-student interaction. Additionally, their focus shifted from managing challenging student behaviours to emphasising TSRs and encouraging involvement of students. The Relational Competence Model (RCM) was used in these studies to analyse participants' perceptions and interactions.

The RCM explores relational competence as manifested in ongoing interactive processes and encompasses three sub-concepts: (1) Communicative competence relates to the teacher's capability to communicate verbally and nonverbally to achieve a high degree of mutual understanding and respect with students; (2) Differentiation competence denotes a teacher's capability to manage the degree of closeness and distance in relation to students; and (3) Socio-emotional competence refers to a teacher's capability to handle emotional indicators of ongoing relationships, including both their own emotions and those of their students (Aspelin et al., 2021b).

Thus, the literature indicates that relational competence is an important type of competence in the teacher and special educator professions and that small-scale interventions can improve PSEs' understanding of relational competence. While several studies have explored teacher–student dynamics in traditional classroom settings, few have considered the potential of digital simulations in enhancing these relationships. The present study expands previous research on relational competence in SETT by using virtual simulations with avatars. Avatar technology differs from video-based reflections in that it is an interactive process, which is fully aligned with the RCM, as it views the manifestation of relational competence in ongoing interactive processes. Moreover, this study makes an important contribution through its specific focus on the relationship between PSEs and students with NDCs.

1.2 TSRs Regarding Students with NDCs

Challenges in TSRs involving students with NDCs are well-documented (e.g., Ewe, 2019; Staff et al., 2023). For example, TSRs regarding students with ADHD tend to be strained, with a higher degree of conflict and less emotional closeness (Gwernan-Jones et al., 2016; Mikami et al., 2019). These TSRs are often problematic from both teachers' and students' perspectives (Ewe, 2019). Similar to the challenges observed in TSRs involving students with ADHD, TSRs involving students with ASD (autistic spectrum disorders) also tend to be of lower quality than TSRs with neurotypical students (Feldman et al., 2019; Losh et al., 2022).

Since TSRs involving students with NDCs are often challenging, researchers have suggested that it is necessary to develop and implement methods to enhance teachers' relational competence (Ewe, 2022). Video-based reflection has proven useful in promoting the relationship between teachers and students with ADHD (Ewe et al., 2023). In an intervention study (Ewe & Aspelin, 2022), video-based reflection helped teachers better understand how to relate to students with ADHD. The teachers also improved how they interpreted and understood the nonverbal signals between themselves and their students. After the intervention, they alternated their focus between the students' nonverbal cues and their own emotional responses to these cues, considering this pivotal in foreseeing and preventing student failure (Ewe & Aspelin, 2022). A follow-up study (Ewe et al., 2023) investigated whether teachers' improved relational competence affected how teachers and their students with ADHD and/or ASD perceived their TSRs. The findings revealed that the intervention changed both teachers' and students' perceptions of their relationships. Thus, this study implies that small interventions of this type can be valuable for teachers' professional development (Ewe et al., 2023). According to Ewe (2022), teachers who teach students with ADHD need "relational preparedness", which refers to readiness for the unforeseen in relation to the students. More specifically, relational preparedness refers to teachers' ability to observe student behaviour and reflect on what it suggests about their thoughts and feelings. It also includes teachers' ability to identify and acknowledge their own emotional reactions to student behaviours. Teachers' relational preparedness enables them to sensitively and constructively anticipate and respond to their students' behaviours. In this way, teachers can prevent stressful social situations and increase their potential to develop positive TSR (Ewe, 2022).

Thus, the literature indicates that TSR involving students with NDCs is challenging from both teachers' and students' perspectives. It also indicates that relationships between teachers and students with NDCs can be enhanced by small-scale interventions such as video-based reflection. This study contributes to this field by using virtual simulations with avatars. We argue that SETT should prepare PSEs for relational challenges in ways that do not negatively affect real students, and that avatar technology might be particularly relevant in training teachers for challenging interactions with students who require compassionate treatment.

1.3 Virtual Simulations for Promoting Relational Competence

Research on virtual simulations in teacher education has increased over the past decade and suggests that virtual simulations can be an effective tool for preparing PSEs for their future profession (e.g., Driver et al., 2018; Hudson et al., 2019; Peterson-Ahmad, 2018). However, Theelen et al. (2019) indicate that it is unclear how virtual simulations can practically support TSR development. This was confirmed by a systematic review of the literature on teacher competencies and virtual simulations, which identified a research gap concerning relational competence (Lindberg & Jönsson, 2023). After the systematic literature review, a study exploring PSEs' relational competence in an avatar context was published. Based on video observations of virtual simulations and interviews with PSEs, the researchers suggested that virtual simulations with avatars could be useful for training PSEs on different aspects of relational competence (Aspelin et al., 2024). Further research is thus needed, and the present study contributes by focusing on how this method can be used to nurture relational competence in TSRs involving students with NDCs.

Having discussed the challenges and the potential benefits of simulation-based training, we now focus on how these interventions can be practically applied to improve teachers' relational competence in classrooms with NDC students. Our research questions guide this inquiry by addressing both perceptions and real-time interactions.

2. Method

This study used a dual methodology involving video observations of interactions with avatars and focus group interviews, which means that this was both an interactional and an interview study. Qualitative methods were selected to capture the nuanced, subjective experiences of preservice educators, which quantitative measures might overlook. Virtual simulations and interviews were conducted online and video recorded. Both virtual simulations and interviews were transcribed verbatim. Therefore, the data consisted of (1) transcripts of video recordings of interactions between PSEs and avatars, and (2) transcripts of PSEs' conversations during breaks in the simulation and focus group interviews. The data used in this study are presented in Table 1.

2.1 Context and Participants

The intervention consisted of online virtual simulations with 37 PSEs and focus group interviews with 18 of the participants. The analysis was based on all verbal interactions involving two of the avatars who exhibited completely different neurodevelopmental conditions. The PSEs' conversations about the interactions were analysed using thematic analysis.

The participants were recruited from the SETT program in Sweden. The university offers both special needs teacher training (SNT) and special education teacher training (SET). SNT training includes specialisations in literacy, mathematics development, and intellectual disabilities. Around 150 students enroll in SETT annually. The PSEs study part-time while working as general education or preschool teachers. All participants hold a teaching degree and have a minimum of three years' experience. Initially concentrated on students with disabilities, the SETT program now emphasizes enhancing schools' ability to support the diverse academic and social needs of all students (Göransson et al., 2015).

Virtual simulations were included in a course titled "Special Education Perspectives on Learning and Development in a School for All Students". This course aims to enhance students' understanding of the roles and tasks of PSEs working with children and students in need of support. The participants in this study were in their second semester of the first year of the SETT program and part of a group of around 150 students. The students were grouped with a mix of SNTs and SETs.

The PSEs were divided into groups within their classes. Each group encompassed various specialisations and diverse professional backgrounds, ranging from preschool to adult education. The course comprised seven groups, with two groups randomly selected for participation in the study. All the students from the selected groups agreed to participate. All 37 PSEs engaged in the simulations; however, not everyone had the opportunity to attend the interviews, resulting in the involvement of 18 PSEs.

Table 1. The foundational dataset for the study

Data	Time	Participants
Video recordings of virtual simulations	3 hours and 23 minutes	37 students (4 groups)
Video recordings of focus-group interviews	3 hours and 39 minutes	18 students (4 groups)

2.2 Procedure

The research process has a progression from a preparatory lecture through simulation interactions, to focus group interviews, and finally to a thematic analysis (see Figure 1).

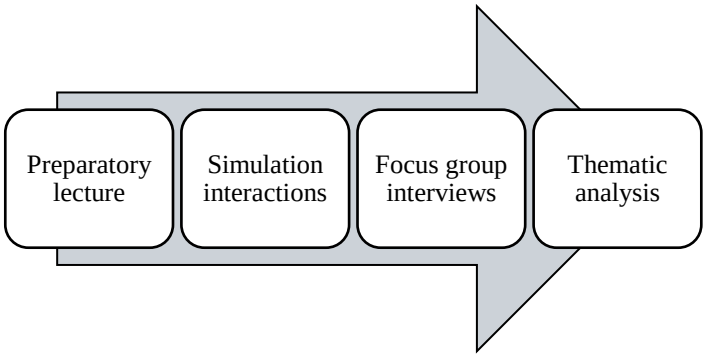

Figure 1. Flowchart of the Research Process

The participants were given a preparatory lecture on teachers' relational competence, including modelling of how the competence is manifested in relation to students with NDCs. Virtual simulations were conducted online based on scenarios of physical movement and health. PSEs were informed that the (virtual) school had undertaken efforts to enhance staff knowledge concerning physical activities and health, aiming to implement health-promoting activities. Acting as representatives of the school's student health team, PSEs were tasked with gathering

information about students' behaviours, attitudes, and values regarding physical activities and health. Their responsibility was to collect suggestions for promoting physical activity within the school environment and managing mobile phones/screens, daily routines, diet, and other similar aspects.

The PSEs were given opportunities to engage with diverse students requiring support and to reflect on the challenges they encountered in the interactions. Prior to the virtual simulations, the PSEs were divided into four groups, each containing about ten participants. Within these units, approximately three PSEs interacted with the avatars and the other PSEs observed. Those involved in the interaction could pause the simulation whenever they needed to discuss strategies with their peers or seek advice. The simulations "kicked off" with PSEs meeting the (avatar) school principal for information about the class before entering the classroom. The class included five avatar-represented students: Savannah, Dev, Ava, Jasmine, and Ethan (see Figure 2). On average, these simulations, including PSEs' discussions during breaks in the virtual simulation, lasted approximately one hour per group session, with three PSEs taking turns participating in each session.

Figure 2. A TeachLivE session with the student avatars the PSEs interacted with

One week after the simulations, focus group interviews were held. The PSEs were placed in the same four groups as during the simulations, with both active participants and observers included. A semi-structured interview format was used, guided by a ten-item protocol addressing: 1) how the PSEs experienced verbal and nonverbal interactions with avatars, 2) how the PSEs managed closeness and distance in the interaction, and 3) how the PSEs managed the students' and their own emotions in the interaction (for more information about the questions, see Appendix A).

2.3 Equipment

There are different types of simulations; in this project, "human-in-the-loop" (HIL) simulations (more specifically TeachLivE™ TLE), were employed since interaction is essential when practising relational competence. The digital avatars in the HIL-simulations were controlled in real-time by a simulation specialist. This specialist underwent training to operate within the simulation and utilised various technical tools, such as voice modulation and an Xbox Controller, to control the avatar's facial expressions, posture, and movements.

2.4 Analysis

The analysis comprised two steps. The first step focused on the PSEs' discussions regarding the interactions, incorporating data from breaks in the virtual simulations and focus group interviews. The aim of the analysis was to identify differences in PSEs' perceptions of relational competence regarding NDCs in virtual simulations. The second step focused on examining the interactions between PSEs and avatars, specifically Jasmine and Ethan. Every verbal exchange which included Jasmine and Ethan was analysed in detail.

Transcripts regarding the interaction with Jasmine included 23 episodes, and transcripts regarding Ethan included 36 episodes. We focused on Jasmine and Ethan because their interactions provided rich empirical material. In addition, selection was necessary due to the scope of the study. Yet another reason, and in a sense, the main reason for focusing on Jasmine and Ethan was that they exhibited extremes in behaviors that significantly differentiated them, aligning with the focus of the study. Mursion is an immersive learning platform that provides TLE, a computer-simulated, immersive, and mixed-reality classroom that includes various avatar profiles. Jasmine's behavioural profile is introverted, empathic, and idealistic. She avoids conflict (i.e., she will put energy into finding a middle ground that satisfies everyone) and she is a "people pleaser" who always seeks acceptance. Ethan's

behavioural profile is extroverted and playful. He is supportive and energetic. Ethan is sensitive and rapidly changes mood. He is confident, but not always right.

In collaboration with a simulation specialist, we sharpened the avatars' behaviour profiles to train the PSEs in dealing with avatars exhibiting behaviours corresponding to NDCs. However, it should be emphasised that the avatars were not presented to the PSEs in terms of their diagnoses. That is, the PSEs were not informed that a specific avatar had NDC. In accordance with the RCM, relational competence is viewed as situated and manifested in interactive processes regardless of potential diagnoses. Therefore, the focus is on interaction with avatars exhibiting a variety of behaviours, irrespective of their diagnoses.

To analyse data, we employed a qualitative thematic analysis, which relies significantly on the phases outlined by Clarke and Braun (2017). We used thematic analysis to recognise, examine, and present patterns derived from the substance and significance of qualitative data (Braun & Clarke, 2006; Willig, 2013). To support this analysis, we initially used the Large Language Model (LLM) GPT-4, a model developed by OpenAI, capable of understanding and generating text. The analysis with LLM was also supplemented with manual analysis.

Before the analysis, all data from the interviews and interactions were transcribed, and a compilation was created comprising episodes in which Jasmine and Ethan were involved or were the focus of the PSEs' discussions. The PSEs were anonymised by assigning different numbers. In the initial analysis process, the first author took charge of coding, which was then followed by a review and several discussions within the research group. The analysis proceeded through the following stages.

The first phase entailed becoming familiar with the transcripts through repeated reading.

The second phase involved examining the interaction and interview data with the LLM to generate codes, themes, and an overall analysis (De Paoli, 2023). In a similar manner to De Paoli (2023), an analysis was conducted regarding generating initial codes, searching for themes, reviewing themes, and defining and naming themes.

In the third phase, the LLM was used for the theoretical analysis of the interview and interaction data. LLM was given a description of relational competence, and based on this description, LLM was instructed to analyse the interview and interaction data.

In the fourth phase, we reviewed the analysis of data using LLM. We then consolidated the patterns and removed quotes irrelevant to the identified patterns. After processing the analysis conducted by LLM, we reviewed all the data to complement it with relevant quotes that LLM had not included in the initial analysis.

In the fifth phase, significant data extracts were selected and presented to illustrate the prominence of the themes, and the extracts were integrated into an analytic narrative of the data.

The researchers translated the theme descriptions and extracts into English.

2.5 Ethics

This research followed the Swedish Research Council's (2024) ethical research guidelines, ensuring informed consent, confidentiality, risk avoidance, and proper retention and archiving of materials. Following these guidelines, only data essential to the study's purpose were collected, excluding participants' personal information. Swedish legislation and institutional requirements did not require ethical review and approval. Each participant provided written informed consent for participation.

3. Results

First, the results are presented based on how the PSEs perceive relational competence as manifested in their interactions with avatars exhibiting NDCs (RQ1). Then, the results are presented based on the manifestation of PSEs' relational competence in their interactions with avatars exhibiting NDCs (RQ2). These quotes illustrate the themes identified in the analysis.

3.1 PSEs' Perception of Relational Competence in Their Interactions with Avatars

In addressing RQ1, our analysis showed that PSEs perceive relational competence as a dynamic interplay of emotion management and active listening. The analysis revealed that PSEs directed their attention towards two distinct facets of relational competence. We categorise the primary, most prominent theme as "Identification and management of emotions", and the secondary theme as "Active listening and validation". The numbers in parentheses after each quote refer to the participant code numbers.

3.1.1 The Primary Theme: Identification and Management of Emotions

This theme is characterised by the PSEs' identification of emotions expressed by Jasmine and Ethan during the interaction and their reflections on how they managed these emotional expressions.

The PSEs indicated that Jasmine expressed signs of discomfort and uncertainty in certain situations. They described her as shy and insecure. They noted that Jasmine "found it difficult to express what she felt and thought" (10) and that she "showed discomfort merely by sitting in the class and answering questions". (17) One PSE noted Jasmine's nonverbal signals of discomfort: "She also signaled with her body language that she was extremely uncomfortable". (5) Another PSE described Jasmine's body language as "hiding":

> Jasmine, she's almost hiding. I mean, when she doesn't speak, she's trying to fade away to avoid getting any questions or attention. (4)

In addition to discussing the emotions expressed by Jasmine, the PSEs also reasoned about how these emotional expressions could be managed. They suggested that a cautious, caring, and attentive pedagogical approach was required. One PSE said: "So, I think it's important to show her that 'I see you'. That I need to approach carefully when building a relationship with her." (14) Another PSE talked about validation: "You want everyone to feel comfortable, and when someone finds it difficult, a bit nervous like Jasmine, then you really want to validate in a way, show that it's okay". (10)

The PSEs identified that Ethan expressed feelings of joy: "Ethan is really cheerful. I think he has a lot of energy, joy, and a lot to say, and he thinks a lot". (18) They also noted that he expressed frustration: "Ethan became quite frustrated on a few occasions because he is so eager". (7) One PSE noted that Ethan got negative affirmation: "He wanted affirmation in some way, but he always got negative affirmation" (6). The PSEs noted that Ethan sometimes became sad, in particular when Ava was snippy towards him: "I thought I could see him get a little sad". (4) The PSEs also discussed how Ethan's emotional expressions could be managed: These discussions were mainly concerned with how to manage situations when Ava was mean to Ethan. One PSE said: "I hesitated about whether I should tell Ava when she was being mean to Ethan", (1) while another PSE had a different attitude: "One would probably have said', Hey, that's not okay to say to someone" '. (14) The PSEs emphasised that they must act when students behave meanly towards each other and not just "let it slide". Simultaneously, they said that they sometimes neglected these situations.

> She makes comments out loud, and then there's this mumbling afterwards, so you can hear her saying something. I feel like we haven't always handled it. It's just that you hear her say those things a bit quietly, and then we let it go. (13)

One PSE problematized this:

> If you don't say anything as a teacher, you're also accepting it. And then there's always someone who is hurt. And if I say something, I might hurt the one who said something. So, do you understand what I mean? So, there will always be someone in the classroom who is hurt. (10)

This quote highlights the complex balancing act that teachers must perform in their interactions with their students. The teacher expresses awareness that every action or lack thereof can impact the TSR. Thus, this quote reveals a relational challenge in which teachers must weigh the potential consequences of their actions on their students.

Interpretation based on RCM: In this theme, the PSEs view relational competence as situated competence, manifested through a teacher's capabilities to establish positive and supportive TSRs by identifying and managing emotions. Considering the RCM, these perceptions can be understood in terms of socio-emotional competence, which refers to a teacher's capability to handle the emotional indicators of ongoing relationships. PSEs' socio-emotional competence was characterised by identification and reflection on Jasmine's and Ethan's emotional expressions during interactions. For Jasmine, the PSEs noticed emotions of shyness, insecurity, and discomfort. They also emphasised the need for a cautious, attentive, and careful approach towards her. For Ethan, the PSEs identified the emotions of joy, frustration, and sadness. Discussions regarding Ethan's emotions emphasised the challenge of managing situations when Ava referred to Ethan. The PSEs' intention is to intervene, and when they do not intervene, they justify it based on the fact that it would hurt Ava.

3.1.2 The Secondary Theme: Active Listening and Validation

On this theme, the PSEs discussed the importance of paying attention to Jasmine and Ethan by listening to and validating what they were saying. They emphasised the significance of giving Jasmine time to talk to and listen to her. One PSE described validating Jasmine as follows: "And I also believe that she's a student who needs validation because we all agree that she's very insecure about everything she does and says". (15)

Another PSE argued that it is important to see and validate Ethan: "Talk to him, validate him, see him". (4) The PSEs attempted to avoid refuting or dismissing what Ethan said.

> She asked a question like, 'Well, what is health?' 'Well, it's eating chips, lots of chips, and pizza' [---]

> Then she quickly went in and affirmed what Ethan said, 'Well, I understand you. Chips are really tasty, I think so too. But Ethan, is there something more than that which is healthy?' (8)

The PSEs argued that there was a risk that teachers would give Ethan too many reprimands.

> If Ethan gets a teacher who isn't interested at all in his bubbly nature [---] there is a risk that he is only physically present during the lessons, and eventually he might stop going to classes if he receives too many reprimands and the teacher doesn't want to build any relationship because they find his behavior a bit challenging. (17)

Interpretation based on RCM: In this theme, PSEs perceive relational competence as situated competence, manifested by teachers' capabilities to establish positive and supportive TSRs through active listening and validation. These perceptions can be understood in terms of communicative competence, which refers to a teacher's capability to communicate verbally and nonverbally to achieve a high degree of mutual understanding and respect with students. The PSEs' communicative competence is characterised by their capability to reflect on how to achieve mutual understanding and respect with Jasmine and Ethan. The PSEs emphasise the necessity of giving Jasmine adequate time to express herself, listen to her, and ensure that she feels validated. They believed that she required specific validation because she was insecure. Regarding Ethan, the PSEs stressed the significance of seeing, talking to, and validating him. They avoid refuting or dismissing what he says, and state that there is a risk that teachers will give Ethan many reprimands.

3.2 PSEs' Manifestation of Relational Competence in Their Interaction with Avatars

In addressing RQ2, our analysis showed that relational competence of PSEs manifest in their interactions by managing emotions and showing understanding and respect. The analysis revealed that PSEs' relational competence is manifested in interactions with avatars exhibiting NDCs through two distinct facets of relational competence. First, their interactions are characterised by what we categorise as "Managing emotions in interaction", and second, their interactions are characterized by what we categorize as "Understanding and respect in interaction".

3.2.1 Managing Emotions in Interaction with Jasmine and Ethan

In these interactions, the PSEs acknowledge and manage their emotional interactions with Jasmine and Ethan. In the episode below, a PSE demonstrates patience and encourages Jasmine to share her thoughts, even when Jasmine displays avoidant behaviour. The PSE provides her repeated opportunities to express herself and shows interest in her opinions.

Episode 1. Interaction with Jasmine

Turn	Participant	Transcript
1	PSE	Jasmine, would you like to share your thoughts?
2	Jasmine	Uh, yeah, I think they've said pretty much what I had.
3	PSE	Yes. Would you like to read some of what you have?
4	Jasmine	Uh. Do I have to?
5	PSE	Uh. It would be really great if you could share a bit of what you have on paper.
6	Jasmine	Not everything. Maybe something.
7	PSE	Yes. Two or three things that you've written.
8	Jasmine	Yeah. Uh. I wrote that I think, one feels good being outside, not inside all the time.
9	PSE	Yes. Absolutely.
10	Jasmine	Yes.
11	PSE	Have you written anything else? It was a really good point about being outside and getting fresh air. That's something we really need for our health.

In the above episode, the PSE asks, "Would you like to share your thoughts?" (turn 1). The PSE acknowledges Jasmine's hesitance to share her thoughts and encourages her to do so. By using the phrase 'Would you like to read some of what you have?' (turn 3) the PSE shows respect for Jasmine's boundaries and encourages her to participate. Despite Jasmine's initial reluctance, the PSE encourages Jasmine by saying, "It would be really great if you could share a bit of what you have on paper" (turn 5). The PSE also affirms Jasmine's contribution: "Yes. Absolutely", which shows understanding and support for Jasmine.

In the following episode, a PSE demonstrates empathy and sensitivity by redirecting the conversation away from criticising specific individuals. This demonstrates the awareness of the potential impact on Ethan's feelings and emphasises the importance of considering students' emotions.

Episode 2. Interaction with Ethan

Turn	Participant	Transcript
1	Ava	I'm not saying I'm perfect or anything, but I'm trying, you know, unlike some others who skateboard, for example.
2	PSE	Yeah.
3	Ava	Like some do in the class, just skateboarding, like, just skateboarding.
4	PSE	But skateboarding can be really fun for one's well-being.
5	Ethan	Now she's picking on me again, it's so boring. She's picking on me. Do you hear that?
7	Ethan	Whatever.
8	PSE	Just a moment, Ethan. Now it's Savannah's turn.
9	Ava	I just said, I didn't say your name Ethan. I just said that some people skateboard, I said. I didn't say it was you.
10	Ethan	But I figured it was me.
11	PSE	Alright, let's leave it there. Now, let's move on so that we can hear what the others have written. Savannah?

In the above episode, the PSE addressed Ethan's concerns and redirected the conversation by emphasising the importance of diverse interests and perspectives in promoting well-being and health. In the episode, the PSE intervenes calmly when tensions arise between Ava and Ethan and guides them to focus on the task at hand.

Interpretation based on RCM: Based on the interactions, the PSEs demonstrate socio-emotional competence by showing patience and gently encouraging Jasmine to share her thoughts despite her initial reluctance. Moreover, PSEs demonstrate empathy and sensitivity by acknowledging Ethan's emotions and redirecting the focus from conflict to constructive dialogue.

3.2.2 Understanding and Respect in Interaction with Jasmine and Ethan

In these interactions, the PSEs communicate to achieve mutual understanding and respect with Jasmine and Ethan. Below is an example of an episode in which a PSE involves Jasmine in the discussion and attempts to understand her:

Episode 3. Interaction with Jasmine

Turn	Participant	Transcript
1	PSE	Jasmine, do you feel like this was everything you talked about, or is there something you'd like to add?
2	Jasmine	Uh, we talked a bit. But that... I don't think it belongs here. What I said.
3	PSE	Would you like to share it anyway?
4	Jasmine	Yeah, well, no but, I have a dog and then I feel... Sometimes it's tough at school, I think many people feel that way. So, when I come home, I'm with my dog at home. A walk and... It feels.
5	PSE	Exactly.
6	Jasmine	Uh, I don't know.
7	PSE	But it's a really great thing to be outside and move around like that. Right?
8	Jasmine	Yeah.
9	PSE	A superb example. Thank you, Jasmine.

In the above episode, the PSE asks Jasmine if there is anything she would like to add, demonstrating an openness to hearing more from her. The PSE also reinforced Jasmine's contribution by affirming the value of spending time outdoors with her dog, thus validating her contribution.

The episode below displays the PSE's interest in and understanding of Ethan's thoughts and experiences regarding health and movement. The PSE follows and clarifies his answer.

Episode 4. Interaction with Ethan

Turn	Participant	Transcript
1	Ethan	I want to move, so because I just can't sit still. You know, we have these one and a half hour lessons sometimes, I just can't sit and do math for one and a half hours, like that.
2	PSE	No.
3	Ethan	I have to move. So I think
4	PSE	Okay, so movement is health.
5	Ethan	I usually skateboard, hang out with my friends, maybe we ah cruise around, sometimes we bike to the playground. Well, I mean, we're not playing at the playground, but we climb and move around, it's nice.
6	PSE	So, when you move, it feels good for your health.
7	Ethan	Yeah, I think so. If we did that. If we did it in school, I wouldn't find school as freaking boring as it is. Sorry, it's not your fault.

In the episode above, the PSE listens attentively to Ethan's explanation about his need to move during lessons, acknowledging his perspective with responses like "No" (turn 2) and "Okay, so movement is health" (turn 4). The PSE acknowledges the potential health benefits of physical activity, indicating an understanding of Ethan's viewpoint.

Interpretation based on RCM: These interactions show that the PSEs demonstrate communicative competence by involving Jasmine in the discussion, encouraging further discussion, attempting to understand her, and validating the value of her contributions. The PSEs also display interest in and understanding Ethan's contribution by taking his viewpoint and following up and clarifying his answers.

4. Discussion

This study addresses two research questions. The first one was: How do PSEs perceive their relational competence as manifested in their interactions with avatars exhibiting NDCs? The analysis of the interviews showed that the PSEs perceive relational competence as a situated competence, manifested by teachers' capabilities to establish positive and supportive TSRs through 1) identification and management of emotions, which in terms of RCM could be called socio-emotional competence, and 2) active listening and validation, which in terms of RCM could be called communicative competence. The second research question was: How does the relational competence of PSEs manifest in their interactions with avatars exhibiting NDCs? The analysis of the interactions showed that the PSEs' relational competence is manifested by their capability to show patience and gently encourage Jasmine to share her thoughts, despite her initial reluctance. PSEs also demonstrate empathy and sensitivity by acknowledging Ethan's emotions and redirecting the focus from conflict to constructive dialogue. In terms of the RCM, this can be referred to as socio-emotional competence. The results of the interaction study also showed that PSEs' relational competence is manifested by their capability to involve Jasmine in the discussion, encourage further discussion, attempt to understand her, and validate the value of her contribution. The PSEs also display interest in and understanding of Ethan's contribution by taking his viewpoint and following up and clarifying his answers. In the RCM, this is referred to as communicative competence. Taken together, the findings indicate that virtual simulations with avatars have the potential to train PSE's relational competence in relation to students with difficulties, such as students with NDCs. The results are discussed below, based on the purpose of this study.

4.1 PSEs' Relational Competence with Regard to Students with NDCs

This study explored how the use of avatar technology can support the development of PSEs' relational competence in relation to NDC students. Overall, our study indicated that it is possible, relevant, and meaningful to work with virtual simulations and avatars to support PSEs in developing relational competence with regard to students with NDCs. PSEs pay attention to different aspects of relational competence in their discussions with students with NDCs, and are trained to communicate with these students. Specifically, the results suggest that avatar technology can support the development of PSEs' relational competence towards students with NDCs in the following respects.

4.1.1 Supporting the Development of Relational Competence as a Situated Competence

The results highlight that PSEs perceive relational competence as situated competence, meaning that it is context dependent and involves the capability to adapt to the specific needs of individual students. Avatar technology simulates real classroom interactions. This allows PSEs to practice key skills by interacting with digital avatars that mimic students with neurodevelopmental conditions. PSEs can train their competence in managing emotions (socio-emotional competence) and communicating effectively (communicative competence). Thus, PSEs are

given opportunities to learn how to manage unpredictable and challenging TSRs, which may be a particularly valuable competency when working with students with NDCs. In other words, avatar scenarios enable PSEs to practice relational preparedness, that is, readiness for the unforeseen, a pedagogical capability that is particularly important for interacting with students with NDCs (Ewe, 2022; Ewe & Aspelin, 2024).

4.1.2 Supporting the Development of Socio-Emotional Competence

The results indicate that PSEs' relational competence is manifested in their capability to show patience, encourage reluctant students to share their thoughts, and redirect focus from conflict to constructive dialogue. These results are interesting, considering that TSRs regarding students with ADHD tend to be strained, with a higher degree of conflict and less emotional closeness than TSR in general (e.g., Gwernan-Jones et al., 2016; Mikami et al., 2019). Avatar technology can support the development of socio-emotional competence by providing PSEs with opportunities to respond to challenging interactions. For example, avatars can exhibit behaviours that require PSEs to practice patience and empathy, thereby strengthening these competencies in relation to students with NDCs. According to Ewe (2022), relational preparedness refers to teachers' ability to observe students' behaviour and reflect on what it suggests about their thoughts and feelings. It also refers to teachers' ability to identify and acknowledge their own emotional reactions to students' behaviours. In the virtual simulations with avatars exhibiting NDCs, emotions were prominent in the PSEs' discussions about the interactions, and they also manifested socio-emotional competence in relation to the students Jasmine and Ethan, suggesting that this competence could be trained in relation to students with NDCs.

4.1.3 Supporting the Development of Communicative Competence

The results also showed that PSEs manifested relational competence through active listening, validating students' contributions, and engaging in meaningful dialogues. Avatar technology can support the development of communicative competence by providing PSEs with the possibility of repeated training. Avatars can simulate various communication challenges, such as students' hesitation to participate or express themselves. By interacting with avatars that exhibit NDCs, PSEs can train themselves to manage these challenges, improve their capability to involve all students in discussions, and validate their perspectives. In virtual simulations with avatars exhibiting NDCs, the ability to actively listen and validate was highlighted in the PSEs' discussions about interactions, which is in line with relational preparedness (Ewe, 2022). PSEs manifested communicative competence in relation to Jasmine and Ethan, suggesting that competence could be trained in relation to students with NDCs.

4.2 Contribution to Research and Implications for Practice

The present study expands existing research on relational competence in SETT using virtual simulations with avatars. Previous findings on TSR regarding students with NDCs have shown that TSRs are challenging and problematic from both teachers' and students' perspectives (Ewe, 2019; Staff et al., 2023). Moreover, studies have indicated that the TSR of students with NDCs can be enhanced through video-based reflection (Ewe & Aspelin, 2022; Ewe et al., 2023). Unlike video-based reflection, avatar technology is based on situated communication, which enables PSEs to train their relational competence in ongoing interactive processes.

Overall, the present study shows that it is possible, relevant, and meaningful to work with virtual simulations with avatars to support the development of PSEs' relational competence in relation to students with NDCs. Teachers working with students with NDCs need to be particularly skilled in "relational preparedness", that is, they must be prepared for the unforeseen and capable of observing students' behaviour and reflecting on what it suggests about their thoughts and feelings (Ewe, 2022; Ewe & Aspelin, 2024). Overall, our study shows that avatar technology enables teachers to anticipate and respond sensitively and constructively to students' verbal and nonverbal signals in interaction. Hence, by providing PSEs with opportunities to interact with avatars with sharpened behavioural profiles, avatar technology can support the development of PSEs' relational competence in relation to students with NDCs. Teacher educators can guide PSEs in this training, and the experiences may contribute to PSEs' confidence in addressing challenging behaviours.

Implications for SETT could involve implementing course modules that emphasise situated learning in which PSEs are given the opportunity to train in challenging interactions in authentic scenarios. In virtual simulations, PSEs can be trained by applying relational competence in different teaching scenarios, such as course modules focused on identifying and addressing student diversity and challenging behaviours. By integrating this type of virtual simulation into SETT, PSEs can engage in training in which they consistently analyse and discuss their observations and actions in response to students' varying behaviours and needs. This would allow them to refine their relational competence in a controlled and authentic environment.

In conclusion, our study demonstrates that virtual simulations using avatars can be an effective tool for enhancing relational competence among preservice special educators. We suggest that this training approach has the potential to support teachers in developing strategies for managing students' emotions and enhancing communication with students who have unique educational needs.

4.3 Limitations and Future Research

It should be noted that this is a small-scale study with a limited number of participants. The findings may depend on individuals and therefore may not necessarily be generalisable to other contexts. It is important to note that while these initial results are encouraging, additional research with larger samples is needed to confirm these findings. Future research should include a larger sample and perhaps a longitudinal design to confirm the findings and rule out alternative explanations for the observed improvements in relational competence. We also suggest that future revisions include follow-up assessments to determine if the improvements in relational competence are sustained over time.

In PSEs' perceptions of relational competence, only socio-emotional and communicative competence are prominent, whereas differentiation competence is neglected. Future research should focus on the latter sub-competence. Indeed, PSEs need to discuss closeness and distance in TSRs without polarisation and develop a conceptual understanding of this competence as well.

Declaration of interest statement

The authors report there are no competing interests to declare.

Funding

This study did not receive external funding.

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Appendix A

Interview Protocol

1) Describe how you experienced the interaction with the avatars

2) How did you engage with the avatars to enable their participation? Provide examples.

3) How do you feel the interaction with the avatars worked concerning communication (both verbal and nonverbal)? Did you and the student avatars understand each other? What did your interaction look like in terms of gestures and way of speaking?

4) How did you create closeness in relation to the avatars? How did you avoid becoming too personal in your interactions with the avatars?

5) Which emotions did the avatars express? How did you manage their emotional expressions? How did you handle your own emotions in the interactions with the avatars?

6) What challenges did you experience in interacting with the avatars? How did you handle these challenges? Are there other ways that could have been used to address the challenges that arose? Provide examples.

7) What is it like to interact with avatars exhibiting some form of difficulty? Is it easier or harder to relate to them compared to real children/students? Why do you think it is so?

8) Can you share something specific about how you experienced interacting with Jasmine? How do you view the importance of a good interaction with her? Provide examples of what challenges and characterizes a good interaction with her.

9) Can you share something specific about your experience of interacting with Ethan? How do you view the importance of a good interaction with students like him? Provide examples of what challenges and characterizes a good interaction with students like him.

10) Do you see any differences in how a teacher interacts with avatars compared to real students? What could be the reason behind this?