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Pre-service teachers' collaborative learning and role-based drama activity in a virtual reality environment

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Abstract

Background: In recent years, the use of virtual reality (VR) environments for education has gained interest in research and education. However, little is known about the potential of social VR environments for collaborative learning.

Objectives: This study explores pre-service teachers' (PSTs') collaborative learning and role-based drama activity, focusing on their self-created fictional avatar characters and their experiences of presence while working on a group-based virtual drama activity.

Methods: PSTs' course on environmental storytelling was used as the context of the study, in which they worked in small groups in a VR environment (AltspaceVR) from the desktop computers due to COVID-19 restrictions. Qualitative research data were collected via questionnaire ($N = 15$). The data were analysed using a community of inquiry model to explore the PSTs' experiences of online presence.

Results and conclusion: The results showed that the PSTs' experienced creating and acting as virtual characters as meaningful and engaging activities, and elements of presence were manifested in their reflections. Based on this case study, it can be concluded that the interactive virtual drama activity has the potential to foster the experience of presence in online learning.

KEYWORDS
Collaborative learning, community of inquiry, drama, online presence, pre-service teachers, virtual reality

1 | INTRODUCTION

Higher education institutions are actively developing and implementing different kinds of distance and hybrid education environments and models to support students' learning and well-being (Crawford et al., 2020) and to offer more blended and flexible learning experiences (Drachsler et al., 2021). During the COVID-19 pandemic, education was largely shifted to online learning environments, teaching was delivered through a variety of applications and devices, and learning environments were built around different interactive software and virtual platforms (Bailenson, 2021; Drachsler et al., 2021; Kalantzis & Cope, 2020). One of the challenges of online learning is

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that physical distance affects interpersonal relationships in the online environment through the experience of isolation and alienation, as students are physically separated from other participants and sometimes even feel ignored by their teachers (Bohnstedt et al., 2013; Richardson et al., 2015). This phenomenon can be explored using the community of inquiry (CoI) model (Garrison et al., 1999; Garrison, Anderson, & Archer, 2010), according to which learners' experience of presence in online education affects their overall online learning experiences and potentially to their participation in different learning activities.

In this study, the theoretical model of CoI provides a thorough view of learning and interaction processes in learning in virtual reality (VR). The original CoI model included three components—cognitive, social and teaching presence—as the key elements for successful online learning experiences (Garrison et al., 1999; Garrison, Anderson, & Archer, 2010). Fayyad et al. (2022) further developed the model to include three additional components: learner presence, emotional presence and teaching managerial presence. The CoI model has been used as a theoretical framework in hundreds of studies on the quality of online education (Elander, 2016; Fayyad et al., 2022; Richardson et al., 2015), but it has not yet been widely applied to studies about VR (McKerlich & Anderson, 2019). In general, the focus of prior research on VR in educational contexts has been more on the usability of VR applications or the learning outcomes than on the actual learning process (Petersen et al., 2022; Radianti et al., 2020). Little is known about the educational effectiveness of VR environments (McKerlich & Anderson, 2019). These environments have gained popularity in education and are also gaining increasing interest in research (Petersen et al., 2022; Radianti et al., 2020). In educational contexts, VR is commonly used to simulate classroom or laboratory work (Kamińska et al., 2019). There is also potential to use VR in teacher education, for example, by enhancing pre-service teachers' (PSTs') reflection possibilities and empathy skills via the use of a VR-based learning framework (Stavroulia & Lanitis, 2019). However, research in this area is still in its experimental stage (Billingsley et al., 2019; Radianti et al., 2020). There is, for example, no consensus on the interaction between empathy, immersion and perspective taking in immersive VR (iVR) (Han et al., 2022), and research about synchronous online learning (Çakiroğlu, 2019; Lehtinen et al., 2023; Martin et al., 2017) and social VR is largely lacking (Alblehai, 2022; Montagud et al., 2022). Social VR platforms may have potential for collaborative learning, as they offer virtual environments in which users can interact with one another embodied in avatars in real-time interactions (Maloney et al., 2020). Prior research has indicated that compared to other presentation formats, VR has the potential to lead to higher levels of intrinsic motivation, engagement and feelings of presence (e.g., Huang et al., 2020; Makransky & Lilleholt, 2018; Ozbek et al., 2017).

In this work, role-based drama activity provides a framework for a group activity in which PSTs' create fictional virtual characters and act out a group task in social VR. The pedagogical rationale behind the decision to implement a role-based drama activity in a VR environment is based on the view that the teaching practice of teacher education requires new types of approaches and technological tools in order to provide students with the opportunity to experience digital learning and collaborative learning first hand, while at the same time learning about the important topic. The topic of climate change was chosen to function as a frame story for the role-based group task, providing a purpose for the activity and aiming to engage PSTs' in goal-oriented work in VR. Moreover, the value of drama activities in this specific topic is essential as a pedagogical structure to illustrate to the pre-service teachers. Drama activity as a playful and narrative learning method provides a creative environment to learn about climate change and fosters a positive attitude towards future (Borba et al., 2024). According to Radianti et al. (2020) literature review on VR in higher education, the true potential of VR lies in learning by doing opportunities that are difficult to implement in traditional education. Therefore, the aim of the current study is to explore PSTs' experiences of presence when they worked as fictional avatar characters in a virtual drama activity during a designed environmental storytelling course; in this activity, drama was used to broaden the participants' perspectives while working in a VR environment (Bowell & Heap, 2010; Colantonio et al., 2008).

2 | THEORETICAL FRAMEWORK

2.1 | Experiences of presence in collaborative learning

Collaborative learning is a specific type of learning and interaction process in which learners in groups negotiate their learning goals and coordinate their shared learning processes together (Roschelle & Teasley, 1995). As collaborative learning consists of discussions, negotiations and reflections on the task at hand, it has the potential to lead to deeper information processing than individuals would achieve alone (Baker, 2015; Dillenbourg, 1999). The premise for successful collaborative learning is that the presence of group members is a significant factor that helps build, monitor and sustain their shared learning processes at the cognitive, motivational and socioemotional levels (Barron, 2003; Isohätälä et al., 2020; Näykki et al., 2017). However, studies have shown that collaborative learning in online contexts faces challenges in keeping group members actively involved and present in group interactions (Bailenson, 2021; Kalantzis & Cope, 2020). There is a need to design pedagogical approaches and learning environments that could potentially increase group members' experiences of presence, including also online education.

This study implements the theoretical framework of CoI to explore experiences of presence. The CoI framework defines *cognitive, social and teaching* presence as the key elements of a successful online learning experience (Garrison et al., 1999; Garrison, Anderson, & Archer, 2010). In a higher education context and in online education, these three elements, together with the ease of use and practicality of the technology involved, have been found to contribute to student satisfaction and persistence in learning (Joo et al., 2011). Of the three elements, cognitive presence includes the activities in which students

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share their understanding and thinking processes, use the shared knowledge for constructing ideas, engage in problem solving and reflect on the learning content and outcomes (Garrison et al., 1999; Garrison, Anderson, & Archer, 2010). Cognitive presence is considered the most central and influential factor that affects student satisfaction, but it is also the most challenging to develop in online education; however, cognitive presence is not sufficient on its own to sustain the feeling of presence (Garrison & Cleveland-Innes, 2005; Garrison, Cleveland-Innes, & Fung, 2010; Joo et al., 2011).

Social presence is an important construct in online group learning (Kreijns et al., 2022); it is essential for the development of higher-order cognitive skills and collaboration (Garrison, Cleveland-Innes, & Fung, 2010). Social presence supports learners in communicating meaningfully and confidently and in developing interpersonal relationships so that they can function both as individuals and as part of a group and a community (Garrison, 2009). That is, the more fluent the interaction is in online education, the closer the participants feel to one another and to the teacher. In the best case, learners can forget the physical distance between them and focus entirely on the topic at hand (Elander, 2016). Social presence is seen as a mediator between teaching and cognitive presence. There have been different definitions and measures of social presence and its role in online group learning (Kreijns et al., 2022). According to Garrison et al. (1999), social presence in an online learning environment is identified by three sub-dimensions: *emotional expression*, *open communication* and *group cohesion*. Emotional expression includes sharing one's own emotional experiences and humour and expressing feelings related to learning (Isohätälä et al., 2020; Isohätälä et al., 2021; Lehtinen et al., 2023). Open communication requires others to recognise and respect an individual's participation and contributions, thereby enabling interaction. A third dimension of social presence is the experience of cohesion among group members. It is based on activities that build and maintain a sense of group commitment (Garrison et al., 1999). Thus, students' positive learning experiences can be enhanced by developing and supporting their social presence (Garrison, Anderson, & Archer, 2010). However, Garrison et al. (1999) definition of social presence has been criticised for not separating social presence from sociability and social space (Kreijns et al., 2022). Kreijns et al. (2022) argued that despite being linked to social space and sociability, social presence should not be considered similar to them. In other words, social space (as a medium attribute) should be referred to when a network of interpersonal relationships is considered in online group learning, whereas sociability (as a group attribute) refers to the capacity of computer-mediated communication tools and online platforms to foster socioemotional aspects of the learning experience when one perceives or experiences another person's social presence.

Teaching presence consists of developing the curriculum content, learning activities and schedules, purposefully monitoring and managing collaboration and reflection, and ensuring learning outcomes through timely support. Subsequent reviews, including video-mediated interactions (e.g., Garrison, Anderson, & Archer, 2010), define teaching presence as being at the core of creating and maintaining social and cognitive presence. In other words, cognitive and social presence are linked to each other and to teaching presence through the structuring of instructional content and the delivery of instruction. Teaching presence aims to create learning processes and learning outcomes that are personally, socially, cognitively and pedagogically meaningful for learners. Teaching presence is essential in creating an atmosphere of trust, open communication, group cohesion and social presence. Therefore, when designing online courses and interaction methods, instructors should understand their students' needs, the demands of the content and the availability of technical support (Watts, 2016) while also being affective and interactive and while using cohesive communication strategies (Christen et al., 2015).

Fayyad et al. (2022) further developed the original CoI model (Table 1), and this extended view on the model is also implemented in this study. In addition to cognitive, social and teaching presence, they considered *learner*, *emotional* and *technical managerial presence*. Learner presence represents the behavioural and motivational structures supporting learners' self-regulation, which, at its best, can increase learning effectiveness. Efforts in task allocation, time management and goal setting are examples of the strategic processes that increase learner presence and support the success of group projects. Fayyad et al. (2022) definition of technical managerial presence is based on prior literature (Bigné et al., 2019; Coppola et al., 2002; Ruarte, 2019). According to Ruarte (2019), technical managerial presence refers to the design and content skills that support the online environment and the achievement of learning outcomes. This includes the creation, management and development of digital content in online education and the assessment of the relevance and purpose of online learning for teaching. In addition to managing the content of the course, the teacher is responsible for the learning process through the strategic and technical management of the course. Fayyad et al. (2022) further developed Ruarte's (2019) definition of technical managerial presence by integrating three corresponding categories (information and data literacy, digital content creation and technical problem solving) from the digital competence framework for teachers developed by Bigné et al. (2019) and two categories (course organising and course controlling) from the study of Coppola et al. (2002) into the definition of technical managerial presence.

Emotional presence is the communication of interactive messages that express immediacy (Elander, 2016). Xu et al. (2013) found that learners' attention to their emotions in an online environment is related not only to their motivation to learn and their self-regulation of learning but also to collaboration within the learning group. Emotional presence creates a learning atmosphere among participants in which different emotions are allowed to be present (Isohätälä et al., 2021; Näykki et al., 2021). The emotions that learners experience in technology-rich learning environments are pivotal for their cognitive and affective learning gains (Lajoie et al., 2020).

2.2 | Educational context of role-based drama activity

Drama is a group-based, interactive, functional and experiential educational activity that focuses on working together using theatre-based

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TABLE 1 Overview of the elements of presence.

Element	Description	Description of student experience	Example	*f*	Cohen's kappa	% of agreement
Social presence	Communication, group cohesion, collaboration	Valuing of learning, opportunity to express views, encouraging collaboration	'— when we didn't think too much about our roles and our new identities, we were able to talk more naturally'.	43	0.6	96%
Teaching presence	Instructor guidance, facilitating social and cognitive processes, building understanding, motivating	Defining and initiating discussion topics, sharing personal meaning, focusing discussion	'There was a lot of support available, and at no point did I feel insecure'.	21	0.9	96%
Cognitive presence	Constructing meaning, exploring the problem, proposing solutions, resolution, reflection	Sense of puzzlement, information sharing, connecting ideas, applying new ideas; Reflection (learning content and outcomes; learning processes)	'I learned to use a new platform, which was interesting and certainly useful for teaching practice'.	44	0.85	93%
Learner presence	Self-efficacy, effort to regulate time and tasks, setting goals	Competence in executing online learning, efforts to divide up tasks, efforts to manage time, setting goals in order to successfully complete group projects	'— one kept the time, to keep us on schedule —'.	29	1.0	100%
Emotional presence	Activity-related emotions, outcome-related emotions, directed affectiveness	Emotion about the inquiry and the consequence of the inquiry, emotion towards the other person	'Working in a virtual world amused me at times, maybe because of the characters'.	22	0.75	89%
Technical managerial presence	Information and data literacy, digital content creation, technical problem solving	Identifying, locating, retrieving, storing, organising and analysing digital information, integrating and rebuilding prior knowledge and content, identifying needs in the use of digital resources, using technology creatively, solving technical problems, upgrading self-competence and of others	'My character functioned in the virtual world as I would in the physical world'.	95	0.64	87%

methods. Drama activities focus on imaginary and fictional situations specific to the theatre, in which learners act both in roles and as themselves. The work is mainly done in a group without an external audience. The main learning objectives are to express one's own ideas and thoughts and to develop general expression, interaction and social and emotional skills (Toivanen, 2016). Developing and learning through drama require high social presence (Robertson & Oberlander, 2002).

Drama and theatre-based methods provide teacher education with functional and experiential working methods that can be used to develop the skills needed in the working lives of teachers, such as sensitivity, responsiveness and intuition (Aadland et al., 2017; Seppänen et al., 2019; Seppänen et al., 2020). According to the Toivanen et al. (2011), drama can be used to improve the quality of learning in teacher education, as drama can facilitate dealing with professionally difficult issues and situations in a safe environment by exploring them together (Bowell & Heap, 2010; Colantonio et al., 2008). Through drama work, PSTs' can experience different roles and can safely explore interpersonal tensions and conflicts through a variety of drama activities. Drama affects participants both emotionally and intellectually, as it offers them the opportunity to explore themselves and deepen their understanding of agency and behaviour in fictional roles. Drama broadens thinking through fictional roles, worlds and stories (Howard-Jones et al., 2008).

Due to the digitalization of education and the COVID-19 pandemic, the prevalence of digital drama education has increased (Zakopoulos et al., 2023). According to Zakopoulos and colleagues' (Zakopoulos et al., 2023) literature review of the use of digital technologies in drama performances to address the sustainability topics in education, VR can be used to create immersive experiences for students to explore drama activities and scenarios. In addition, online collaboration tools may be implemented to enable students work in groups remotely and collaborate in the drama activities (Zakopoulos et al., 2023). However, the use of drama activities in online teacher education is an understudied topic (Dyment & Downing, 2020). There are only a small number of previous studies on specific discipline areas, such as drama-based learning, in the context of technology and online/hybrid learning in teacher education (Dyment & Downing, 2020). The shift to online and hybrid learning has created a need for the active development of learning environments, and the potential of VR as part of higher education has become an issue in recent years. Kim et al. (2017) have explored VR drama in teacher education from the perspective of school bullying prevention. They found that the more immersive and close-up the view is in VR, the greater the participant's level of reaction to the drama. However, in Kim's and colleagues' (Kim et al., 2017) VR drama study, students did not work collaboratively and were not involved in the drama activity with a specific role. In this present study, VR drama in teacher

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education is explored using avatar characters and roles, and students will work collaboratively to complete a task. VR and role-based drama activities can work as a pair because both are characterised by their support for experiential and immersive activities (Ripka et al., 2020). In VR, as in drama, the focus is on facilitating immersion and presence—the experience of *being* or *acting* in a physically different place (Schwind et al., 2019).

2.3 | VR as a collaborative learning environment

VR can be defined as a computer-simulated space in which users can interact with and in the virtual environment through their agents (i.e., avatars). The VR experience consists of four critical elements: the virtual world or space, immersion, sensory feedback and interactivity (Sherman & Craig, 2003). The nature of prior studies on VR in education has been experimental, focusing especially on the usability of VR applications or learning outcomes, while little is known about the learning process and the pedagogical effectiveness of VR (Petersen et al., 2022; Radianti et al., 2020). Overall, there is a lack of studies on the use of social VR in educational contexts and on social behaviour and interaction processes in VR (Alblehai, 2022), that is, VR for improving communication, collaboration and soft skills (Radianti et al., 2020). For example, Çetinkaya (2020) conducted a systematic literature review of previous studies that applied the CoI framework in 3D virtual learning environments. The focus of his study was on language learning. According to the literature review, only three peer-reviewed articles (Ozbek et al., 2017; Pellas & Boumpa, 2016; Pellas & Boumpa, 2017) were found in 10 databases. In these studies, the implementation of the CoI framework in a 3D virtual language learning environment supported students' high learning gains, enhanced the experience of meaningfulness (Pellas & Boumpa, 2016) and meaningful learning outcomes (Pellas & Boumpa, 2017) and increased the experienced social presence among learners (Ozbek et al., 2017). Furthermore, in Ozbek and colleagues' study (Ozbek et al., 2017), avatar characters strengthened teacher–student and student–student relationships by enabling communication and virtual role-play activities. Çetinkaya (2020) concluded that the implementation of the CoI framework could help create deep, meaningful and collaborative learning experiences through the development of teaching presence, social presence and cognitive presence. It has been found that immersive environments have the potential to reduce feelings of psychological and social distance, especially in online education, but more research is needed on the implementation of the CoI framework in VR (McKerlich & Anderson, 2019).

It has been argued that highly iVR, referring to VR which shuts down physical reality and offers high fidelity, promotes more positive emotions and presence, as well as increases motivation and engagement, compared with a non-immersive desktop VR version (Makransky & Lilleholt, 2018). On the other hand, a highly immersive head-mounted display version of VR might lead to cognitive overload in VR, which is commonly reported in prior VR studies (Makransky et al., 2019). Han et al. (2022) examined how iVR promotes PSTs' presence and empathy skills. In their study, highly iVR did not increase empathy more than lowly iVR did, which suggests that immersion may not produce empathetic reactions alone. A stronger emotional reaction was triggered when a high level of immersion was combined with a first-person perspective with a virtual body, as it strengthened the experience of embodiment, and lowly iVR promoted more empathy when the user did not have a virtual body and took a first-person perspective as a bystander. In conclusion, the use of VR should be aligned with the design of VR and the educational content to increase learners' presence.

3 | METHODS

3.1 | Aim and research questions

The aim of this study is to explore PSTs' experiences of presence, as defined in the CoI model (Fayyad et al., 2022; Garrison et al., 1999): cognitive, social, instructional, learner, emotional and technical managerial presence, in a collaborative role-based drama activity in a virtual environment (AltspaceVR). The research questions are as follows:

1. How did the PSTs' reflect on the experience of presence in the creation of avatar characters for the virtual drama activity?
2. How was the experience of presence reflected in the PSTs' collaborative learning experiences during the virtual drama activity?

3.2 | Participants and research context

The participants of this study were PSTs' ($N = 15$) who studied in a teacher education programme at a Finnish university. Teacher education students in Finland need to complete a three-year bachelor's degree in education (180 ECTS credits) and a two-year master's degree in education (120 ECTS credits) to qualify to work as primary school teachers in grades one to six (students aged 6–12). One ECTS (European credit transfer system) is equal to 28 h of study.

The study was conducted as part of a teacher education course on environmental storytelling, which aimed to promote climate change awareness through arts-based methods and media education. The course was organised in spring 2022 and overall, the course lasted for 3 months and students had seven online teaching sessions. The participants for this study were not selected, they were all part of the pre-service teacher training course. All students took part in the activities, but only those who gave written consent to the research were included in this study. The total number of participants in the course was 17 and they were evenly distributed in the groups (4–5 members per group). However, out of the 17 participants, two did not give consent for the research and two did not respond to the questionnaire, so the total number of participants in this study was 15 students who gave consent for the research and their responses to the questionnaires were analysed.

Role-based drama work was chosen as the activity for the teaching experiment because the intention was to explore how drama, as a group-based, interactive and experiential pedagogical activity, can be

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applied in a VR environment. In addition, drama was used to support students in dealing with sometimes-distressing topics related to climate change by distancing themselves from the subject matter and by acting in imaginary roles and an imaginary time and place. According to Neelands and Goode (2015), drama as a research tool offers participants a connection with the full range of human experiences. The purpose of the drama work was to discover questions and themes that emerged from the needs and current experiences of the participants.

The drama activity was conducted in different instructional phases, which are presented next. *First*, the students were introduced to the drama activity with a short introductory lecture by the drama teacher (a co-author of this manuscript). During this lecture, the focus was on the main purpose of the drama work, its main principles and the frame story of the forthcoming drama activity. *Second*, the students were introduced to the VR environment (AltspaceVR) with a short tutorial, and they were provided with the opportunity to meet two experts on the functionalities of the VR environment (co-authors in this manuscript). In this study, we implemented VR desktop environment due to COVID-19 restrictions as the teaching was organised as online distance education at the time of this study was conducted. *Third*, the students were instructed to create avatar characters representing who they wanted to be in a virtual role-based drama activity. These phases were conducted prior to the actual drama activity, and in the following, the different phases of the drama activity in the VR environment are introduced in detail.

The actual virtual drama activity consisted of different phases and lasted for 90 min (Figure 1). It started with all the participants and teachers gathering via a Zoom video conference; here, the teachers ensured that all the students understood the drama activity, that they had created their fictional avatar roles, and that they knew how to log in to the VR environment. Next, all the participants moved to the AltspaceVR environment, in which the university VR campus (*detailed information removed for the peer review*) was located. We selected the actual working environment to be an island because it fit our frame story of climate change.

Working in the VR environment was separated into different phases (Figure 2). The *first* phase involved getting to know the surroundings and moving to the meeting point. The *second* phase consisted of listening to the frame story and instructions for the group task when everyone had gathered at the meeting point. The drama teacher, in the fictional role of an environmental expert, gave the students an update of the world climate situation and asked them, as media representatives, to work as a group and develop a media strategy that can influence citizens environmental awareness and appeal to their emotions and consumer behaviour. The avatar characters created by the PSTs' were divided into five groups of well-known media representatives (TikTokers, bloggers and vloggers, magazine editors, radio journalists and YouTubers) and were tasked with designing environmental thinking campaigns for their target media groups. In the *third* phase, after the task instruction, the groups moved to work in different parts of the virtual island. The working phase of the groups involved introducing themselves as the characters, and brainstorming and designing their own campaigns, which they then formulated into a written output using the ThingLink tool. The *fourth* phase of the virtual drama session involved each group presenting the results of their media campaigns and ThingLink work when the groups had gathered back at the meeting point. The final phase of the work was reached when all the groups and teachers had gathered back into the Zoom environment. This was to close the drama work together and to safely transform back from their fictional roles.

3.3 | Data analysis

The data were collected through an online questionnaire completed by the PSTs' ($N = 15$) immediately after their group work. The questionnaire was designed to measure the participants' reflections on their collaborative work and, in particular, the creation process of the avatar characters and their experiences of presence during the drama activity (CoI model; Fayyad et al., 2022; Garrison et al., 1999). Eight open-ended questions were created to identify participants' experiences of different elements of presence during VR activity, and these were as follows: 1. Describe the creation of your avatar character; what kind of character did you create, and how did your character function in VR? 2. Describe your group work in the virtual world; what went well, and where were there any challenges? 3. Describe how

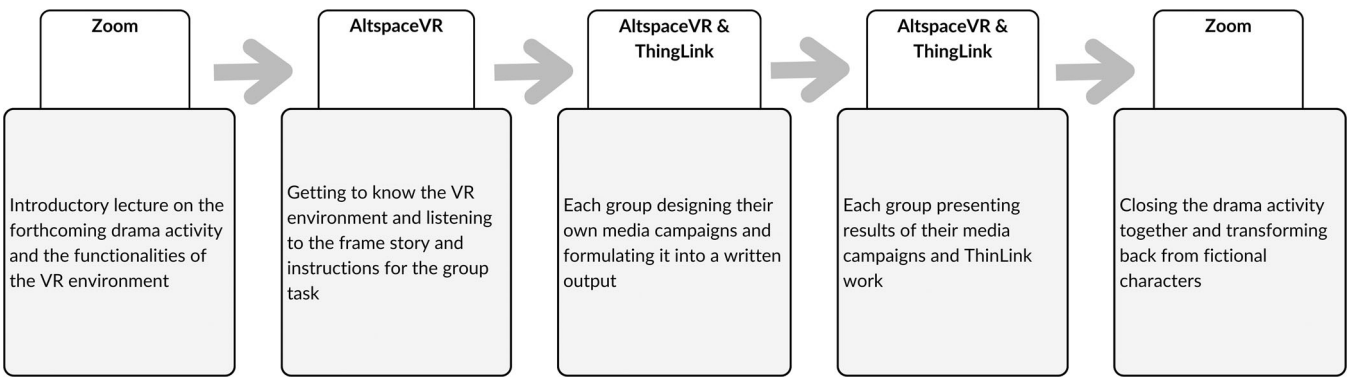

FIGURE 1 The timeline, phase descriptions and software used in each phase of the drama activity.

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FIGURE 2 Pictures from the drama activity in the virtual reality environment and instructions for the task on the ThingLink tool (lower left).

you organised group work in the virtual environment (e.g., task sharing, time management and commitment of the group members)? 4. Describe how the teaching arrangements supported your work in the virtual environment. 5. Describe how VR supported your group's work and learning; how do you think did your own digital pedagogical skills develop? 6. Describe the interaction of your group in the virtual environment. 7. Describe the emotions or feelings aroused by working in a virtual environment. 8. What new perspectives did you gain from the drama activity on Altspace for your future work as a teacher? In order to avoid leading questions, the questions were formulated as broad and open-ended, most of them encompassing several themes within the CoI model.

In the data analysis, the data were analysed using the CoI model as a theoretical framework. The analysis proceeded by initially familiarising oneself with the questionnaire data, discussing the preliminary findings based on the readings and then designing a data analysis protocol based on the CoI model. The whole analysis process was planned together with the team of authors, and the team had regular discussions as the analysis progressed. The second and third authors of this article were particularly involved in the qualitative analysis. They have a wealth of previous experience in qualitative analysis. The coding scheme followed the theory of social presence, and the data were coded based on six elements of presence according to the CoI model; social, teaching, cognitive, learner, emotional and technical managerial presence (Garrison et al., 1999; Fayyad et al., 2022). This means that every time a written reflection included a description of aspects related to a specific element of presence, that part of the reflection was coded to the specific theme. In the next phase of the analysis, the coded reflections were further analysed by counting the frequencies of each element and selecting examples to be presented in the article (Table 1). Percentage agreement and Cohen's kappa were used to evaluate coding agreement and establish reliability. Data reliability was analysed on 38% of the data. The subset of data was selected randomly, but taking into account that responses from all participants were included, resulting in cross-coded data that were well representative of the entire dataset. Percentage agreement ranged from 87% to 100% and Cohen's kappa values ranged from 0.6 to 1.0, indicating substantial to perfect agreement (Cohen, 1960). The team planned the analysis together, had regular discussions as the analysis progressed and also assessed the reliability of the analysis. Sections with weaker agreement were discussed and meaning negotiated as a group, and the descriptions of the categories were refined. The results are presented according to the research questions in the results section, with qualitative examples from the data.

4 | RESULTS

4.1 | How did the PSTs' reflect on the experience of presence in the creation of avatar characters for the virtual drama activity?

The first research question explored how the PSTs' reflected on the experience of presence when creating fictional avatar characters for the virtual drama activity (see Table 2), that is, how the opportunity to act in two realities and view phenomena, events and interactions

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TABLE 2 The pre-service teachers' experience of presence when creating fictional avatar characters for the virtual drama activity.

Element	Avatars supporting the experience of presence	Avatars limiting the experience of presence
Social presence	The possibility to communicate, express views and collaborate as avatars	Limited non-verbal communication as avatars
Teaching presence	Clear instructions and facilitation to support the creation of avatars	Unclear instructions for the creation of avatars
Cognitive presence	The possibility to share and connect ideas and to reflect on the drama process as avatars	Not understanding the purpose of the avatars for the drama activity
Learner presence	Competence in executing the virtual drama activity as avatars	Incompetence in executing the virtual drama activity as avatars
Emotional presence	Positive emotions about the avatars	Negative emotions about avatars
Technical managerial presence	Positively assessing avatar relevance and purpose for teaching needs, succeeding in creating avatars	Negatively assessing avatar relevance and purpose for teaching needs, struggling in creating avatars

parallel to real life in a fictional character and, after the drama activity, as themselves was implemented in the virtual drama activity.

The PSTs' described the creation of their fictional avatar characters as a meaningful and inspiring phase of the drama activity. Teaching presence, manifested in clear instructions and facilitation, supported the PSTs' creation of the avatar characters. Most of the PSTs' created characters who acted and looked like themselves, while for some PSTs, the activity provided them with the opportunity to be someone else.

> I built a character that looked like me. For some reason, I chose a character with features similar to mine. In the virtual world, the character acted very similarly to how I would have acted in real life.
>
> (YouTuber, student 13)

> I tried to portray a certain kind of Twitch style, somewhat known in Finland, in which men in their 30s play games and livestream their lives. I had to study it a bit, but I found some common traits, such as sponsor clothes/hoodies/loungewear and possibly some kind of headgear…
>
> (Blogger/vlogger, student 5)

Most of the PSTs' experienced emotional and technical managerial presence through positive emotions about the avatars created. They believed that the avatars were relevant aspects of the virtual drama activity. On the other hand, some PSTs' struggled to create avatars because of technical issues or because they did not understand the purpose of the avatars for the drama activity.

> There were technical problems logging in to the island, and eventually, all the changes I made to the character were reset when I had to try different emails to get in. However, this didn't matter, as I have experience editing the character.
>
> (Radio journalist, student 3)

> The character looked like me and acted quite normally. In this activity, I didn't feel that the role made any difference from the actual activity.
>
> (Magazine editor, student 1)

It can be concluded that acting in a fictional role is an important part of emotional presence and learner experience in the drama activity. Acting as a character builds connections between fictional and real events in a virtual drama and is manifested in positive and negative emotions and feelings of (in)competence to execute the virtual drama activity as a fictional character.

> Being in a new environment felt a bit challenging at first, and there were perhaps difficulties in concentrating on the task, when looking around and trying things out. It was also a bit of a challenge to act in the characters because we knew one another. But I still found it a fun and a different way to work, which worked well for me.
>
> (Magazine editor, student 8)

> At first, it was challenging to remember the names of the characters, and staying in character was maybe a little difficult, but when I thought that my character was someone who resembled me, work became easier.
>
> (Blogger/vlogger, student 7)

As the drama activity progressed, the fictional situation and characters became more and more recognisable and familiar. The connection between the events of the drama and everyday life began to emerge, leading to the experience of cognitive presence through exploring the drama activity together in the fictional virtual world and to the experience of social presence through the opportunity to collaborate and communicate with one another as avatars.

4.2 | How was the experience of presence reflected in the PSTs' collaborative learning experiences during the virtual drama activity?

The second part of the results section continues to explore how the experience of presence was reflected in the PSTs' collaborative learning experiences during the virtual drama activity. An overview of the

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TABLE 3 The pre-service teachers' experience of presence in collaborative learning during the virtual drama activity.

Element	The virtual drama activity supporting the experience of presence	The virtual drama activity limiting the experience of presence
Social presence	Respectful and clear communication, possibility to express views, encouraging and valuing collaboration	Limited non-verbal communication, group members unmotivated to collaborate
Teaching presence	Clear instructions and facilitation by the teachers, the teachers are present and available during the task, they create a safe learning atmosphere	Unclear or uninspiring instructions for the virtual drama activity
Cognitive presence	Understanding the aim of the virtual drama activity, sharing and connecting ideas, reflecting about the virtual drama process, its progress and its outcomes	Not understanding the aim and purpose of the virtual drama activity
Learner presence	Competence in executing the task, succeeding in dividing tasks, managing time and setting goals	Incompetence in executing the virtual drama activity, struggling in dividing tasks and managing time
Emotional presence	Positive emotions about the drama activity, its outcomes, including positive emotional reactions towards other students	Negative emotions about the drama activity and its outcomes, including negative emotional reactions towards other students
Technical managerial presence	Positively assessing the virtual drama activity's relevance and purpose for teaching needs, succeeding in creating avatars, not experiencing technical problems	Negatively assessing the virtual drama activity's relevance and purpose for teaching needs, struggling in creating avatars, experiencing technical problems

results is provided (see Table 3), and the PSTs' experiences of presence in a VR environment are explored in more detail.

The PSTs' reflected on their learning experiences of the virtual drama activity through the six elements of presence. Technical managerial presence framed their reflections. They assessed how well the virtual environment supported the virtual drama activity. Some of the PSTs' felt delighted for not experiencing any technical problems, whereas others were frustrated by the technical issues that affected the virtual drama activity. The more the PSTs' experienced technical challenges during the drama activity, the more that technical managerial presence was emphasised, while other elements of presence were less present in such reflections.

> The virtual world provided visual support for the work in addition to sound. It gave a sense of presence and allowed us to represent the physical world.
>
> (Blogger/vlogger, student 6)

> Because of technical problems, the virtual world made it difficult for our group to work together. However, it also supported acting as characters through the avatars, screen names and speech. The virtual environment provided a change from Zoom, which is perhaps already used too much in university studies.
>
> (YouTuber, student 13)

In their reflections on their experiences of cognitive presence, the PSTs' briefly stated the outcomes of the learning process, for example, by describing the progress of the drama activity, collaborative knowledge building or the new skills learned through the task. In addition, one of the PSTs' combined social and cognitive presence by considering the importance of interaction in the learning process.

> — The limits [of technology] made it difficult to work, and the interaction was a bit clumsy. However, the presence of the group and the clear task assignment supported the work. It was very interactive and solution oriented.
>
> (Blogger/vlogger, student 6)

It was stated in many reflections that VR affected the experience of social presence through limited communication possibilities. In addition, some of the PSTs' thought that the nature of the drama work made them insecure about how to interact with one another. If the group interaction was successful, and no interaction-related issues were encountered, it was briefly described as 'very similar to normal'.

> The interaction was maybe a bit stiff at first, as we didn't really know how to be in the roles. Maybe when we didn't think too much about our roles and our new identities, we were able to talk more naturally.
>
> (TikToker, student 8)

Similar to the briefly mentioned positive experiences of social presence, the PSTs' described, in a few words, their positive experiences of teaching presence. They were satisfied with the support and clear instructions given by the teachers, which created a safe atmosphere and helped the PSTs' focus on the task. During the virtual drama activity, for instance, it was found important that the teachers stayed in the background and allowed the students to work on their own. The experiences related to learner presence were described through the commitment of the group members to the task and how they divided the task roles among themselves. A few deepened their reflections on learner presence by describing the feelings that emerged from the distribution of the task roles.

> — I felt a bit lazy when I didn't write anything myself on ThingLink, but several people clearly took

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> responsibility for it. Everyone was very committed to the work, which was certainly why it felt effortless.
>
> (Blogger/vlogger, student 5)

Many of the experiences of emotional presence were associated with technical managerial presence, particularly through the technical problems experienced and the resulting sense of frustration. For example, at the group level, YouTubers and radio journalists experienced more technical challenges than the others did, and their reflections were particularly framed by the experienced challenges. The members of the magazine editor group described that they did not experience any emotions during the task, whereas TikTokers would have preferred to work on a video conference platform instead of VR. On the other hand, all members of the blogger/vlogger group expressed greater feelings of excitement and meaningfulness of their learning experiences than the other groups did. In conclusion, the PSTs' from different groups had both similar and different experiences, which were shaped not only by the VR environment used but also by the interactions between the group members and the experienced meaningfulness of the virtual drama activity.

5 | DISCUSSION AND CONCLUSIONS

This study described PSTs' experiences of presence during a drama activity conducted in collaborative groups in a VR environment as part of an environmental storytelling course in teacher education. Drama methods using fictional time, place and roles are used in teacher education, but there is little research on the potential benefits of using them (Aadland et al., 2017; Seppänen et al., 2019), especially in online learning (Dyment & Downing, 2020) and as a part of social VR. However, some studies have shown that even a relatively short drama activity can lead to positive effects on PSTs' interactional skills (Seppänen et al., 2020). In this study, the drama activity provided a framework for the use of a virtual environment for educational purposes. The environmental storytelling and climate change theme and the task related to climate change mitigation made it visible to the PSTs' the goal-oriented work they were expected to engage in the virtual drama activity, to provide solutions as to how they, in a role of media experts, could influence people's environmental awareness and prospective behaviour.

The CoI model was chosen as the framework for this research, as it has been successfully used in several previous studies on the quality of online teaching (Elander, 2016; Fayyad et al., 2022; Richardson et al., 2015). According to Çetinkaya (2020), the implementation of the CoI model can lead to deep, meaningful and collaborative learning experiences in VR by developing the experience of presence. However, there is a lack of studies exploring the CoI model within collaborative learning in VR or any other immersive environment (Çetinkaya, 2020; McKerlich & Anderson, 2019). More generally, research on the educational effectiveness of VR environments, particularly social VR, is still in its infancy (Alblehai, 2022; McKerlich & Anderson, 2019; Montagud et al., 2022).

The first research question explored how the PSTs' experienced presence when creating and acting as fictional avatar characters in a VR environment. The PSTs' created their avatar characters in two ways—either by creating avatar characters that resembled them or by building imaginary characters that were different from them. Both approaches to avatar role-playing provided a fictional person's perspective on fictional reality and its events. Most of the PSTs' found creating and acting as virtual characters as meaningful and engaging activities. The role player operated in a space of experience and learning between the real world and the imaginary world, which can be referred to as the potential space for learning through a drama activity. Role-playing offered opportunities to explore and discover new perspectives and possibilities, as the participants allowed the story to take them along. The positive experiences in the PSTs' reflections argued for the development and integration of social virtual activities, such as virtual drama, into teacher education. In the future, the social aspects of avatar-based work should be further explored, for example, by examining the role of the social dimension in learner engagement and interaction in VR (Alblehai, 2022).

The second research question explored how the experience of presence emerged in the PSTs' learning experiences during the virtual drama activity. The results showed that the PSTs' experienced elements of presence, as defined by the CoI model (Fayyad et al., 2022; Garrison et al., 1999), during the virtual drama activity. The most common experiences of presence were related to technical managerial presence, such as describing their working as avatar characters in VR. The PSTs' also highlighted issues related to the practicality and ease of use of technology in their experiences, for example, by comparing their VR experiences with other online teaching methods. Some PSTs' thought that VR increased the immersiveness and meaningfulness of the drama activity. On the other hand, some would have preferred to work on video conference platforms instead of VR, as they were more familiar with video conferencing and did not think that VR had a significant effect on the drama activity. These technology-related experiences were reflected in the experiences of presence (Joo et al., 2011). Therefore, it can be concluded that the use of VR should be aligned with the design of VR and the educational content and educational goals to increase learners' experiences of presence (Han et al., 2022).

According to Garrison et al. (1999), the experience of social presence is characterised by open communication, a sense of belonging and emotional expression. The PSTs' reflections suggest that they experienced social presence during the virtual drama activity. They expressed that they worked well together in the VR and that drama-related aspects, such as the frame story, supported social presence in the drama activity. Overall, many PSTs' felt that the interaction worked well and naturally, increasing their sense of social presence and their experience of being closer to one another (Elander, 2016; Garrison, 2009). On the other hand, some PSTs' stated that the non-verbal communication possibilities enabled by the VR software, such as emoji usage and nodding of avatars' heads, did not provide enough real-time interaction, which affected the overall group interaction. These experiences are important for the drama activity, as

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experiences of social presence also through non-verbal behaviour, have been found to influence the success of drama (Robertson & Oberlander, 2002). In the future, the importance of non-verbal communication (Tyrväinen et al., 2021) and movement (Sobocinski et al., 2024) in the VR environment for the effectiveness of online learning and presence should be examined in more detail. For example, Sobocinski with colleagues (Sobocinski et al., 2024) highlighted the potential of implementing sensor data, such as, motion capture and heart rate variability in iVR environments to capture learning processes in more detail.

According to the students' reflections, cognitive presence was experienced during the drama activity. The PSTs' described how the learning process progressed and how working in VR proceeded. Experiences of cognitive presence can be considered important for learning, as prior research has found that it affects the experience of satisfaction in learning (Joo et al., 2011), yet it is evidenced to be the most challenging element of the CoI model to be enhanced in online learning (Garrison & Cleveland-Innes, 2005); this might explain why reflections on cognitive presence in this study were brief. On the other hand, the PSTs' did not report cognitive overload either, which is a common issue in learning in iVR (Makransky et al., 2019). The design of this study, in which a desktop version of VR was used (because of COVID-19 restrictions), might have reduced information processing and supported the students in focusing on the task, as it is more likely that cognitive overload can hinder learning in a head-mounted display version of VR (Makransky et al., 2019).

Prior studies on VR have focused more on the usability of VR applications and the learning outcomes than on the actual learning process (Petersen et al., 2022; Radianti et al., 2020). In this study, learner presence and teaching presence deepened the analysis of the experienced virtual learning process. Experiences of learner presence were manifested in this study through the reflection of the regulation of effort, particularly through time management and task sharing, and (in)competence in executing the drama activity. It was seen that the students in the same group shared similar experiences of learner presence through the collaborative task sharing and the execution of the drama activity. In the PSTs' experiences of teaching presence, they described the importance of a successfully given assignment and the teachers' presence and support during the virtual drama activity, which contributed to a sense of safety. In addition to the feeling of safety, the virtual drama experience evoked other emotions, such as frustration with technical problems and amusement at the drama-based nature of the task. These emotional experiences can be interpreted as reflecting emotional presence (Elander, 2016) and the learning atmosphere (Näykki et al., 2021).

The interpretation of a qualitative study needs to be critically evaluated. The design of this research focuses on PSTs' reflections on the experience of presence in a virtual drama activity. PSTs' understanding of climate change mitigation was not measured before or after the virtual drama activity. In the future, a causal relationship between the learning experience and learning gain in VR, that is, a deeper understanding of climate change mitigation, should be explored further to expand the current understanding of the pedagogical effectiveness of VR in learning. In this study, the PSTs' written reflections on the virtual drama activity were explored using the CoI model as the basis for the analysis. However, whether VR used as a learning environment for the task created the experiences of presence cannot be argued, as other facets of learning might have influenced the experience of presence, such as the PSTs' interpersonal relationships among group members and their previous knowledge and experiences of the drama activity, environmental issues and the use of the VR environment. These topics should be more carefully explored in the future studies.

The small sample size of the data limits the generalisation of results, but as this study was a part of the authentic course setting, the number of participants is satisfactory. Future studies could explore the similar setting with a larger group of participants. Also, the results of the actual behaviours and interactions through observational or video data would provide more understanding of the collaborative learning in VR. In the future, it would be interesting to explore the learning experiences of virtual drama activity on a larger scale with a larger sample of data and by combining video data with questionnaire data. Furthermore, research on social VR is lacking (Alblehai, 2022; Montagud et al., 2022), and there is no consensus on the interaction among empathy, immersion and perspective taking in immersive social VR (Han et al., 2022). The strength of this study can therefore be seen in its exploration of a virtual environment from the perspectives of presence and drama. This study also describes how the experience of presence was affected not only by the use of technology but also by the group interaction and experienced sense of meaningfulness of the task. In addition, this study is one of the first to explore social VR in actual learning situations and in the context of teacher education. In conclusion, more research needs to be built on a solid theoretical foundation, a careful selection of VR design elements and a strong pedagogical standpoint, as well as to describe carefully the design and development process in order to provide more generalizable results on the use of VR in education (Radianti et al., 2020).

The effects of physical distance on relationships and their developments in online environments have been identified as challenges in online teaching, for example, through feelings of isolation and alienation created by the online environment (Bohnstedt et al., 2013; Richardson et al., 2015). Strengthening the experience of presence brings new perspectives to the development of online teaching. Drama activities, as well as VR, can be used to enhance the creative and experiential nature of online learning by supporting learners' sensitivity, immersiveness, responsiveness and intuition (Aadland et al., 2017; Seppänen et al., 2019, Seppänen et al., 2020, Ripka et al., 2020). Both in VR and in drama, the focus is on creating immersion and presence, the experience of *being* or *acting* in a physically different place (Schwind et al., 2019). Therefore, pairing virtual drama and drama can be considered one way to support learners' meaningful online learning experiences.

AUTHOR CONTRIBUTIONS

Piia Näykki: Funding acquisition; conceptualization; writing – original draft; writing – review and editing; methodology; project administration;

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resources; supervision; validation; investigation. **Saara Pyykkönen:** Formal analysis; writing – original draft; writing – review and editing; visualization; conceptualization; methodology; investigation; validation. **Jenni Latva-aho:** Formal analysis; writing – review and editing; writing – original draft; investigation; conceptualization; validation; methodology. **Tuula Nousiainen:** Conceptualization; methodology; writing – original draft; writing – review and editing; software; investigation. **Emilia Ahlström:** Methodology; software; writing – original draft; conceptualization; writing – review and editing; investigation. **Tapio Toivanen:** Conceptualization; methodology; writing – original draft; writing – review and editing; investigation.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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