Towards a Virtual Collaborator in Online Collaboration from an Organizations' Perspective

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Abstract. In this empirical study, we present the specifications of virtual collaboration in times of the Covid-19 pandemic in an organization that worked mostly co-located beforehand, and requirements for a virtual collaborator (VC) resulting from those specifications. Related work shows that a VC can support virtual teams in achieving their goals and promote creative work. We extend this with insights from practice by observing creative collaborative workshops in the automotive industry and conducting interviews with facilitators and participants of these workshops. We identify challenges that participants face in virtual collaboration, and derive design guidelines for a VC to address them. Main problems arise due to the virtual interaction lacking nonverbal communication and the preparation phase requiring more planning and effort. A VC could help by influencing group cohesion, networks between participants, and the virtual working environment as well as by contributing content.

Keywords: virtual collaboration, artificial intelligence, technology-based agents, virtual creativity, virtual workshops

1 Introduction

Due to the Covid-19 pandemic and the shutdown situation, the working world has been forced to shift quickly from a presence-oriented co-located to a completely virtual work experience in no time. Employees have been confronted with virtual tools to collaborate with each other to accomplish their tasks [1]. One scenario for such a collaboration are virtual workshops in organizations, which were - before the pandemic situation - often conducted onsite. Besides the advantages, virtual collaboration comes with new challenges for facilitators and participants of the workshops. The virtual setting lacks non-verbal communication and interaction, which causes a different team atmosphere and a variety of challenges and counteracting behavior [2, 3]. Furthermore, the facilitator and the participants need to manage different communication and information streams over speech and text at the same time virtually [4]. Additionally, small interactions such as showing, highlighting or organizing demand a tool functionality and effort, which is less complicated in onsite workshops [5]. These might result in cognitive overload which can have a negative impact on attention and creativity [6], and calls for automated support of virtual workshops based on artificial

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intelligence (AI). Many research articles already deal with the cooperation between humans and AI [7-8] and show a great potential of AI for the future of work [9-14]. Specific factors such as trust and skepticism in AI regarding collaboration with humans [15-18] are already being researched. However, there is a lack of a holistic field research approach and especially of AI-supported virtual collaboration in the creativity process [19-20]. Further research is demanded by scholars via research agendas [21-22] and panel discussions [23]. A so-called virtual collaborator (VC) goes further in this respect: it is not limited to assistance functions, but should be considered as an equal virtual teammate in a collaborative work environment, acting with the user [24].

At this point, we position our research and investigate from an internal organizational view the challenges that facilitators and practitioners face in creative virtual workshops compared to onsite workshops, and how a VCs can be designed to address these challenges. For this purpose, we ask the research questions Q1: Which challenges occur in virtual creative workshops for the facilitator and participants in comparison to onsite creative workshops? Q2: How can a VC be designed to support the facilitator and practitioners during the workshop? To answer the research questions, we follow a qualitative and explorative approach by Döring et al. [25] and Mayring et al. [26] by conducting semi-structured interviews with participants and facilitators of creativity workshops in an innovation and creativity unit of an automotive company. The aim of this study is to identify the challenges of virtual collaboration in creativity workshops, and to develop design guidelines (DGs) for a VC following the approaches of Hevner et al. [27] and Gregor et al. [28]. This paper continues with related work on VCs and virtual collaboration before presenting our research approach. We delineate our findings with the identified challenges as well as the DGs for the VC. We discuss our results in connection to existing literature and outline limitations of our research. Finally, we provide a conclusion and highlight our contribution.

2 Related Work

Collaboration is defined as acting together pursing a common goal in a coordinated way [29]. With the help of computer technologies, a new type of collaboration has emerged in which people can work together regardless of time and place. This includes communication and certain types of interaction [30], which has led to more and more research into how to use technology to support collaboration processes. These include shared data storage, shared workspaces and editors, but also increasingly technologies that address group processes and seek to steer behavior in teams [31]. Furthermore, the collaboration research is extending its scope towards artificial collaboration partners such as conversational agents [3, 22, 23]. While the concept conversational interface [32-33] reduces interaction between system and user to conversation, the terms artificial collaborator [34] or artificial companion [35] focus on physical instantiations.

However, to focus on the cognitive capabilities of a system, Siemon et al. [24] defined a VC as a technology-based agent that is able to perceive its environment, process information, make and learn decisions, act on them, and interact with humans and other machines to achieve a common task goal with more or less autonomy [24].

In other studies, a VC was assigned the role of the organizer [36] or the representation of other views and perspectives [37]. VCs can also support the collaboration process and expand their capabilities, for example in decision-making [38-39] or in reducing complexity and time expenditure. This is how the achievement of objectives can be optimized [40]. However, the VC must consider the entire system of collaboration, not just individual effectiveness. To achieve this, the goals and distribution of tasks between participants and VC must be clearly defined [41]. To achieve optimal results in collaboration, an adequate human-machine relationship is important. If the collaboration goals are achieved [42-43, 36, 12], not only the relationship between participant and VC improves, but also the collaboration itself [44-46]. To this end, the VC should be seen as an equal partner in the collaborative relationship in terms of power and control [47-48]. This leads to an optimal performance of both participants and the VC [47, 49, 41]. However, according to Nass et al. [42] perception of the VC as a machine team partner also plays an important role. Furthermore, Nass et al. [49] found that individuals in groups apply social rules and have similar expectations towards computers and just accept being in a group when asked to be [16, 50-55].

Research has shown three essential requirements for VCs, space awareness [56-59], role allocation [59-61] and the human-machine relationship [57, 43, 62]. Space awareness needs to be considered, since the interaction between humans and machines is virtual, whereas humans usually interact in a physical environment when working co-located [56]. This results in the second requirement, role allocation, as the VC must have a clear picture of the participating roles and environment. This leads to the VC being able to collect data by profiling the entire system of VC, participants and their communication streams such as text, speech and video functions, as well as the working environment to gain insights and function optimally [60]. However, this requires continuous transparency in the entire process to provide this clear picture [61]. The human-machine relationship as the third important prerequisite requires communication, which can make an important contribution to the quality of results. Giving input via mouse, keyboard or only verbally is not sufficient for an adequate human-machine relationship. As humans communicate both verbally and via body language, these modalities must also be recognizable by the VC to allow emotional and contextual communication [57, 53, 62].

Although research has already shown some important prerequisites for collaboration with a VC, the organizational view especially real-world cases within organizations rather than organizational or management research has not been sufficiently explored [19-20]. Aspects [63] such as data security, current systems used in the organization and reducing redundancies in tool landscape [18-21] need to be considered. Also, organizations deal with different challenges in collaboration and especially in creativity sessions such as hierarchies in groups and group effects like social loafing [17].

3 Research Environment – Creative Unit in the Industry

In the following, the working method of the investigated creative unit (CU) in the industry in the analog as well as digital context is explained. The first author is a

frequent facilitator of DT workshops in this CU. The CU bases its work strongly on the design thinking approach in the 6-phase model according to Schallmo & Lang [64]. Design Thinking (DT) is a method for solving existing problems and involves various stakeholders with different backgrounds at an early stage. The focus is consistently on the needs of the users, who are involved at every stage. Depending on the phase in the DT process, a thematically appropriate workshop is designed [64], which is explained below as an example in both analog and digital implementation using the third phase "Defining the point of view". This phase allows the team to evaluate, interpret and weigh the insights, and create a common basis on the contents, summarized in a typical, fictional persona [64]. The “Defining the point of view” phase is a good example to analyze due to its various tasks to be solved regarding both team and individual work, which is why it has been chosen for this particular study.

The analog workshop is conducted in a room with utensils for creative work such as whiteboards, pens, different types of paper and other accessories for visualization purposes [64]. No technical aids or technical utensils are used in analog workshops. At the beginning of the workshop, an introduction to the workshop and the participants as well as the agenda with contents and breaks is presented [65-66]. Following the goal of the "define point of view" phase to scan, synthesize, and analyze the previously conducted interviews, the participants talk about the content: What were the insights? What was mentioned particularly frequently? What was not mentioned?

Subsequently, the information obtained is visualized e.g. in a user journey. The user journey represents the path of using a solution with the respective experience and contact points of the users [67]. A template with the corresponding fields is provided using a whiteboard. The team members discuss the contents for the fields and fill them in by hand. During the entire process, the facilitator, as a neutral party, primarily pays attention to supporting the discussions, for example by asking questions or providing their own impulses. After all individual tasks have been discussed, the next steps are discussed. It may happen that, due to the iterative nature of the DT process, the team takes a step back, for instance realizing that more information on the potential users is still needed [64]. After the workshop, the facilitation team prepares and provides the documentation. Digital workshops at the CU also follow the DT principles and process described above, but differ in their implementation. While a physical room is provided for analog workshops, digital workshops take place in a virtual room. The CU presented here uses Microsoft (MS) Teams as a collaboration tool, primarily the conference function. The workshop is prepared by appropriate explanations and templates using PowerPoint slides, which are presented in the conference. Specifically, each step is explained verbally and in writing on the slide. In the next step, participants are divided into groups of maximum six people. Each group has a facilitation team consisting of two people. The groups can be formed automatically in a randomized manner using the "Break out rooms" function in MS Teams [68]. The content-related work phase then starts with the prepared templates. The facilitation team can choose between two options: Either participants write directly into the templates, for example, during the loud brainstorming [69-70] or the participants first write down their thoughts for themselves using the MS Teams chat function [71]. Once the time has expired, the facilitation team gives a signal for all participants to simultaneously send their thoughts

to the group chat. Then, each team member presents, and the facilitation team transfers the presented content from the group chat to the prepared template for documentation purposes. This is particularly suitable, if participants have not worked frequently with the program used. All work phases are carried out according to this principle. Here, too, the next steps are discussed, and a feedback round is held. Digital editing in the templates during the workshop usually eliminates the need for follow-up work, or at least greatly reduces it.

Table 1: Differences between analog and digital DT workshops

Criteria	Analog	Digital
Material	Whiteboard, pens, paper, and utensils for handcrafting	Laptop, digital whiteboard and chat in MS Teams, PowerPoint Slides
Work Style	Stand up, in groups, discussions, work in silence	Individuals in dispersed locations, break-out-rooms in MS Teams for group work, or in presenting mode
Environment	Physically in workshop room	Individually in private spaces, other locations, in front of the computer

4 Research Approach

We collected data from the perspective of potential users of a VC by conducting semi-structured interviews (see Appendix A at https://bit.ly/3yvnu4q) lasting thirty to forty minutes. We chose interviews as an appropriate approach when lacking fundamental information for a phenomenon [25]. The interviews first addressed challenges of analog and digital workshops as well as requirements for a VC related to them. We aimed to gain insights about an organization´s perspective with regard to handling virtual creativity and collaboration workshops [72]. Interviewees are employees of the CU and were selected according to their role as facilitator (F) or participants (P) as well their workshop experience. We chose to consider both perspectives as different roles result in different challenges and needs. Besides, participants are an important main user of the VC whereas facilitators give us broad insights as they have worked with many different teams. Workshop experience (WE) for facilitators was measured by the number of digital workshops conducted (High > 60; Average < 60 workshops) and for participants (High > 10 workshops; Average < 10 workshops). Separation criterion was the average of the highest and lowest facilitation experience (100 and 20) as well as highest and lowest participation level (20 and 1). The criteria gender, age and job background were added for the sake of achieving a heterogeneous sample; for the topic itself, criteria workshop experience as well as relevant training are expected to be significant. After conducting nine interviews, results began to reach their plateau; therefore, twelve interviews seemed sufficient. The interviews were partially transcribed and analyzed using the qualitative content analysis by Mayring [26]. In a bottom-up approach, categories were built inductively, resulting in two sections, “Lack of nonverbal communication and human-like atmosphere” and “Workshop preparations and digital functions”.

Table 2. Criteria & characteristics of interviewed facilitators (F) and participants (P)

No.	WE	Relevant Training	Gender	Age	Job Background
P1	High	Participate frequently	Female	29	Compliance Manager
P2	High	Participate frequently	Male	31	Risk Manager
P3	Average	Participate by demand	Male	36	Legal Expert
P4	Average	Participate by demand	Female	32	Service Designer
P5	Average	Participate by demand	Male	35	UX Designer
F1	Average	None, by practice	Female	36	IT Consultant
F2	Average	None, by practice	Male	29	Innovation Manager
F3	Average	None, by practice	Male	39	IT Consultant
F4	High	In training to DT Expert	Female	32	Communication Manager
F5	High	In training to DT Expert	Male	35	IT Consultant
F6	High	Certified DT Expert	Female	29	Innovation Manager
F7	High	Certified DT Expert	Male	29	Innovation Manager

5 Findings

5.1 Challenges (C) of virtual workshop implementation

Lack of nonverbal communication and human-like atmosphere: The biggest and most frequently mentioned difference is the lack of body language and direct feedback (**C1**). The chance to get a first impression of a situation and its participants is eliminated. Often, the atmosphere at the beginning of a workshop is very reserved and participants do not talk to each other until the facilitator has officially opened the workshop. But even during the workshop, direct feedback is often not possible. If the participants are tired and need a break, they show a lack of concentration or yawning. In addition, participants very often interrupt each other due to a lack of body language, as they cannot see when others take a breath and start speaking. All interviewees also mentioned that participation was generally lower, holding back to avoid interrupting others (**C2**). The mute function, which always came into effect in large groups when a person did not speak, was also a hindrance to speaking. Especially for facilitators, it is difficult to focus participants' attention on themselves to guide and moderate. It is difficult to assess, whether participants are fully dedicated to the workshop or doing other activities on the side, such as answering emails or dealing with other topics: "You can see they're part of the meeting, but are they fully engaged?" (F7). It was also mentioned several times that in a virtual working environment, it was easier to intentionally leave a discussion or work phase (**C3**). About their own involvement, P1, P2 and P3 mentioned that they were more often distracted by other things on the screen or even the mobile phone and did several things at once. This led to an information overload and required discipline. During breaks and interruptions in the work phase, the opportunity to talk informally with each other is limited as well as networking while having lunch together. Yet, the virtual working environment made it possible to read documents or collect facts on a topic to contribute more adequate arguments to a

discussion. Furthermore, it was easier to structure one's thoughts and take notes. The participants were sometimes very motivated due to the current exceptional situation. Since everyone is affected by the Covid-19 pandemic and has empathy for the other participants and facilitators, participants were particularly ambitious. In addition, P1 and P2 indicated that they felt more confident because they felt protected by being separated from the presence of other people. Also, participants stated, that they felt more pressure to prove that they are fully engaged in the workshop, because it was not easily seen due to the virtual situation (**C4**). Therefore, they felt especially motivated to engage in the workshop. This applies especially when the participants did not know each other beforehand. If participants only got to know each other during the workshop, they were initially more reserved and tense, than if they had known each other before (**C5**). Thus, the desired cohesion in the group did not exist as in a co-located setting. The participants mentioned that moods and other interpersonal subtleties do not come across as well as in co-located situations. There was also more discussion and dispute. One assumption behind this is the protection that results from the virtual, more anonymous working environment. On the other hand, participants and facilitators who knew each other before reported that they met on a different, more personal level. This was mainly since participants also got to know each other's private environment in the videos. Since everyone was subject to the regulations on mobile working, everyone could understand, if by chance a child or partner was visible in the picture. This strengthened the group cohesion: "Through online collaboration one got to know the colleagues differently. It welds them together, you get a glimpse into their home, into their private lives." (F1).

Workshop preparations and digital functions: A fundamental view of the interviewees was that in virtual workshops, dedicated planning and preparation was essential and took more time and effort than in the co-located way (**C6**). It was necessary to go through all the possibilities that could occur during the workshop and at the same time prepare alternatives in case something did not go well. In addition, the objectives of the workshop had to be defined more precisely to align the methods and process with them: "You have to go through the whole workshop more often, what are the possibilities in the interactive sessions, and what alternatives do we have." (F4). A clear advantage of virtual workshops is that workshop materials such as pens, whiteboards and paper no longer need to be prepared, as everything is processed on digital whiteboards and PowerPoint slides. However, this need for planning also means that e.g. spontaneous visualizations or a change of methods is harder to conduct (**C7**). Decisive planning and digital processing make follow-up work much easier. After the implementation, a lot of content and material is preserved, which is often not the case in a co-located workshop, because different media is used. Chat messages can also be retained, in which important spontaneous ideas and comments may be found.

Regarding the choice of methods, participants and facilitators had different opinions. While participants thought that all methods can be digitally reproduced, facilitators saw this rather less (**C8**). Especially the Understand, Observe and Define phases from the DT process are easier to conduct digitally than the phases Ideation, Prototyping and Testing. This is since the last three phases need more visualization possibilities, which are rather difficult in the digital implementation (**C9**). The interviewees, especially the

facilitators, stated that the method selection is more decisive for virtual than for co-located implementation. There is a lack of movement in the setting and spontaneity in the change of methods, because tools need to be prepared: "The first three phases of the Design Thinking process are well digitally feasible, after that it becomes more difficult." (F7).

Another important factor is working with digital tools. The participants are often not used to working with them and need more time for discussion and reflection (**C10**). This makes the facilitator's work even more difficult, since in addition to the facilitation, they must also explain digital tools. Both facilitators and participants cited technical skills and the handling of digital media as important factors for successful implementation. The virtual implementation has the clear advantage that there are no geographical borders to hinder, so that participants can take part in the workshop regardless of location and do not have to travel to the event: "Every meeting is only one click away" (P2).

5.2 Resulting Design Guidelines for the VC

We derive the following DGs for the VC according to Gregor et al. [28] in a virtual creativity workshop from the interviews based on the mentioned Cs above and stay in line with Hevner et al. [27] and Gregor et al. [28].

Networking and influence on group cohesion: To bring together participants with similar interests and skills, the VC should be able to collect information from databases and networks from the intra- and internet (F2). This should be a stimulus for networking and exchange. In advance, a workshop-specific profile could also be created. However, networking should not be too active, but rather in a subliminal, subtle way (F2): “Something like ‘Do you know XY? She is also an agile coach.’, based on what is stated in my LinkedIn or intranet profile.” (F2). This results in **DG 1: Networking Opportunities**: *Allow networking of participants by automatically delivering non-personal information from networks in intra- and internet and creating a workshop-specific profile, because the virtual environment is a barrier for informal exchange between participants, who meet virtually for the first time.*

The VC could also identify moods based on voice and conversation analyses and give corresponding tips to the facilitator or have a direct steering effect on the participants (P1, F6). At the same time, an opening and inspiring mindset could also be conveyed to stimulate the creative process in the workshops: “When people are open-minded to get a kind of coaching from the VC, this could help” (F6). The VC could guide the participants into an open mindset through one-on-one written or verbal conversation (F6), utilizing the data from the previous voice and conversation analyses, which results into **DG 2: Influencing Group Cohesion**: *Create an open and inspired mindset for participants by identifying moods based on voice and conversation analyses and giving tips to the facilitator, because an open and inspiring mindset stimulates the creativity process, which leads to innovation creation.*

Influence on the virtual environment: The VC should accompany the participants and facilitators during the entire workshop (P1). In doing so, the VC should have an organizational and supporting effect on the immediate virtual environment.

On the one hand, the VC should take over time keeping, if necessary and on the other hand, it should also include a reminder function that gives a hint about the upcoming agenda item and introduces the next phase (P1). In addition, the VC should provide different virtual rooms for different situations and make something appealing with a welcoming text and a round of introductions (P1, F4). This is intended to replace the role of the host, who welcomes the participants (P1, F4): "The VC could walk through the rooms, he could say, 'Here's what's on the agenda,'" (P1), which results into **DG 3: Support during whole virtual workshop**: *Support both facilitators and participants by taking over tasks like time keeping, reminder function, introduction to the next phase in virtual rooms and provide support for handling digital tools, because explanations and support of participants for handling the virtual environment is time consuming and takes away the facilitator´s focus from guiding the participants content-wise.*

To achieve a balanced discussion, tracking the share of a conversation of the participants is of great importance. The speech proportions of the participants should be monitored in order to balance the contributions. This might encourage silent people to speak and very dominant personalities to take a step back (F7). Therefore, the VC should be capable to balance the speech proportion with social badges by actively encouraging passive participants to contribute to the team discussion (F7), which results in **DG 4: Tracking conversation shares**: *Track the share of a conversation of all participants and provide hints if imbalanced to both facilitators and participants, because dominant personalities might take over the conversation and, therefore, leading to imbalanced workshop results.*

Contributing content: Furthermore, the VC should be able to support the process by providing information and background knowledge (P2). Semantic analyses and keyword searches will be used to retrieve knowledge to support the research phases. Creative sessions should also be enhanced by input, for example by showing examples or inspiring images or sounds. Here, the VC should take on the role of participant and fact provider, and at the same time visualize the generated knowledge (P2): “The VC could offer broad knowledge on certain keywords in a visualized form.” (P2), which results in **DG 5: Provide information and inspiration**: *Support knowledge generation and exchange by providing visualized information and background knowledge using automated semantic analyses, and keyword searches, and showing examples, and images or sounds, because searching for information regarding a specific topic might take up a lot of time during a workshop that might be needed for other phases in the DT process.* In contrast, the VC should also be able to contribute directly to broadening perspectives, e.g. as sparring partner for exchanging views (F2, P2). For example, P2 stated that opposite views would be useful to obtain and build on another perspective, while F2 rather said that similar ways of thinking would foster the joint building of ideas. F2 tended to focus on harmonization and cooperation, while P2 focused on the complementation of the ideas. In addition, the VC is supposed to recognize, when a discussion becomes monotonous and then bring in new perspectives and contributions to enhance the discussion and make it run in a new direction. In this way, new connections could also be pointed out to obtain the broadest possible picture, which results into **DG 6: Provide perspectives of different user groups**: *Support idea generation and provide inspiration for participants by providing new perspectives from*

different points of view, e.g. from a specific user group´s perspective, because user centricity is a key for successful innovation resulting from DT.

Using the analytical power of AI, it was frequently stated that the VC should be capable to analyze and evaluate the idea of a user regarding potential and fields of application (P2). In addition, the internet should be screened for existing similar ideas (P2), resulting in **DG 7: Evaluate generated ideas or solutions**: *Support idea generation and evaluation by providing information and potential use cases for similar products/services/ideas from the internet, because research about existing products/services/ideas might be time consuming.*

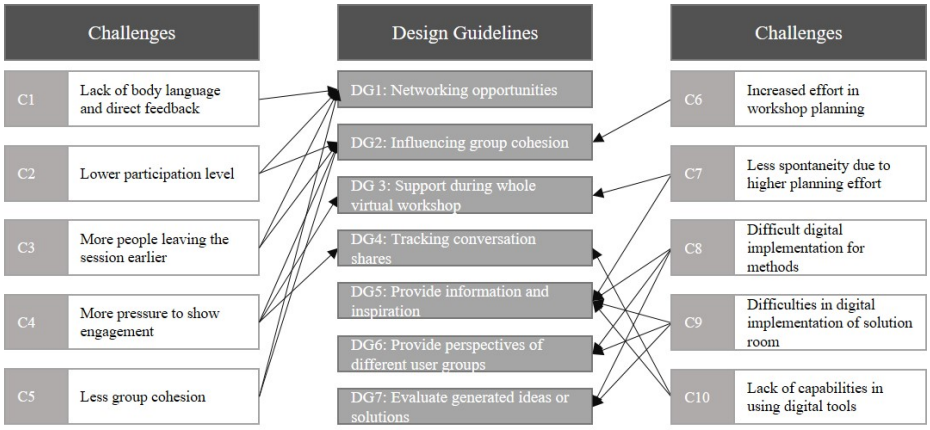

Figure 1. Challenges and respective design guidelines

6 Discussion and Limitations

The interviews especially show that nonverbal communication and the lack of it is the most challenging part of virtual collaboration. Nonverbal communication needs to be compensated or replaced by virtual interaction. This substantially reduces the familiar clues for the first impression, since less non-verbal communication is possible (F5). Moreover, at the beginning of a workshop the participants are very reserved until the facilitator opens the workshop. Even during this time there is no direct feedback, and the video function is rarely switched on - whether for reasons of network load or lack of will. The literature also shows the overriding role of face-to-face encounters and non-verbal communication: the success of virtual collaboration lies in penetrating such physical differences that requires building up a common understanding and trust [73]. This was also mentioned by F6 in the interview: "More time must be reinvested digitally to build trust, but it is also possible" (F6). The lack of nonverbal communication may also lead to misinterpretations. Communication in virtual collaboration is more difficult due to the lack of nonverbal cues and concurrent feedback [74]. It increases the cognitive load and concentration effort on the participants, because they need to do two things at the same time: listen and process the received information and reply digitally by typing or turning on the microphone or video [75]. Virtual rooms also make several

concurrent conversations about different topics more likely, which can lead to more misinterpretations due to the lack of supporting information [74-75]. These aspects were also reported by P1 and P3: "You accidently interrupt more often, and then you're afraid to say anything. By the time you unmute, the moment to speak is gone" (P3). For example, P3 reported that the mute was an obstacle to speaking. If you wanted to start speaking, someone else had already interrupted you. The moment to contribute to the discussion is very short, and often passes by when the mute is lifted. As a result, participation decreased: "It was just generally quieter, all the microphones were muted, there was no consenting 'hmm' in between." (P1).

Motivation is another huge factor that was frequently mentioned by scholars. While virtual collaboration might get frustrating due to technological glitches (“I worried about the internet connection, especially as facilitator as I´m responsible for the workshop” (P2)), the overall motivation helps to overcome these as well as communication and collaboration barriers due to the use of collaboration technologies [76]. The overall increased motivation and pressure [77] was also mentioned with regard to the Covid-19 pandemic since everyone is affected and has empathy for other participants as well as for the facilitators (“I mean, we´re all affected by it, we just tried our best to participate” (P1)). It is also helpful for the general improvement of collaboration, if the participants knew each other beforehand. This has been mentioned in other studies as well as in the interviews (F3-4, F4, F6-9). Studies have shown that team members should know each other in terms of their (cultural) background [78] and their knowledge and skills [79]. The more familiar people are with each other, the less cultural differences there are, which can greatly help the success of virtual collaboration [80]. This is also reflected in the interviews. The interviewees stated that trust and the right mindset are of great importance for the success of digital collaboration. Trust is harder to build digitally than in co-located settings, but it is still possible (F7).

Scholars found the virtual implementation of workshops requires technological skills and knowledge of the possibilities of the collaboration tools, even more so when technical issues occur [80-81]. Accordingly, F1 and F6 stated that rules of play for the handling of the collaboration medium used had to be established and enforced by means of the facilitator, such as muting to minimize background noise. They also mentioned that much more had been invested in planning the workshop beforehand to be able to convert co-located formats into digital ones. Therefore, the facilitators had to deal with the media to get to know all the functionalities (P1, F6). These challenges address research question Q1. It is also assumed that a VC could suggest suitable methods based on the goal of the workshop or the mood of the participants to better respond to the needs of the group. This could also further encourage creativity. Scholars have shown that technology-based agents can enhance human intelligence by providing information or explanations to users [82-83]. AI-based agents can influence group decision making and team performance to achieve user goals [84-86, 37]. Although this is another task of the facilitator, the VC could support the facilitator in this respect or take over this task completely, so that the facilitator can individually supervise the workshop participants. This could be achieved by the VC analyzing the group in terms of its roles and other aspects, e.g. to achieve a balanced group or present a missing perspective or identify through voice analyses whether breaks or changes are necessary [37, 87].

While our research provides valuable insights, it is also subject to some limitations. First, our findings and their generalization are limited to the conducted interviews and our observations in the short period of a few months. Therefore, in further research it would be interesting to investigate, if and how the level of experience of participants and facilitators in the digital execution of workshops changes by time. Considering the current state of the art AI applications, some DGs might be easier to implement than others, which is to be considered in this study. Also, we only considered the Define-phase in this study. Future research should investigate further DT phases and consider several DT phases combined, such as the Define, Ideation and Prototype phases. Furthermore, a general uncertainty about the role and impact of the use of AI [88] could be a strong limiting factor in the exploratory design of a virtual collaborator.

7 Conclusion and Contribution

In this paper, we derived the challenges of virtual collaboration as well as DGs for a VC for virtual creative workshops. Based on qualitative interviews with facilitators and participants, the views of potential users were developed and matched to their experienced challenges and differences between virtual and co-located implementation of workshops. The analysis resulted in two major challenges of virtual implementation and seven DGs.

In summary, our research contributes to theories and concepts on collaboration with AI and virtual collaboration itself [3, 23, 80] as well as on specific requirements such as space awareness [56-59], human-machine relationship [57, 54, 62] and role allocation [59-61]. In conclusion, as for (work) space awareness [56-59], we contributed DGs 3, 5, 6 and 7. These can make up for the lack of the usual physical environment and inspiration by providing specific information, inspiration, additional perspectives as well as evaluate generated ideas or solutions to get to the right direction of results. For human-machine relationship [57, 53, 62], we provided DGs 1, 2, and 4 to enhance communication between participants, facilitators and VC in order to match human communication and balance out the lack of body language and gestures. Also, empathy can be increased here to further improve human-machine relationship as well as quality of results in the workshop [57, 49, 62]. For role allocation [59-61], we contributed DGs 2, and 4, which can support the VC to define each participant´s role by improving group cohesion through increasing participation, planning and analyzing in different situations as well as working on balanced conversation shares and supporting throughout the whole workshop.

We contribute specific DGs regarding an organizational environment, that can serve as a foundation for further research in virtual collaboration and supporting collaboration with the help of AI in an organizational environment that worked mostly co-located beforehand. We specify challenges and phenomena resulting from ad-hoc virtual collaboration of participants that worked from home and tried to adopt learnings from co-located work to the virtual implementation of creativity workshops.

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