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Fostering Academic Peer Exchange in Distance Learning

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Zusammenfassung

Virtuelle Welten (VWs) sind in der Hochschulbildung seit mehr als einem Jahrzehnt präsent, haben aber in den letzten Jahren infolge von COVID-19 und dem Metaverse-Hype wieder stark an Bedeutung gewonnen. Dennoch ist die Förderung des Austauschs unter Studierenden und der sozialen Interaktion in VWs in der Hochschulbildung noch nicht ausreichend erforscht, zudem gibt es kein entsprechendes Designwissen. Daher leiten wir Designprinzipien systematisch ab, indem wir Designanforderungen aus wissenschaftlichen Beiträgen zu VWs unter Einbeziehung der Dozierendenperspektive sammeln und in Meta-Anforderungen überführen, die wir dann zu Gestaltungsprinzipien zusammenführen. Diese übersetzen wir in konkrete Designfeatures, die wir in einer echten Lehreinheit in der virtuellen Welt mit Masterstudierenden umsetzen. Die Evaluation erfolgt über Fokusgruppeninterviews nach praktischer Anwendung unseres Designwissens und zeigt den theoretischen und praktischen Mehrwert unseres Beitrags zur Förderung der sozialen Interaktion in Fernlernsettings aus Sicht der Lehrenden und Lernenden.

Stichwörter: e-learning; Virtuelle Welt; Fishbowl Methode: Soziale Interaktion: Design Science

Abstract

Virtual worlds (VWs) have been present in higher education for more than a decade but have regained substantial traction in recent years as a result of COVID-19 and the metaverse hype. Nonetheless, facilitating peer exchange and social interaction in VWs in higher education has not been sufficiently researched nor is specific design knowledge available. Therefore, we derive design principles systematically by collecting design requirements based on scientific contributions on VWs, encompassing the instructor viewpoint, before turning them into meta-requirements that we then merge to design principles. We translate these into tangible design features instantiated in a genuine VW teaching unit with master students. The evaluation in focus group interviews after the application of our design knowledge demonstrates the theoretical and practical value of our contribution to strengthening social interaction in distance learning settings from teachers' and learners' perspectives.

Keywords: e-learning; Virtual world; fishbowl; social interaction; design science

Introduction

Education in general and design science education, in particular, has long been deemed to be a face-to-face proposition, hence online learning has been undervalued as a potential teaching alternative (Güler, 2022). Nonetheless, the recent pandemic of COVID-19 compelled educative institutions to quickly transition to online teaching and learning (Kinnett & Steinbach, 2021) and there is a widespread tendency of sticking (at least partially) to online learning (Luebcke et al., 2022). The need for students to develop online collaboration and social interaction competencies (Fleischmann, 2014, 2021) despite not learning together in a physical environment, is a current major challenge, but important for students' retention (Isleib et al., 2019; Tinto, 1975).

Due to the high level of social presence virtual worlds (VWs) (Edirisingha et al., 2009) seem a perfect solution for covering both cognitive and social aspects of learning (Stahl, 2004) and they have proved their superiority over traditional videoconferencing solutions e.g., in terms of social interaction (Rinn, Markgraf, et al., 2023). VWs are digital environments resembling physical settings and empower students to interact with peers or objects with their visual representations called avatars (Bainbridge, 2007; K. M. Lee, 2004; Pannicke & Zarnekow, 2009). Spatial presence leads to immersion, the feeling of being in the environment (Mantovani & Castelnuovo, 2003). Avatar and environment identification can cause a flow experience (Csikszentmihalyi, 1990; Lecon & Herkersdorf, 2014). The VW *Second Life* triggered a hype that also reached higher education in 2009 and 2010 but soon lost research interest (Rinn, Khosrawi-Rad, et al., 2023). With new technologies emerging (e.g., eye tracking or full-body motion sensing), building blocks toward the metaverse, a new general trend is visible. Through the hype around the metaverse, a concept or vision that connects interoperable virtual worlds supplemented by new technologies like head-mounted displays or haptic devices (A. Davis et al., 2009; Dionisio et al., 2013; Dwivedi et al., 2022), VWs regain research importance. Against the background of the development of a *Digital Networked Infrastructure for Education* in Germany, from whose funding line this contribution originates, it is not only the distribution and low-hurdle availability of the virtual world as a platform that is crucial for a wide-range application. For any digital learning tool, not the software itself, but the pedagogical concept is decisive for its success in terms of learning outcome and motivation (Kerres & Preußler, 2012).

Although online learning research already covers a wide range of topics (Güler, 2022), there is a lack of design knowledge on how to design VWs for educational purposes in general and for social interaction and peer exchange, in particular (Rinn, Khosrawi-Rad, et al., 2023). Therefore, we intend to contribute to research and practice by answering the following research question (RQ):

RQ: *How to design an online session for academic peer exchange and social interaction in higher education?*

While elaborating on that RQ, we designed a course based on a broad foundation of theories plus our teaching experience. We teach a cohort of about 20 master students in a Design Science Research (DSR) course every semester but had to shift from an original physical setting to an online course due to COVID-19. We redesigned this course to instantiate and evaluate the design principles we had derived rigorously.

After explaining our methodology along the DSR paradigm, we provide four design principles resulting from the theoretical knowledge base and the teachers' requirements identified. We also present an expository instantiation in the form of a fishbowl session in a VW and evaluate our design contribution with semi-structured interviews before discussing its implications.

Methodology

To solve our immediate problem and in addition, address a whole problem class as identified in the introduction, we followed the approach of Design Science Research (DSR) as the overarching paradigm, as it is an established framework in the information systems context to find rigorous solutions for relevant problems (Hevner, 2007). The structure of the paper follows the design cycle pattern proposed by Vaishnavi & Kuechler (2007), consisting of the steps of *Awareness of the Problem, Suggestion, Development, Evaluation, and Conclusion*. While the awareness of the problem is covered in the introduction, the other steps are dealt with in the chapters of the step name. For a suggestion, we referenced the theoretical foundation from a systematic literature review to build upon common theories of former VW developments and extend them systematically with theories for our specific context (Rinn, Khosrawi-Rad, et al., 2023). This systematic literature review coded and analyzed 89 articles from high-quality outlets for virtual world applications in higher and further education. Besides other results, theories for prototype development were identified. We screened these theories and incorporated context-relevant ones as theoretical foundations. Needs elicited from our teaching experience in VWs are aggregated into user stories as proposed by Cohn (2004) to then merge these with the theoretical foundations leading to meta-requirements. We transformed the latter into generalized and more abstract design principles following Gregor et al. (2020). Our development and evaluation in December 2022 were guided by the *Technological Pedagogical Content Knowledge* framework (H.-Y. Lee et al., 2022; Mishra & Koehler, 2006) and design features we had derived from the four design principles. In terms of their evaluation, we referred to the "human risk and effectiveness strategy" (Venable et al., 2016) setting a naturalistic focus to gain a mixture of formative and summative feedback. The evaluation itself was twofold, interviews are complemented by observations. After the session, we conducted semi-structured interviews with three focus groups. These focus groups were identical to the groups that worked together on a common research project. The interviews covered four key areas, arising from the four design principles: (1) perception of the VW and social presence, (2) peer exchange and social interaction effectiveness of our pedagogical approach, (3) usability from a user's perspective, and (4) technology training. The superordinate question is our RQ on how to design a setting for students' exchange and social interaction. We transcribed the interviews manually based on the automatic transcription by Microsoft Teams and then coded them with MAXQDA, using a coding guide as proposed by Mayring (2015). The code system was deducted from the four design principles and the corresponding interview guideline and resulted in four main categories. These were supplemented exploratively with subcategories during the coding process and were reflected in the coding guide regularly. A reviewer process was established to increase objectivity.

Results

Suggestion

First, we describe the selection results for the theoretical foundation, subsequently, we describe relevant aspects of the selected theoretical foundations to make sure meta-requirement derivation is comprehensive. By reanalyzing the results of a priorly conducted systematic literature review (Rinn, Khosrawi-Rad, et al., 2023), we systematically reduced the kernel theories found there to an initial set of five relevant theoretical foundations (TFs) for our design. The inclusion criteria for the theories chosen were supporting literature for communication technology fitting online settings for collaborative learning and peer exchange following the *Technological Pedagogical Content Knowledge* framework (Mishra & Koehler, 2006). The resulting theoretical foundations are Computer-Supported Collaborative Learning (Stahl, 2004) (TF1), Media Richness Theory (Daft & Lengel, 1986) (TF2), Technology Acceptance Model (F. D. Davis, 1989) (TF3), Social Presence Theory (Short et al., 1976) (TF4), and Constructivist Learning Theory (Jonassen, 1994) (TF5). The importance of social identity is supported by the fact, that over 40% of the analyzed articles within the systematic literature review contained the word “identity”. Since our application context is group exchange, we added Social Identity Theory (TF6) based on Tajfel and colleagues (Tajfel, 1970; Tajfel & Turner, 1979), which is regarded as a key pillar for online learning communities (Gu et al., 2022). Furthermore, we added the *Interactive Constructive Active Passive* (ICAP) framework (TF7) (Chi & Wylie, 2014) because of its importance for educational design (e.g., Wambsganss et al., 2020). The task-technology fit (Goodhue & Thompson, 1995) (TF8) ensures the match of the two aspects, namely communication technology and course target. This choice is backed by literature (Levy & Ellis, 2006).

In *Constructivism*, knowledge is not transmitted but constructed, and therefore the learner plays an active role in learning (Jonassen, 1994). The *ICAP Framework* is also based on active learning but adds a more detailed view and practical approach in comparison to Constructivism. Within the ICAP framework interactive learning, e.g., through debating, is the highest level of learning, although learning is switching between different modes (Chi & Wylie, 2014). In the understanding of *Computer-Supported Collaborative Learning*, the teacher acts as a facilitator to foster communication and complex interaction so that students can build collaborative knowledge that goes beyond the knowledge of all group individuals (Stahl, 2004). *Media Richness Theory* says that different media have differing levels of information transmission in a certain time frame (Daft & Lengel, 1986). Transferred to online media, this means that the communication tool should support as many (social) cues as possible and enable immediate feedback (Dennis & Kinney, 1998). The *Technology Acceptance Model* explains influencing factors of actual system use which are mainly perceived usefulness and perceived ease of use. Perceived ease of use is influenced besides others by usability and previous training (F. D. Davis, 1989). The *Task-Technology Fit* model explains the impact of information systems on individual performance when carrying out a task. Ideally, the functionality matches the task requirements. Technology does not just involve hardware and software but also user support and training (Goodhue & Thompson, 1995). *Social Presence* is described as a "feeling of being together" when interacting and is often cited as a rationale for the use of virtual worlds in education (e.g., Edirisingha et al., 2009; Zhang, 2008). *Social Identity Theory* assumes that people use social norms to identify themselves to belong to a certain group (Tajfel, 1970). So social norms must be expressible in the online setting.

The resulting eight theoretical foundations were complemented by user stories (Cohn, 2004), which we derived from our online teaching experience and institutional prerequisites. Since service-related aspects and multi-perspectivity (including teachers and staff members) were only found in one article of the systematic literature review, namely Pakanen et al. (2020), we include this in our research since it is essential in a naturalistic evaluation strategy (Venable et al., 2016). The user stories (US) are formulated as follows:

No.	**Teacher User Stories**
US1	As a teacher in higher education, I need an online communication tool that is adaptable to various pedagogical approaches without the need for programming skills or high preparation efforts to make sure teaching is effective and efficient.
US2	As a teacher in higher education, I need an online communication tool that has low hardware requirements to make sure no student is excluded from participation.
US3	As a teacher in higher education, I need an online communication tool I feel comfortable with to be able to concentrate on pedagogy and content when teaching.
US4	As a teacher in higher education, I would like learners to be familiar with the communication tool to be able to concentrate on pedagogy and content when teaching.
US5	As a teacher in higher education, I want my courses to be inclusive for all students, independent from e.g., personality and abilities, to make sure no student is excluded from active participation.
US6	As a teacher in higher education, I would like to motivate and engage my students e.g., via adding gamification, to increase the learning outcome.

Table 1. Teacher User Stories

The theoretical foundations and teacher user stories lead to meta-requirements (MR) resulting in four design principles (DP) that we formulated following Gregor et al. (2020) as depicted in the following figure.

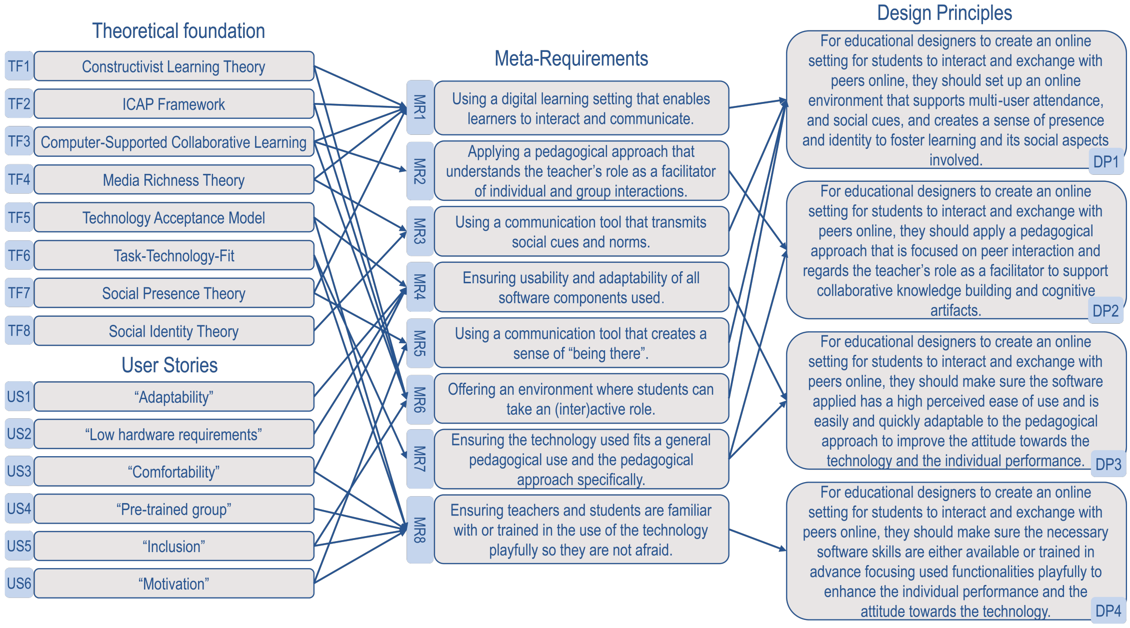

Figure 1. Mapping Diagram

Development

We developed design features (DFs) for the design principles that are both, product and service related to comply with the naturalistic approach along an exemplary course session. The central model for our online course design is the *Technological Pedagogical Content Knowledge* framework by Mishra & Koehler (2006). In addition to the importance of knowledge in the three main areas, namely technology, pedagogy, and content, the intersections between them are especially important to be able to combine e.g., the right technology with appropriate pedagogy.

To instantiate and evaluate our four introduced design principles and the corresponding design features just described we developed a prototype of an inter-group exchange session in a DSR class, where the students had to discuss and compare outcomes from their respective DSR projects in three teams to benefit from learnings and best practices from the other groups. The class lasted about 90 minutes and was facilitated by two of the authors in a VW.

We translated design principle DP1 into five design features and instantiated these in a highly developed commercial VW (TriCAT spaces) that offers multi-user capabilities. We chose this VW over others (e.g., ENGAGE or CyberCinity) because it is not only optimized for usage with head-mounted displays but for control via mouse and keyboard. That means the avatars walk through the virtual world instead of getting beamed. Furthermore, avatars are displayed with their full bodies and not just head and shoulders (DF 1.1). Moreover, this VW has spatial audio that resembles reality allowing participants to detect the direction and distance of their peers’ avatars, whereas avatars in different rooms cannot hear each other (DF1.2). Users may pick from a variety of avatars representing gender, ethnicities, and styles. They may also be customized in terms of clothing color and a specified range of accessories such as hats and spectacles (DF1.3). This selection should help users to identify with their avatar. Avatars should appear more realistic and natural with automatic lip synchronization and motions with spoken text (DF1.4), while they also support interactions like clapping and raising hands or sitting down on chairs (DF1.5).

The fishbowl approach (DF2.1) was chosen because of the design principle DP2 for facilitating inter-group exchange among three student teams working on different DSR projects. Fishbowl is a method to organize group discussions, whereby students are separated into an inner and an outer circle of chairs (Priles, 1993). We transferred this setting to a VW with virtual chairs to have students' avatars sit on them. Participants in the inner circle, the fishbowl, discuss predefined questions, while those in the outer circle listen and take notes before a rotation takes place. The fishbowl circle partners are predefined and mixed with group members from the different DSR project groups to stimulate inter-group exchange and, ideally, create a lasting social peer network beyond the session and even the seminar.

DP2 and DP3 are closely intertwined because the educational method adopted in DP2 determines the forms of adaptability required in the DF that instantiates DP3. The latter is present in eight design features. We used two separate roles for effective rights management and to avoid overburdening students with capabilities they do not require: the session leader role for educators with extra functionality like participant management and a more condensed version for students (DF3.1). The menu on the left side (*see Figure 2*) is foldable and organized into primary categories (14 for session leaders and 9 for attendees) (DF3.2). The interaction functions of the avatars are incorporated as a taskbar to be utilized fast and easily for natural social engagement (DF3.3). The interaction with objects is executed by clicking them (e.g., to sit on a chair) (DF3.4). Participants can select between two perspectives: the ego view, which displays the VW through the eyes of the avatar, and the follower perspective, which places the camera behind the avatar so the user can witness their own avatar's movements (DF3.5). The VW has an editor that allows educators to add and remove furniture (such as tables and chairs) and electronics (e.g., media walls or PCs). This editor was used to prepare the chair circles, the media walls for disseminating the protocol, and a countdown timer for timeboxing the discussion rounds (DF3.6). The foundation for the furniture adaptation was a room scenario that includes numerous conference rooms of various sizes, an auditorium, a training center, and an outdoor space (DF3.7). This promotional video (TriCAT, 2022) depicts this baseline scenario. We integrated Miro as a supplementary digital whiteboard for synchronous documentation of outcomes since it is web-based, permanent, and easy to use. The Miro board can be launched in the VW's integrated browser, allowing participants to write on the board and not lose immersion because they still see the VW. This is especially useful when participants have only one screen (DF3.8).

While we embedded a strong teacher focus in DP3, DP4 heads more toward service orientation. DP4 resulted in six design features. Since one of the instructors was already familiar with the selected VW, she introduced it to the second teacher beforehand to acquaint herself with the environment. Both educators had prior expertise in teaching DSR courses by using the fishbowl method either physically or digitally. Thus, both created the concept collaboratively to combine all necessary knowledge types as proposed in the *Technological Pedagogical Content Knowledge framework*. Being the VW designers, we required a countdown timer, three chair circles, a mechanism to provide group assignments, and a way to make the outcomes of various participants available to all

(DF4.1). We prepared a short manual for student introduction on how to download and log in to the VW and delivered it to all participants ten days in advance (DF4.2). In that communication, a contact person was mentioned (e-mail and phone) to offer direct support (DF4.3). The e-mail also pointed to a tutorial that enables users to asynchronously get used to the control and navigation with their respective avatars (DF4.4). We offered three dates of choice to synchronously give support for installation, login, and first steps within the environment to make sure everyone had the chance to make use of that offer. We communicated these technical checks as voluntary (DF4.5). During the session, one of the teachers methodically guided through the session, while the other one served as technical support staff (DF4.6).

Figure 2 shows a screenshot of the original course setting with students sitting on the chairs in the virtual fishbowl. It illustrates some of the design features introduced in this section.

Figure 2. Course Setting in VW with attributed Design Features

Evaluation

We conducted three semi-structured interviews in German language with eleven participating students from a German technical university in December 2022. Among the participants were six female and five male master students majoring in Technology-oriented Management, aged 23-27. *Table 2* provides an overview of the group composition, the topic, and the selected method for their DSR project as well as the interview duration (FI#).

No.	Participants	DSR RQ and its Methodical Approach	Duration
FI1	3 participants: 2x female, 1x male	How to design PCAs in Virtual Worlds? Systematic Literature Review	66 minutes
FI2	4 participants: 3x male, 1x female	How to design emotion-reactive PCAs? Workshops + Quantitative Evaluation	56 minutes
FI3	4 participants: 3x female, 1x male	How to design motivational PCAs? Qualitative Interviews + Workshops	66 minutes

Table 2. Interview Participants

The coding process resulted in 140 different codes in four main categories. The majority (9 out of 11) did not have prior experience with VWs. Five of them were using only one screen to enter the VW and the other six had two or more screens available. Aspects mentioned more than four times (from different persons) are rated as generally relevant and reported in the following section. We added our observations for explaining interview results and name suggestions for improvement that were at least mentioned twice.

Regarding DP1, we observed vivid discussions and collaborative exchanges between the students after the first two rounds of “warm-up” getting used to the VW and the fishbowl method alike. Six interviewees perceived the VW’s graphics as “old-fashioned”, and one compared it to “Sims back in 2004” and another with “computer games from ten years ago”. Eight participants desired more options for avatar individualization to better match their real identity. The selection from approx. 20 pre-defined avatars per gender with the adaptable color of clothes and additive accessories were perceived as not enough, especially in terms of hair color, clothes style (more casual preferred), and ethnicity. However, a certain level of immersion can be implied, since the proximity and the virtual eye contact of the teachers’ avatars are recognized and preferred by six interviewees over the facilitators being located outside the chair circles as tested by the teachers for the first rounds. The general room design was regarded as suitable for the context, the meeting room for the formal part and the fishbowl discussion itself, and the informal part outside the building in a park atmosphere. Low(er) latency is desirable for six interviewees to reach an even more natural communication without unintended interruptions of others that might be perceived as rude. Especially shy students seemed to be hindered by that.

Five interviewees regarded the fishbowl method (DP2) as a suitable approach to interactively exchange experiences and get to know contacts and experts for (future) reference. The decisive factor for value-added for students was the similarity of the topics they work on. Five students directly or indirectly mentioned that prerequisite for an exchange to be active and sustainable. Eight interviewees see room for improvement in our session in this regard.

In terms of adaptability (DP3) the deployed solution with the editor functionality to adapt to the pedagogical concept of the fishbowl method with chair circles turned out to work fine and effectively alike. Preparation time took us less than 60 minutes and included all necessary agreements and arrangements. Once created, the room adjustments can be reloaded for upcoming sessions. Concerning ease of use of the embedded tools (VW with Miro) the students' feedback resulted more fragmented. The VW itself was perceived as intuitive by five interviewees. Nevertheless, the virtual chair placement (close to each other to generate proximity) turned out to be problematic for beginners to walk in between and was negatively mentioned five times. Seven participants preferred the use of the follower perspective, the reasons mentioned were the easier navigation seeing the own avatar, and the wider visible angle. Eight interviewees criticized that we embedded Miro as an integrative whiteboard since it overwhelmed them technology-wise because they were either not used to working with it or found it over-engineered for the given purpose. The alternatives they named all pointed in the direction of simpler solutions like Google Docs, using VW functions only, or personal handwritten notes.

Students appreciated the diverse synchronous (three dates for technical test sessions) and asynchronous technical introduction (short manual and offline tutorial) options we offered. Ten made use of the synchronous session for a complete tech check and an introduction to navigation and other functions like changing the perspective or sitting down. The only one who did not participate in one of these sessions turned out to have major problems in changing the seat between the rounds. This was perceived negatively by the peers, so eight would have preferred the synchronous tech check to be mandatory. Since individual preferences differ the variety of technical introductions was generally appreciated. The short manual was perceived as being sent too early, 3-5 days in advance would be better than 10 days (5/11). Moreover, having a clear separation of roles during the session (one teacher as facilitator for the fishbowl method and the other as technical support) was recognized and rated positively (10/11). Six students even claimed the tech check had increased their anticipation towards the learning session. Our findings indicate that the initial two fishbowl rounds were not as engaging as the subsequent ones. When asked about the reasons and how to enhance future sessions, students explained that they needed time to familiarize themselves with the VW and the fishbowl method. Seven out of eleven interviewees suggested incorporating playful warm-up activities to improve the sessions. Other suggestions for improvement included synchronizing the VW and providing asynchronous means of conducting a technical check. On a positive note, the students appreciated the spatial audio and the name signs above the avatars' heads, and they deemed the method highly suitable for educational settings that last more than half a day. Compared to a face-to-face peer exchange setting, the lack of nonverbal cues and the anonymity of the VW were identified as major drawbacks. However, there were no objections to our previously defined design principles. The overall success of the session can be concluded by the fact that 10 out of 11 students preferred the VW over a video conference if given the choice. This is even an improvement from the initial anticipation expressed by six interviewees when they first learned that the fishbowl session would take place in a VW.

Discussion

While some results give clear instructions, others are more ambivalent and therefore discussed in this section and compared to other study results. From that general discussion and the results above, we derive specific implications for researchers and practitioners.

The similarity of the DSR project topics was seen as a major prerequisite of the fishbowl method for participants to gain a direct value added. Theories from social sciences postulate that communities share a common goal or vision and each individual is looking for a personal benefit from the group interaction (*community of purpose*) which means our results are in line with these individualization theories (Hitzler et al., 2009). The wish for more individualization of the avatar points in a similar direction. Research on avatars reveals that avatar realism influences trust (Aseeri & Interrante, 2021) and interaction (De Simone et al., 2019). On the other hand, avatar (facial) realism does not affect social presence or body ownership (Dubosc et al., 2021). The users' demand for (more) mimics is also supported by research (Wu et al., 2021) just as the desire for adapting the ethnicity (Schlimbach et al., 2022). The expectation for better graphics is rooted in the experience of today's computer games but contradicts the prerequisites for low hardware requirements for inclusion. There are contrary opinions in research, while Dionisio et al. (2013) assume there is a need for realism, Girvan (2018) questions this position naming the commercial success of the videogame Minecraft. The fact that the follower perspective was preferred over the ego perspective could be rooted in the low previous experience in using VWs but might lead to lower immersion than the ego perspective.

Implications for research: The anticipation and the visible enjoyment of participants could be caused by the novelty and are not necessarily rooted in the VW itself or the course design. Long-term studies on motivational changes over time are needed. Furthermore, it would be helpful for designers of VWs to know how much individualization for avatars is desirable. Thinking towards the metaverse an avatar standard format would even make sense to transfer a user's online identity from one VW to the other. In practice, "Ready Player Me" is an initiative toward that goal (Ready Player Me, 2023a), but especially professional VW (e.g., TriCAT spaces, ENGAGE, Virbela) do not support those avatars (Ready Player Me, 2023b). Researchers and developers of VWs should keep hardware and bandwidth requirements as low as possible to decrease latency and enable communication to be more natural. Since mimics are an important social cue in theory and practice (Feine et al., 2019) developers should include low-barrier solutions e.g., based on webcam facial expression capturing.

Implications for practice: As an educator when you schedule a class in a VW be sure to reserve 15-30 mins. for a (playful) introduction with the aim that participants get used to the technology, and the pedagogical approach and if applicable get to know their peers. Recommend or enable a follower perspective for beginners in VWs and make sure objects (like chairs) are not placed too close to each other. Communicate in time that the usage of LAN in favor of WLAN can decrease the latency, which is the voice transmission time delay. If you can make use of the integrated tools that the VW offers and do not add additional complexity with external tools like Miro. In this case, the task-technology-fit was not optimal and the choice for Miro was rather based on our habit, instead of completely rethinking the course design. For the fishbowl method to succeed sustainably, we recommend either varying the topic or the methodology between the teams but not both as we did.

Conclusion and Outlook

The question is no longer whether social interaction and peer exchange can occur online but how to effectively design and scale it. Virtual Worlds (VWs) demonstrate high potential as a vehicle for social interaction and peer exchange due to their social presence and level of development. However, motivation and effective exchange do not stem from the VWs themselves but must be facilitated through appropriate pedagogical design. Our study chose the fishbowl discussion as a suitable approach, but it is crucial to ensure that there are enough similarities in the topics to be discussed. The design principles derived from eight theories, models, and frameworks and six user stories from the teachers' perspective contribute to general design knowledge and have practical relevance, as demonstrated by the high number of design features identified. Our study includes a service perspective in the design principles and design features to reflect the service orientation of education. The stakeholders involved in that service perspective were teachers, learners, and technical support.

Subjectivity influenced our observations, so we established a peer review process to maximize objectivity in the coding process. Our focus was social presence, and our evaluation centered around a VW. The proposed design principles are intended to be general and can be applied to hybrid solutions, such as Gather Town, which combines video and a virtual world, or even to pure videoconferencing solutions. Further evaluations can strengthen or refine these design principles. Our naturalistic evaluation aimed for productive operation and emphasized the importance of scalability and transferability for teaching staff with limited time. Introducing students to the technology remains a significant effort, and optimization and automation should be pursued to streamline the process. In this course, a didactical service blueprint (Wegener et al., 2012) could be an appropriate foundation and embedding further technology like conversational agents might increase the level of automation as well as students' flexibility in learning (Khosrawi-Rad et al., 2022).

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