The Place Metaphor in 3D CVEs: A Pedagogical Case Study of the Virtual Stage

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Abstract—**This paper outlines a pedagogically-oriented case study of the use of a 3D collaborative virtual environment (3D CVE) to break down barriers between partners from different cultural backgrounds whilst performing collaborative activities on a 3D 'virtual stage'. The 3D collaborative laboratory (3DCollab) described in this paper served as a learning exchange platform to address the need for ICT students to practice collaborating remotely. It facilitated cultural exchange in a risk-free, fun, and informative environment where learning was constructed and played out on virtual stages in a 3D CVE, in the performance of a dramatized version of Plato's "Allegory of the Cave". Based on the students' feedback, we discuss how the design features of the virtual stage place metaphor provide a support for educational role-play and socialization.**

Index Terms—**virtual stage, 3D collaborative virtual environments, collaborative learning**

I. INTRODUCTION

The need for cross-cultural understandings in group work and learning is well documented [see 1, 2]. Cross-cultural encounters are necessary to make students more culturally aware when they enter their chosen ICT professions. Remote collaboration addresses this need. This paper outlines a pedagogically-oriented case study of the use of a 3D collaborative virtual environment (3D CVE) to break down barriers between partners from different cultural backgrounds whilst performing collaborative activities on a 3D 'virtual stage'. A number of different remote collaboration systems have been used to date [see 3, 4, 5]. They range from simple email text and file transfer to chat and sophisticated video conferencing tools. The set of tools described here incorporate many of these existing technologies in combination with a 3D CVE, featuring synchronous and asynchronous information exchange. It is part of a system developed over a number of years of previous use of remote collaboration 3D CVEs by the authors, see e.g. [6]. The 3D CVE components described here were chosen for a number of reasons. Such technology has been used previously in collaborative design situations , see e.g. [5], and it also capitalizes on a pre-existing common interest by students in the international multi-user 3D computer game culture. Finally, the ability of the 3D CVE to support informal socialization is also acknowledged in previous research (see e.g. [7, 8]).

The set of tools used in this project facilitated cultural exchange in a risk-free, fun, and informative environment where learning was constructed and played out on 'virtual stages' in a 3D CVE, in the performance of a dramatized version of Plato's "Allegory of the Cave". The benefits of this experience were that students could work in teams collaborating across time zones on a single project complimenting each other's skills and learning about new ways to work and learn in a global environment. This fostered deeper understandings of alternate meanings to everyday occurrences and work practices and design computing assumptions. The 3D CVE component and the 'virtual stage' metaphor allowed for anonymity and 'role-play' and hence less inhibited cooperation and expression in an online collaborative environment. The project involved students across three cooperating institutions: The University of Queensland (Australia); the National Yunlin University of Science and Technology (Taiwan); and, the Norwegian University of Science and Technology (Norway). It builds on previous exercises conducted by the authors [6].

In this paper, we describe the experiences from the project, focusing specifically on the virtual stage place metaphor and its features that support learning and collaboration. The discussion is primarily based on the students' feedback. To conduct an analysis of the virtual stage metaphor, we use a characterization framework for educational 3D CVEs developed earlier by the first author [9]. This framework is based on the analysis of a number of existing 3D educational virtual worlds, especially within the Active Worlds (AW) Educational Universe (www.activeworlds.com/edu/). The metaphors behind the design of virtual places are quite diverse – from replication of real universities to other planets. The worlds are also used for different purposes, from demonstrations of art and scientific concepts to meetings between physically remote students. In this framework place metaphors can be characterized in terms of appearance (resembling real campuses and buildings or looking completely 'abstract'), structure (mutual relations between different parts of the environment, rooms within buildings) and roles (meeting place, information space, virtual stage, demonstrations and exhibitions, workplace). The role of a virtual place can be determined by several factors. For example, they can be places intended for playing certain roles (e.g. a meeting place). But they do not always do so due to inadequate design or various social factors. For example, a meeting place initiated by end users (students) directly, is more often likely to be actively used than an 'official' meeting place – one 'enforced' by the teacher. The role of place is also defined by the design, available facilities and artifacts contained there, such as announcements and pictures. In the

following paragraphs we concentrate on the role most relevant for the project described: the virtual stage metaphor.

The metaphor of the 'virtual stage' has already been adopted in a number of 3D educational environments (see the educational worlds in AW). Though this metaphor seldom exists in a 'pure' form, its elements are present in practically all 3D CVEs where users can 'play' a certain role. They express their identity in different ways to those expressed in a physical-world reality and are able to 'disguise' their 'true' identities behind their choice of avatar and 'nickname'. The virtual stage can be used for a number of educational purposes. In addition to the 'unintentional' role-play as described above, virtual stages can be used for role-play as part of a history or drama course or for teaching stage design. Virtual stages can be prepared by teachers for certain classroom activities, generated by agents or created by the students, such as a part of a school project. The corresponding facilities and design features to support these activities include the appearance of the place, creating an appropriate atmosphere for role-play (for example, a historical scene), flexible and modifiable virtual stages, and a repository of props and stages as well as interactive elements needed in a performance.

The design features of the virtual stage place metaphor used as a case study in this paper are framed by the educational context. The associated pedagogical, cross-cultural and collaborative aspects are studied on the basis of the students' feedback after a dramatized performance of Plato's "Allegory of the Cave". The rest of the paper is therefore structured as follows. In the next section we describe the case study settings and the resulting performance in the virtual world. Section 3 discusses the design features and facilities of the virtual stages used during the performance according to the characterization framework outlined above. Section 4 presents some suggestions for improvements to the design of virtual stages for educational use, based on the students' feedback. Suggestions for the improvement of the characterization framework are also outlined. Section 5 discusses the suitability of 3D CVEs for educational role-play and theatrical performance, while Section 6 concludes the paper, with directions for future work.

II. THE CASE STUDY

The suit of tools chosen for the 3D collaborative laboratory (3DCollab) comprise three primary groupware applications: Yahoo messenger (video and chat), Active Worlds (3D CVE and chat), and email (text and file transfer). The interrelationships between these tools were, at times, direct. Students could converse with each other using video, voice, and chat to get instructions on how and what to build in the AW 3D CVE. At times, the students were instructed remotely by the teachers directly within the AW 3D CVE moving from the Yahoo video and chat screen to the 3D CVE environment and back. This approach proved to be very effective.

Students from three institutions cooperated on this project: the University of Queensland (UQ, Brisbane, Australia), 67 first year Bachelor Multi-Media; the National Yunlin University of Science and Technology (NYUST, Douliou, Taiwan), 8 Master of Computational Design; and, the Norwegian University of Science and Technology (NTNU, Trondheim, Norway), 61 fourth year

Computer Science students. They collaborated on the script writing, construction, and performance of Plato's "Allegory of the Cave". Plato's parable was chosen because, in philosophic terms, he describes the process of getting educated in the affairs of the world. As such it was deemed an appropriate vehicle for ICT students to learn about the value of collaboration as an educationally transformative ideal. It also served as a motive for engaging in the technology and as a theoretical framework for investigating notions of cross-cultural understandings in information technology. Furthermore, as it details a physical environment, it also provides a scenario suitable for reconstruction in a 3D CVE. Following the performance, the students delivered reflective group essays. The results presented in this paper are mostly based on the essays delivered by the Norwegian students, who acted as the audience. In these essays they discussed different aspects of virtual stages for educational purposes, with the background in the performance of Plato's "Allegory of the Cave". This data source is also supplemented by chat logs, analysis of the created virtual stages, and direct observations of the participants during the play.

All teams had access to the same material: Jowett's [10] translation of Plato's "Allegory of the Cave"; the Active Worlds 3D virtual world environment and tutorials for building in it; Yahoo messenger; and, various email applications. Plato's parable was divided into 5 acts. Each section took about one hour to complete. There were up to 40 participants online at the same time. Between each act participants regrouped at a predetermined place in the 3D CVE where they were met by a guide who took them to the next scene. Participants could interact with the actors and ask questions as the play proceeded.

In Act 1 we were introduced to the Plato parable and a cave setting for his philosophical discussion. The audience could read a scripted dialogue in the chat text field. Debates ensued between the actors (in Australia), the investigators (in Taiwan), and the interlocutors (in Norway). The first act finished with a debate between all these groups on the relative merits of freedom, rights, and responsibilities. This established a performance protocol that was followed in the subsequent acts. For example, the audience was in some cases asked to choose a 'bird' avatar to be visibly separated from the actors and to avoid blocking view for others (Fig. 1).

The team for Act 2 chose to thoroughly contemporize Plato's parable. This act starts out in a suburban house with two occupants discussing the responsibilities of 'getting educated'. The conversation continued with various actors coming and going adding to the conversation (Fig. 2). The audience was encouraged by a guide to keep up with the main actors and to follow the conversation as they wondered the streets. Participants were invited to debate their views on the relative merits of education.

Figure 1. In Act 1 the participants established a common performance protocol.

Figure 2. In Act 2 the actors are walking around the streets and the audience follows them while at the same time carrying on a conversation.

In Act 3 we started out in a garden setting. In this act the script addresses Socrates' debate with Glaucon on the importance of having knowledge of astronomy. We were instructed to look up at some stars in the sky. We noticed they look flattened, as if painted onto the sky. Moving up into the space of these objects they assumed a three-dimensionality not obvious from the ground. This triggered a discussion by most of the participants present on perceptions and how much of what we perceive is merely an illusion. Some participants drew direct parallels with the illusory life portrayed by the shadows on the wall in their version of Plato's cave (Fig. 2).

In Act 4, participants were encouraged to stand around a fire inside the cave (Fig. 3). The circle was symbolic of an ancient classroom setting. In this act all participants were encouraged to engage in a debate on notions of the 'self'. This particular act highlighted the potential redundancy of the 3D CVE. Once participants had found their way into the cave and marveled at its elaborate construction and texturing, most attention was focused on the textual debate in the chat text field.

In the final Act 5 we began in a columned citadel overlooking an eclectic collection of modern city buildings, streets, and a park. This act completed Plato's parable by addressing the issue of wisdom. This was the last act and many of the participants had been actively online for more than five hours. The group leader sensed the waning interest and led everyone to an elaborate skate park housed within a virtual warehouse. With loops and

ramps, it was quickly taken over by playful activity. It was also a fitting end to the final act's overall theme: 'does wisdom bring happiness?' Everyone agreed that much enlightenment comes from playful activities.

Figure 3. Plato's "Allegory of the Cave" reconstructed as a stage set in the 3D CVE in Act 3.

Figure 4. Gathering around the fireplace in Act 4 the students discuss deep philosophical notions creating immersion in the unfolding narrative of the allegory.

Figure 5. Combining discussion and playful activities in Act 5.

III. Analyzing Design Features and Facilities of an Educational Virtual Stage

The different design features and facilities of the virtual stages used in this project, proved suitable in supporting an educational virtual performance. This is gleaned

predominantly from the students' feedback. Direct citations from the students' essays are given in quotes.

In terms of the characterization framework outlined in the Introduction, there was both intentional and unintentional role-play on the 'virtual stage'. Intentional role-play followed the major intention of the exercise – an online performance of Plato's "Allegory of the Cave". Unintentional role-play included those instances before and after the formal play when participants simply 'played around' and socialized on the virtual stage. In this sense, the virtual stage afforded a platform where participants could 'practice' their gestures, moves, and texting in a risk-free environment.

One of the central design features of a virtual stage as presented in the framework is the appearance and settings of a stage creating a proper surrounding and atmosphere for the performance. The students chose widely different appearances for discussing the philosophical issues in the "Allegory of the Cave", as discussed in the previous section. According to the evaluation by the audience, the majority preferred a more 'authentic' appearance as in Act 1. The setting featuring the shadows on the wall (Fig. 1) and a cave was "a part of the discussion topic" and thus "made it easier for us… to get into the topic", contributing to a greater sense of immersion and being "in the right mood". The avatar costumes in the ancient Greek style contributed further to creating the proper impression. Generally this stage design "effectively visualized the classical interpretation of the allegory with the sense of being in a cave, and afterwards moving out in to the open, free world".

The appearance of the stage in Act 2 (Fig. 2) reflected American suburbia. It created controversy concerning its suitability for the topic of the play. It provoked remarks such as "a city landscape is not suitable for the Cave allegory". This setting was also criticized for being "too realistic", and lacking a "proper stage". However, students also claimed that this setting created a heightened sense of "immersion" ("like cut out from a movie!") in the environment. It "contributed to the illusion of feeling like really being in some special place in the (virtual) world". This perception was further enhanced by "moving around a lot, making it feel similar to the hectic pace of modern everyday life", "making conversations in the setting [more] familiar to users". According to the students, this familiarity contributed to a more "home cozy" feel, making it easier to socialize. The overall structure, with several small rooms and homes, was identified as facilitating smaller, private meetings. This approach had both advantages and disadvantages in terms of mediating a message compared to the more traditional solution in Act 1. As the former "mediated the message more clearly", the latter managed to "create more debate….connecting to a context better known to the audience", thus demonstrating the appropriateness of Plato's ideas to modern society.

According to one of the students' essays, the setting of the stage in Act 3 took "the most advantage of the 3D aspect", as it "utilized 3-dimensional star objects to show depth as a metaphor for the actual allegory". Showing the stars from different angles, and thus the transformations they went through, provided a feeling of a "theatrical performance". This appeared to be a more appropriate usage of a 3D CVE. This was in opposition to the performance in Act 4, which mostly involved discussion,

and "could have as easily been done using a non-3D workspace such as MSN".

The stage in the last Act was a generic and multipurpose one. It included places for acting and discussions but also a "dancing floor for those who want to socialize, and a skating park for those wanting to play" (Fig. 5). The intention behind this design was to allow participants the flexibility to "glide over" from one activity to the next. As this setting was successful in providing a more relaxing atmosphere, especially keeping in mind that the performance had lasted for 5 hours and it was late evening in Australia, it was less successful on facilitating a focused discussion. As noted in one of the essays, "…discussion did not function very well, what else to expect if one puts a pile of anonymous strangers together in a 3D world with many funny possibilities (disturbing factors)?"

An issue that was relevant for all the settings is related to the extent that the stage designs facilitated movement around the scene by both audience and actors alike. In most cases, freedom of movement was considered a negative by the audience and a sign of poor stage design. Many of the stages were described as "too small for the audience or too wide spread without proper guidance". For example, "to be required to walk through the stage was another thing that made it more difficult to follow the plot, because other members of the audience could block the view (especially in the small stage of group A in Act 1), or one could get lost (the teleporting or 'jumping' from one scene to the next tactic used by group B in Act 2)". A majority of students' comments expressed a preference for a more static setting where the audience had a fixed and recognizable place to be. The possibility to "walk around and talk to people" was, however, in some cases evaluated as "informal but useful to strengthen social ties…easy to make a meeting."

Apart from the appearance of the stages, the students discussed the other facilities provided and their role in the play. In one of the essays it was noted that: "the existing facilities and design features are sufficient for this purpose. The main actors in the role-play are the avatars; additional features which let the environment play an active role at the stage might be confusing and misleading from the goal of the stage". As such, much focus was put on using appropriate avatars and what the corresponding expressions meant for the performance. While using 'Greek' avatars for the actors was considered appropriate and contributing to the 'mood', it was also noted that as many used the same avatar, the overall feel was too "uniform". While people changing avatars was experienced as "confusing" by some, it was in some cases relevant and important for the overall "feel". For example, some changed into a 'bird' avatar when flying up to see the starts in Act 3. The expressive possibilities for users were in most cases identified as insufficient and inappropriate for the task. For example, it was difficult to identify who was typing which line in the chat field at any one time. According to one student, "saying lines through text only makes the 'empathy' in the role difficult", in this way reducing the overall expressiveness. The standard AWs gesture set included features such as 'karate' and 'Macarena'. These were identified as of little relevance for this particular performance. It was noted that little emphasis was placed on props, possibly because of their predominantly static function. On a number of occasions,

it was suggested that both avatars and props should be used more actively for separating the audience from the actors, as it was when some chose to become 'bird' avatars in Act 1 (Fig. 1). In addition to the existing facilities and props it was suggested that if "the topics of the stages were other than philosophical, a use of a whiteboard or something applied to the scene would have been useful" for communicating more information.

When we compare the provision of facilities to the associated learning goals within the characterization framework as described in the introduction, we find a direct correlation between the deliberate choice by the teacher to not provide any stage templates and similar facilities and a varied and creative stage design outcome leading to deep engagement by the students in the exercise. Facilities were not provided by the teacher at the beginning in order not to limit the students' freedom of expression in designing the scenes for the play. This resulted, as planned, in the students taking control of their own design/workplace.

IV. IMPROVEMENTS TO THE VIRTUAL STAGE DESIGN AND THE CHARACTERIZATION FRAMEWORK

Based on the analysis of the students' feedback, we can summarize the possible improvements to the design of a 3D CVE acting as a virtual stage in an educational context:

- A recurring suggestion was that there should be better and clearer separation between the actual stage and the place for the audience, as well as the audience and the actors (as was done in the case of the audience taking a bird avatar in Act 1 for better overview and to avoid confusion). This includes also the demand for separation of the different flows of conversations/chat, such as the lines said by the actors vs. the discussion by the audience/different groups within the audience.
- Enhancing and individually tailoring atmosphere with music and lightening will also enhance the theatrical mood, giving the user an individualized experience. For example, "one could perhaps start playing music to a given user on the basis of some sort of trigger mechanism (for instance upon entering the cave)". This is a natural part of the performance in the virtual environments but not so easily achieved in a real theatre.
- It is recommended to add or use more extensively video and audio components, "to actually see the 'real' face of the people talking, for instance by presenting a real image", though "the side effect of this would be of course loss of anonymity".
- A wider repertoire of stages and props is required, including the ones reflecting the cultural diversity of the participants, as well as those promoting a closer resemblance to the real theatre, such as "chairs for the audience". A wider choice of avatars is also necessary.
- There is a need for better flexibility and adaptability of the virtual stages, such as stages changing size automatically depending on the amount of actors on it at any given time. The same applies to more flexibility in terms of manipulating the objects and making

gestures, such as the possibility for lifting and pointing at objects.
- Introducing a greater degree of dynamism in the performance is recommended to make it more realistic and engaging, including moving the props and the avatars to a greater degree.

In addition to the revision of the design, the analysis of the virtual performance and the students' feedback suggests some revisions and improvements to the characterization framework as elaborated below:

- Often the virtual stage facilities mentioned in the essays were not directly related to a place but to communication/user dimensions such as gestures and avatars. For example, it was mentioned that an avatar's 'look' was also important for 'mood setting' and that communication ability is another aspect of virtual stage. Often the role played by the place was confused with the roles of the users inhabiting the stage. This suggests improving avatar and communication possibilities provided by the environment, among the other facilities and design elements for the virtual stage. In this context, the avatars could also be considered 'props', indicating presence or absence.
- The characterization framework for the virtual stage should also include a passive or active dimension indicating interactivity opportunities with the props. For example, props that only have a static or decorative role vs. props that can be manipulated (such as teleports). This also refers to what extent the overall chosen stage design supports a passive or active role for the audience in the performance.
- The notion of 'flexibility' of the virtual stage in the characterization framework should be elaborated further. This includes:
  - The possibility of flexible adjustment of the stage to accommodate the different sizes of the audience and different play situations.
  - Flexibility as the possibility for free movement of the audience/actors and therefore viewing of the stage from different angles.
  - As the different stages of the process require different degrees of flexibility, the requirements for such flexibility should be specified for each part of the performance and stage design. As one student group remarked, "since the stages have been set up by the learners before starting the play, flexible scene modification is not in the intention of this virtual stage. Oppositely, the intention for the learners is to present their stage at the final performance."
  - One of the essays provided an unexpected interpretation of the 'virtual stage flexibility' concept, implying a 'loose border' between the stage and the place for the audience.
- Students mentioned some aspects/roles of virtual stages which are not included in the characterization framework, such as "virtual stages as gatherings". One of the essays stressed the role of a virtual stage in providing "the opportunity to meet students in the same situation, from other corners of the world".

V. SUITABILITY OF 3D CVEs FOR ROLEPLAYING AND THEATRICAL PERFORMANCES IN EDUCATIONAL SETTINGS

There were divided opinions among the students concerning the suitability of 3D CVEs for role-play and theatrical performances in educational settings. The first option was in most cases preferred, with the analogy to the wide usage of role-play in commercial 3D game worlds, especially games such as World of Warcraft. It was noted that it was "easier to socialize while being a different person in a virtual world, as one does not have to fear that one's actions will influence one's real life". What was especially relevant in the cross-cultural context of this case study was that, as one of the essays stated, "in a 3D virtual world, creed, skin color, or look don't count much, and allow individuals to be credited for their true value and not for the clothes or the appearance they have. In this way, people who carry major physical handicaps appear as capable and as beautiful as anyone else". In this way, role-play in 3D CVEs can promote an unbiased cultural experience.

Concerning the use of 3D CVEs as a 'virtual stage' in an educational context, we can mention a number of advantages, based on the students' feedback. These include:

- An informal and socially uninhibited atmosphere, facilitating a freer interactive mode between actors and the audience, as the "audience looses inhibitions" and there is "no distance between the actors and the audience making it psychologically easier for the actor". However, such a mode implies a trade off between "constructive feedback vs. unwanted interruption".

- An easy, cheap and flexible set-up for a performance, including "potentially greater possibility to use special effects than in a real theatre", and an efficient, collaborative, acting process over a distance compared to chat and audio solutions. As one of the groups puts it, "socially one gets a better feeling of closeness when a person's virtual projection stands by…could easily see where the actors stand", thus supporting the awareness of one's collaborators.

- 3D virtual places "allow the potential for full recording of any activity, interaction, exchange. As a consequence, such recordings enable the ability to re-experience or re-use past events for many different purposes". In this way, one could create a repository of virtual stages and performances that keep traces and tracks of the participating people and their activities for later reuse and reference, allowing knowledge sharing over time.

- Using avatars as representations for the actors can have a number of advantages. For example, as one group puts it, "avatars can be as elegant and good looking as you design them. Your avatar is always in great shape, plus it can be dressed, customized and characterized in an increasing number of ways".

At the same time, using a 3D CVE for a virtual theatre has a number of limitations as summarized in the following:

- The major limitation is connected to the avatars and their technological affordances in AW, such as support for mimicking and movement, leading to poor means of expression, "misinterpreting the message the actors is trying to convey" and difficulties with interacting with the audience, such as "watching others laugh and cry".

- Current technical limitations, especially in connection to AW technology, such as poor support for lighting and sound and limited viewing angles, make it difficult to get an overview of the whole scene or stage.

- Finally, as was repeatedly mentioned in the essays, 3D CVEs, at least with the current state of technology, fail to provide a proper 'theatrical atmosphere'. As one group expressed, "the virtual play lacked the anticipation that is connected to a visit of a [real] theatre: dressing up at home, moving to the theatre, entering the building, seeing the other members of the audience dressed up in a nice environment, going to the seat, waiting for the lights to go off and the watching the play". The lack of this atmosphere was one of the reasons for the 'non-theatrical' behavior of the audience freely moving around and interrupting the play.

To summarize the discussion, the suitability of a 3D CVE as a virtual stage has to be evaluated in every concrete case. In certain situations, other tools should be considered. This can be explained by comparing the use of graphical means in the third and fourth acts, as discussed in Section 3. Therefore, the use of 3D is only justified if one takes "a more visual approach to the role-play, to use the possibilities of collaborative shaping of the stages, and also the possibilities of special stage effects to a larger extent". It was also mentioned that, "3D virtual worlds have more possibilities than ordinary theatre and could be really useful in this direction, especially when connecting people over large distances", but only if the representation of avatars is improved and provides a more realistic impression.

VI. CONCLUSIONS AND FUTURE WORK

The particular case study reported here addressed the notion of an educational theatrical performance and course-related role-play in a 3D CVE. A 3D CVE was chosen because it was deemed more suitable for representing role-play and theatrical performances than 2D representation alone. It provided the opportunity to produce a play without the cumbersome organization of a traditional setting and its physical props, involving geographically dispersed users. As opposed to alternative tools, such as 2D chats and forums, the 3D CVE allowed an active social involvement and the visualization and concretization of performed activities to occur in a 'virtual stage' setting central to the pedagogical aims of the exercise. As summarized by one of the groups, "the use of the technology in this manner was quite inspiring".

This case study allowed us to explore how the different features of virtual stage place metaphors can support educational role-play and socialization in a cross-cultural context, from the students' perspective. We have also discussed the possible improvements to the design of educational virtual stages for future use. Recent trends show that role-play in 3D CVEs is increasingly popular – something many of the participants involved in this exercise were already familiar with. One of example is the

expanding community within environments such as Second Life (www.secondlife.com) and Active Worlds. Another is the growing popularity of online games. Therefore, we believe that the results presented in this paper can, to a significant degree, be generalized and used to facilitate and improve educational role-play in other environments and situations.

Future work includes further exploration of the different aspects of educational role-play in 3D CVEs, especially in cross-cultural contexts, and their associated social and pedagogical aspects. Focus should also be on how 3D CVEs could be supplemented by other collaborative tools to provide a variety of role-play modes that can be flexibly adapted and tailored to particular educational contexts.

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