

CHAPTER 3

The Notion of Presence in a Telematic Cross-Disciplinary Program for Music, Communication and Technology

Robin Støckert

Norwegian University of Science and Technology

Andreas Bergsland

Norwegian University of Science and Technology

Anna Xambó

De Montfort University

Abstract: This chapter examines how students in a two-campus, cross-disciplinary program in Music, Communication and Technology (MCT) experience the sense of presence of peer students and teachers, some physically co-localized while others are present via an audiovisual communications system. The chapter starts by briefly delineating the MCT program, the audiovisual communications system and the learning space built around it, named the Portal, and the research project SALTO which frames the current study. We then review research literature on presence relevant to this particular context and use this as a basis for the design of an online survey using a combination of Likert items and free text response. Our main findings, based on responses from the 16 students who participated in the survey, are that the mediating technologies of the Portal affect the experience of presence negatively, but that formal learning scenarios are less affected than informal scenarios that require social interaction.

Keywords: cross-campus, distance learning, e-learning, future learning space, presence

Citation of this chapter: Støckert, R., Bergsland, A., & Xambó, A. (2020). The notion of presence in a telematic cross disciplinary program for music, communication and technology. In Ø. J. Eiksund, E. Angelo, & J. Knigge (Red.), *Music technology in education – Channeling and challenging perspectives* (pp. 77–101). Cappelen Damm Akademisk. <https://doi.org/10.23865/noasp.108.ch3>
Lisens: CC BY-NC-ND 4.0.

Creating arenas and learning spaces for collaboration and communication that bring teachers, students, researchers and artists together to share new ideas, resources and knowledge is more relevant than ever due to the circumstances caused by the COVID-19 pandemic. Distance learning solutions and platforms to help schools, universities and teachers facilitate student-active learning, share strategies and provide social caring and interaction, which all are necessary in order to minimize learning disruption during the closure periods and through the aftermath of COVID-19. Mediating technology is available, but it is up to us to create the content and safeguard the sense of human presence in the process by preserving the constituent parts of dialogue, interaction, gestures and finely-tuned, intimate and highly responsive communication (Pentland, 2010).

A combination of governmental digital strategies, reforms within higher education and the sudden need for distance learning solutions due to COVID-19 serves as the backdrop for this chapter. The starting point of our study is founded on the cross-university Master's Program "Music, Communication and Technology" (MCT) with its associated telematic learning space (the Portal). The development of student-active learning methods in the Portal is coordinated through the research project SALTO (Student-Active Learning in a Two-Campus Organization).

We proceed by discussing the concept of presence and several factors related to it. This discussion forms the basis for our survey. After discussing some methodological issues, we look at the results of the survey, then discuss possible explanations and relations to other findings in the literature. We conclude the chapter by briefly suggesting how our research may affect the development of pedagogy, learning spaces and technology.

Background

To serve increasing numbers of students and meet their expectations of learning anywhere, any time and in any format, universities need to transform and create flexible learning environments. This transformation requires a redesign of learning spaces and pedagogy. Suitable technologies must be acquired to support active learning and create arenas for interaction with the option of sharing experiences, social activities,

workspaces and resources, both asynchronously and synchronously, through distance learning, online learning and blended or hybrid learning scenarios.

The Norwegian Government has introduced a long-term plan for research in higher education, where digitization and use of new technology will be a part of both the strategy and efforts to simplify, renew and improve the efficiency of higher education (Ministry of Local Government and Modernisation, 2016; Ministry of Education and Research, 2018; Directorate for ICT and Joint Services in Higher Education and Research, 2019).

It is a complex task with many factors influencing the organization, quality and effect of cross/multi-campus teaching and learning. However, to navigate this transformation towards functional telematic learning spaces, the main point on the map should be a good user experience which maintains and accommodates social human interactions and engagement, a sense of belonging and presence and, finally, facilitates a good and supportive learning environment across distance, time and space (Anderson & Date-Huxtable, 2011; Bahmani et al., 2019; Bahmani & Hjelsvold, 2019; Lillejord et al., 2017, 2018; Ministry of Education and Research, n.d.; Morgan et al., 2016; Støckert & Stoica, 2018, 2020).

MCT

“Music, Communication and Technology” (MCT) is one of Norway’s first joint Master’s programs, run by the two largest universities: the Norwegian University of Science and Technology (NTNU) and the University of Oslo (UiO). The two-year program is hosted by the Department of Musicology at UiO and the Department of Music at NTNU. The Portal and MCT represent a new type of learning strategy and environment that prepares students for the fourth industrial revolution: a future where the borders between the online/offline, physical, digital and biological worlds are blurring, resulting in a fusion of advances within artificial intelligence, machine learning, physical computing, the Internet of Things and other technologies (Kivunja, 2015, p. 444; O’Neill, 2018.; Schwab, 2017; Støckert et al., 2017).

The Portal

The Portal is a flexible, telematic, shared space and consists of dedicated physical rooms at UiO and NTNU that are interconnected through Uninett (Norway's research and education network). The Portal can be described as a "black box" theatre stage with props to create scenography for several learning scenarios. The physical rooms use mirrored set-ups for defined student-active learning scenarios with regard to the applied AV equipment and its placement. These mirrored set-ups create the illusion of an extended and shared space. They enhance eye contact and provide the same orientation of people, sound and shared workspaces/screens when pointing or looking at the same object respectively from each side of the Portal. Nevertheless, the Portal's possibilities and limitations influence the students' and teachers' daily experiences and notions of presence related to activities like human-computer interactions, social interaction, resource sharing, communication and collaboration (Støckert et al., 2019b).

SALTO

SALTO started in 2018 and is a three-year project within the NTNU Teaching Excellence scheme (NTNU, n.d.; Støckert, n.d.). The NTNU initiative consists of a portfolio of development measures with the purpose of developing innovative approaches to learning, teaching and assessment. The SALTO research project was set up parallel to the MCT program, first to support the design, development and implementation of the Portal, and second to adapt and evaluate "student-centered" activities such as flipped learning, problem-based learning and team-based learning in a cross-campus learning scenario with teams consisting of members from both locations (Bergmann & Sams, 2012; Davidson & Major, 2014; Michaelsen et al., 2004; Støckert et al., 2019a; Xambó et al., 2019a; Xambó et al., 2019b).

Working in the Portal, students and teachers explore, evaluate and reflect on educational, methodological and technological strategies together. SALTO documents these experiences through interviews, observations and online questionnaires during the project period (Støckert, n.d.).

Presence

With today's society's ubiquity of mobile networked technologies and social media, our ideas of "here and now", related to social contact and communication, are deeply affected by the way in which the very same technologies blur the sense of time and space. Mediating technologies often make people appear present to one another, even if they are not sharing the same physical space and time. This form of *present absence* (Rainie & Wellman, 2012) closely resembles what is often referred to as *presence* in the literature, which refers to the experience that something or someone is "here and now" through the use of mediation technology. In the context of learning in mediated environments, the concept of presence is often specified as *social presence*. According to Lowenthal (2010b), the theory of *social presence* is perhaps the most widely-used theoretical construct to describe and understand mediated interaction in online learning environments. Despite the frequent use of this term, several authors note that there is not a clear, agreed-upon definition of the term (Lowenthal, 2010a, 2010b; Cui, 2013; Kreijns et al., 2014). Nevertheless, we will attempt to delineate some aspects of presence relevant to our inquiry into learning activities in the Portal, which we will subsequently apply in the design of a survey about the topic. These aspects are: attention and compensatory behavior; audio quality and level; video quality, camera perspective and image size; and social awareness and interaction.

If we look at attempts to define presence and social presence, many explicitly involve the role of technology. For some theoreticians, the experience of presence is simply the result of "overlooking" or "disregarding" the technology or mediation part of the experience, or accepting the illusion of non-mediation (e.g. Lee, 2004; Lombard & Ditton, 1997). In other words, for presence to occur the mediating technology needs to retreat into the background of the experience while the human participants and their communicative actions need to be in the foreground. This is often seen as a result of *selective attention*, where the perceiver attends to what is interesting or relevant (the mediated content) while the properties of the medium or communications channel itself are filtered out (e.g. Nash et al., 2000; Schubert et al., 2001; Witmer & Singer, 1998). Thus, *selective*

attention can also be seen as a form of compensation by the receiver, which enhances the content or message of the medium even if the mediating channel degrades or adds noise to the signal. In the research literature on online learning this compensation is also observed (Kock, 2005; Kock & Garza, 2011). Moreover, in *media compensation theory* it is argued that media users do not passively accept the obstacles posed by the media, but instead compensate for the obstacle by changing their communication behavior, often in an involuntary way (Hantula et al., 2011). Other theoreticians might not explicitly refer to the practice of “overlooking technology” but view social presence more generally as “a theory of how technology might affect, distort, and enhance certain aspects of social cognition” (Biocca & Harms, 2002). The most relevant technologies in this context can be grouped into *audio* and *video*.

On the audio side, different factors have been related to the experience of presence. Some studies indicate that degraded audio quality will affect the experience of presence negatively (Lessiter et al., 2001; Reeves & Nass, 1996). In a study by Bergsland (2010, p. 230), using a phenomenological approach with vocal sounds only, he argues that the experience of traces of the technology involved in recording or mediation, or the use of audio manipulation techniques, can contribute to directing focus towards the technology and/or mediation, and thereby reduce the sense of presence. Bergsland’s findings correspond with the more general view that a degraded sense of “realism” will affect presence negatively (Lombard & Ditton, 1997). Although somewhat lacking in empirical support, Lombard and Ditton’s (1997) review suggests that the audio level might have a positive effect on presence, at least up to a point. This is not very surprising, since in real-world settings people who are located close to each other will sound louder, whereas those who are distant from each other will sound softer.

Regarding presence and the video side of the technology, Lombard and Ditton (1997) list a number of studies that point to the finding that the properties of a video image such as its size and resolution, as well as the proportion of the visual field covered by the screen relative to the full field, affect the experience of presence. Also, in Lee’s (2004) review, presence is closely associated with variables such as image resolution,

color quality, clarity of image, image size, field of view and scene update rates. Lastly, Perrin et al. (2016) studied how subjects experienced the sense of presence with three different image sizes, using both subjective and physiological measures, and concluded that the sense of presence was experienced as higher for the largest screen size compared to the smaller ones.

In addition to aspects directly related to technology, aspects of social interaction and engagement with mediated others are also often linked to the experience of social presence. For example, Tu (2000) sees interactivity, that is, a two-way exchange with the possibility of immediate response, as contributing to social presence. Similarly, Biocca et al.'s definition of social presence involves an "awareness of the co-presence of another sentient being accompanied by a sense of engagement with the other" (2001, p. 2). Their definition hints at their three-level model of presence ranging from its individual perceptual aspects to the collective and interactive. We find this theory of presence interesting since it involves both individual and collective aspects of the phenomenon which seem highly relevant for the different scenarios in the Portal. At the lowest level of their model they posit perceptual awareness of the spatial co-presence of the other's mediated body. At this level, one can assess the other's internal state of mind or categorize basic properties like gender and age. The middle level posed by Biocca & Harms (2002) is a subjective level characterized by increased attentional (cf. the discussion above), psychological and behavioral engagement with the other. The highest level is one of mutual accessibility, interdependent behavior and shared emotional states. Although this theory embraces many complex aspects of experience and communication, we are in agreement with the idea that different levels of presence and co-presence add valuable nuance to the term.

Method

In line with a great deal of research on presence and social presence and our focus on the subjective experience of aspects related to presence (Cui et al., 2013) we have chosen a subjective assessment using an online questionnaire. Our respondents were recruited from the first and second-year

students on the MCT program, students who are present in the Portals at either UiO or NTNU on a daily basis. The respondents were not rewarded for their participation. Since it was a fully anonymized web survey, it was not required to notify or apply to the Norwegian Centre for Research Data for research ethical reasons.

The questionnaire was implemented in the online survey tool Select. Survey.net and had a total of 27 questions divided into four parts (see Appendix A). The first part asked about study year and local campus (NTNU and UiO). The second and third parts had answer possibilities with five Likert items. Of 20 questions, 18 focused on understanding to what extent the students experienced or perceived a certain aspect of presence, or became engaged in particular aspects, with the alternatives being *to a very large extent*, *to a large extent*, *to a moderate extent*, *to a small extent* and *not at all*. The last two questions in part three asked about *how often* the students noted a modified behavior in themselves or in those remotely localized when communicating through the Portal, using the alternatives *always*, *very often*, *sometimes*, *rarely* and *never*. The fourth part used free text entry to gather additional opinions.

The questions in part two were organized in pairs, asking the same question for issues related to the *remote*, i.e. where their cross-campus peers are localized, versus the *local* sides of the Portal, i.e. where the participant and their home-campus peers are localized, in order to compare their evaluations of the same experience, locally versus remotely. For the sake of brevity of presentation, the questions about the remote and local sides of the Portal are presented together using a slash between the question numbers in Appendix A.

From the data set we translated all the answers using Likert items into the numbers one to five. We then calculated the proportion of answers falling into the five different categories as a percentage value, and then presented this in column charts for each of the questions. For questions that were given pairwise to assess local and remote aspects of the participants' experiences, the results are presented in the same chart for easy comparison. The results for audio quality and level and video image quality and size are also presented in the same chart for the same reason.

Results

In total, 16 questionnaires were submitted. This is over two thirds of the total number of students in the MCT program.¹ Of these 16, ten were first-year students and the remaining six were second-year students. Regarding location, nine were students in Oslo and seven in Trondheim. Since at the time of the study there was only one active female student in the program, there was little point in asking about participant gender.

Using the quantification of the Likert items, we calculated the average rating with standard deviations for each of the questions in Table 1 (Appendix B). Furthermore, the distribution of answers is shown in Figure 1 (Appendix B). If we look at questions 3–14, which were related to different aspects of presence, the responses indicate that the sense of presence locally and remotely taken together is somewhere between moderate and large ($M = 3.63$, $SD = 0.67$). Comparing the responses for the remote condition ($M = 3.02$, $SD = 0.68$) with the local condition in Table 2 ($M = 4.23$, $SD = 0.73$), we see that the difference between the average ratings is more than a whole Likert item ($M\ diff = 1.21$). The difference between the remote condition and the local condition is also very evident if one compares Figure 3 with Figure 4, showing the Likert item distribution for the remote and local conditions, respectively. Moreover, doing a two-tailed Mann-Whitney U Test gives a z-score that indicates that the difference in conditions is statistically significant ($z = -8.40652$, $p = 0.00001$). All this indicates that, in the remote condition, the different aspects of presence are markedly affected in a negative direction by the mediating technologies in the Portal, compared to the largely unmediated interaction in the local condition.

As for the results regarding the technological factors affecting the level of engagement with students and teachers on the remote side of the Portal, as seen in Table 3 and Figure 2, the mean ratings are relatively high for audio quality ($M = 4.00$, $SD = 1.22$) and audio level ($M = 3.75$,

¹ Although for one submission not all answers were completed, we chose to include the data from the respondent in the data set since the missing answers were the free text ones and, thus, it did not affect the calculations based on the Likert items.

$SD = 1.39$), whereas the ratings for video, including video image quality ($M = 3.25$, $SD = 1.20$), video image size ($M = 3.38$, $SD = 1.27$), and video image perspective/camera placement ($M = 3.06$, $SD = 1.39$) are somewhat lower. Comparing the averages for the questions about audio ($M = 3.88$, $SD = 1.31$) and video ($M = 3.23$, $SD = 1.29$) respectively, we can observe that the students rated aspects of audio as more than a half Likert item ($diff = 0.65$) above that of the video aspects when it comes to the level of engagement with remotely localized students and teachers.

Two of the questions addressed compensatory behavior, i.e. whether there is any modification in behavior in the face of the mediating technology. Here, one question (21) addressed how often the respondents had experienced this for themselves, whereas the other (22) addressed whether they would like fellow students to modify their behavior to appear more present to them. The results for these two questions (Q21: $M = 3.63$, $SD = 1.11$, Q22: $M = 3.81$, $SD = 1.13$) differed by 0.18, thus, not very marked. It must be noted, though, that both these ratings are closer to “very often” than “sometimes”, and that the modification of behavior is something that the respondents experience goes both ways.

When we looked at the free text, the answers referring to presence and engagement in the Portal, issues related to audio, video and modification of behavior recurred. Overall, as many as half of the responses addressed issues of technology. Moreover, 7 out of the 16 mentioned audio level and/or quality as the factor that is most important in making remote teachers and students more present, whereas another 7 of the answers mentioned video image size, quality and/or perspective for the same questions. Other factors not brought up in the Likert-item questions were mentioned in the free text questions, often as positively or negatively affecting engagement and presence. These included speaking clearly (3 responses), the placement of the microphone and/or speakers relative to each other (2 responses), audio feedback (2 responses), the tidiness of cables and equipment (2 responses), the predictability of the technical set-up (2 responses), gazing into laptops (2 responses), having only one person speaking at a time (2 responses), attentiveness toward others on the remote side of the Portal, noise from touching/moving objects (1 response) and group work (1 response).

Discussion

Our main finding is that students on the MCT program experience a higher degree of presence for those who are co-present locally compared to those who are connected via the audiovisual technology of the Portal. These findings are in accordance with several older studies comparing face-to-face settings with computer-mediated communication, favoring the former (Miranda & Saunders, 2003; Rice, 1993).

Going into more detail, we can look at Table 2, presenting the difference in average ratings between local and remote conditions. Since the questions in part 2 are formulated in pairs, so that the same aspects are addressed and that the only difference between them is that the aspects relate to the “local” or the “remote” partners in the communication, the difference between them can, at least in part, be explained by the mediating technologies involved. A larger difference will therefore indicate that the mediating technologies play a larger part, whereas a smaller difference will indicate that the effects of the mediating technologies are more modest.

Here, we can observe a relatively small difference for two question pairs referring to concrete learning scenarios (teacher/student presentations and open discussions) and engagement and attention relative to these factors (Q7 & Q8; Q9 & Q10). The lower differences in ratings between local and remote suggest that the mediating technologies pose fewer problems in these scenarios and that the difference in the sense of presence between local and remote is lower. For the question relating to student or teacher presentations this result might be partly explained by our practice of displaying the presentation slides on our main screen, regardless of whether the presentation is local or remote. Thus, if the students focus solely on the presentation slides there is no difference between local and remote presentations. For the other question pair about engagement in open discussions, however, one would think that even with high quality audio and video the difference would be greater. Also, it might be a little puzzling that the difference in rating for questions 11 and 12 about interaction with teachers and student peers between local and remote is 0.5 of a rating point higher, with the remote average being as low as 3.0. One explanation could be that “engagement” is a more passive form of

participation, in which one pays attention and follows what is said, and that “interaction” is a more active one. Paying attention to a presentation or a discussion might therefore be experienced somewhat similarly. This explanation could also be supported by the responses to some of the other questions.

At the other end of the scale, we found a more marked difference for local versus remote for the questions about the students’ experiences of sharing a common social space with their peers (Q5 & Q6). With more than one-and-a-half Likert-item average difference ($diff = 1.56$) between the ratings, and among the two lowest overall average ratings for the remote question (Q5: $M = 2.69$, $SD = 0.68$), it seems that the Portal as an audiovisual communications channel represents a major obstacle when it comes to mediating social relations when compared to the learning space of the co-present local peers. The questions about whether the students experience that they are present together with other students (Q13 & Q14), and about the degree to which the students experience that their peers are present and able to perceive them (Q3 & Q4), give a similar impression, although the differences between local and remote are somewhat less pronounced (Q3&Q4: $diff = 1.38$, Q13&14: $diff = 1.38$).

Our findings indicate that social aspects of presence and the impression of being together in the Portal are more difficult to achieve than presence and engagement in more formalized settings. This is also supported by some anecdotal observations from the social get-together in the Portal with students and staff before Christmas 2019. This occasion was the last time the students gathered before the Christmas break and the teachers had provided food and drinks. Apart from one spontaneously-initiated activity, namely singing the birthday song for one of the students, minimal social interaction happened through the Portal. In a situation where one could both see and hear the people on the other side, participants consistently chose to talk and interact socially with those gathered locally. Thus, the overall impression is that for the more structured and guided activities that are a part of the learning situation, communication through the Portal is less different than communication with local students and teachers, whereas for the social aspects of communication, the Portal is more of an obstacle. However, there are other factors that might

play a part here. It is natural that the level of social interaction outside of the formal teaching hours would be greater between the students at each campus, e.g. in lunch breaks and other breaks. The Portal is typically not the place where the students have their breaks, and in both Trondheim and Oslo, the areas for coffee and lunch breaks are located outside of the Portal, called the “decompression area” for a good reason. Still, it might be important to facilitate less formal social activities in addition to formal learning in the Portal in the future. Research like that of Hommes et al. (2012), who found that among medicine students, informal social interaction was strongly associated with their learning, indeed points in this direction.

There are also interesting findings about the technological aspects of the Portal in our study. First of all, technology appears to be important for the engagement of the students. The questions that addressed to what degree different technological aspects affected the engagement with students and teachers (Q15-Q19, see Table 3) showed that the students rated these aspects higher than to a moderate extent ($M = 3.29$, $SD = 1.29$). But perhaps more interestingly, different technological aspects were also addressed in half of the free text responses. Second, it is interesting to note how the experience of audio quality and level affected the engagement with students on the remote side of the Portal, and that these aspects (Q15 & Q16, $M = 3.88$, $SD = 1.31$) were rated on average half a rating point higher than for video image quality, size and perspective (Q17, Q18 & Q19: $M = 3.23$, $SD = 1.29$). Although these questions were about engagement and not directly about social presence, this was perhaps surprising, at least in the light of some of the early social presence research which regarded video as evoking a higher sense of social presence than audio (Lowenthal, 2010b). One explanation for our findings might, naturally enough, be the nature of the MCT program itself, with courses that focus mostly on audio and music, and the majority of students having an interest in or a background involving sound and/or music. Although this would likely give the students a bias, it might also reflect how different channels of audio communication can make a difference to interaction and engagement. The Portal in its current state is, for example, set up with LoLa, software for uncompressed and low-latency audio communication

over the Internet, as the first choice for audio, whereas “off-the-shelf” videoconferencing tools, that use compressed and gated processing, is the back-up solution. As teachers, we have observed that the back-up solutions are considerably more tiring to attend to than the uncompressed one, and have also picked up signals from the students that they experience the same.

Furthermore, our findings show the importance of modifying behavior to adapt to the technology. When the students were asked about their own behavior and the behavior of those on the remote side of the Portal, their answers clustered between “sometimes” and “very often.” Moreover, even if the free text answers perhaps do not point in any single direction, collectively speaking they still bring up several different topics related to the modification of behavior, including speaking one at a time, talking with clear enunciation, talking into the microphone, gazing into laptops and more. These types of behavior fit well with the behaviors described in the so-called *media compensation theory*, mentioned in the theoretical section above. One might think that students would modify their behavior automatically, but the fact that the students both remember doing this themselves frequently and also wanting their remote peers to do it indicates that they need to be intentional and conscious about adapting their behavior to compensate for the technology. Thus, it is apparent that it is not enough to design learning spaces filled with different communications and learning technologies; it is also important to focus on how students as well as teachers interact and adapt to the same technologies.

Conclusion and Outlook

How and to what degree do the students in the MCT program experience different aspects of presence in a cross-campus telematic learning space such as the Portal?

Our study suggests that students on the MCT program experienced aspects related to presence differently for those who were localized remotely compared to those who were co-localized. The experience of various aspects of presence is clarified with the following points of distinction:

- a) For structured learning scenarios, attention, engagement and the sense of social presence is not so much affected by the technological mediation provided by the Portal.
- b) For the social aspects of presence, however, the differences seemed to be more marked, and we noted how some anecdotal observations pointed in the same direction as our results.
- c) We observed how the students reported media compensatory behavior on their own behalf as well as for their peers.
- d) Lastly, different forms of technology appear to be important for the engagement of the students, and our findings indicate that aspects related to audio are more important than aspects related to video.

As our findings indicate that audio quality is ranked higher than video quality, we recommend enhancing and preserving the auditory quality (Bower et al., 2017; Zydney et al., 2019) from sender to receiver. Good acoustics in the telematic space are crucial to obtain speech intelligibility and good listening conditions. No moderately-priced technology can really compensate for poor room acoustics. The combined space layout and technology must deliver enough quality in the audiovisual domain to preserve aural and visual cues (human signals) like eye-contact and body language, to enhance online, social, cognitive and teacher presence across distance. It must create a “stage” where people can interact, build trust and understand that audiovisual cues have an impact on teaching, student-active learning, group work and interpersonal dynamics (Pentland, 2010; Yu et al., 2020).

Based on the findings regarding structured learning scenarios and media compensatory behavior, it is crucial to establish a common understanding of the concepts, rules, etiquette, interaction and how to behave on the “stage” in an online learning space. In other words, to attain a common understanding among participants of what we want to achieve and how to get there. This will require teachers and students working together on the same team, whether it is a cross-campus or a shared telematic/blended/hybrid learning space. It is hard to make predictions, especially about the future of telematic learning spaces. However, a vision might be to create a new shared arena for lifelong learning, accessible for

all, enabling cultural exchange and social interaction, playing and learning together, and safeguarding the sense of human presence and mutual respect in the process.

Acknowledgments

The authors wish to thank the students who participated in the study. Also, we would like to thank MCT teachers and administration for their help in the realization of this study. This research is conducted as a part of the SALTO project (Student-Active Learning in a Two-Campus Organization) and is funded by NTNU Toppundervisning.

References

- Anderson, A., & Date-Huxtable, E. (2011). ICT-assisted multi-campus teaching: Principles and practice to impact equity of experience for students. In G. Williams, P. Statham, N. Brown & B. Cleland (Eds.), *Ascilite 2011: Changing demands, changing directions* (pp. 85–92). University of Tasmania. <https://www.ascilite.org/conferences/hobart11/downloads/ProceedingsV3.pdf>
- Bahmani, A., & Hjelsvold, R. (2019). From theory to practice: Teaching assistants' role in multi-campus education. In I. O. Pappas, P. Mikalef, Y. K. Dwivedi, L. Jaccheri, J. Krogstie, & M. Mäntymäki (Eds.), *Digital transformation for a sustainable society in the 21st century* (pp. 654–664). Springer International Publishing.
- Bahmani, A., Hjelsvold, R., & Krogstie, B. R. (2019). ICT-based challenges of repurposing a single-campus course to multi-campus settings: A pragmatic case study. In I. O. Pappas, P. Mikalef, Y. K. Dwivedi, L. Jaccheri, J. Krogstie, & M. Mäntymäki (Eds.), *Digital transformation for a sustainable society in the 21st century* (pp. 641–653). Springer International Publishing.
- Bergmann, J., & Sams, A. (2012). *Flip your classroom: Reach every student in every class every day*. International Society for Technology in Education.
- Bergsland, A. (2010). *Experiencing voices in electroacoustic music*. [PhD thesis, NTNU], Trondheim.
- Biocca, F., Harms, C., & Gregg, J. (2001, May, 21–23). *The networked minds measure of social presence: Pilot test of the factor structure and concurrent validity*. [Conference Paper] Presence 2001, Philadelphia, PA.
- Biocca, F., & Harms, C. (2002, October, 9–11). *Defining and measuring social presence: Contribution to the networked minds theory and measure*. [Conference Paper]. Presence 2002, Porto, Portugal.

- Bower, M., Lee, M. J. W., & Dalgarno, B. (2017). Collaborative learning across physical and virtual worlds: Factors supporting and constraining learners in a blended reality environment. *British Journal of Educational Technology*, 48(2), 407–430. <https://doi.org/10.1111/bjet.12435>
- Cui, G. (2013). Evaluating online social presence: An overview of social presence assessment. *Journal of Educational Technology Development and Exchange (JETDE)*, 6(1), 3.
- Cui, G., Lockee, B., & Meng, C. (2013). Building modern online social presence: A review of social presence theory and its instructional design implications for future trends. *Education and Information Technologies*, 18(4), 661–685.
- Davidson, N., & Major, C. H. (2014). Boundary crossings: Cooperative learning, collaborative learning, and problem-based learning. *Journal on Excellence in College Teaching*, 25.
- Directorate for ICT and joint services in higher education and research (UNIT). (2019). *Action plan for digitalisation in higher education and research*. <https://www.unit.no/sites/default/files/media/filer/2019/07/The-Action-Plan-for-digitalisation.pdf>
- Hantula, D. A., Kock, N., D'Arcy, J. P., & DeRosa, D. M. (2011). Media compensation theory: A Darwinian perspective on adaptation to electronic communication and collaboration. In G. Saad (Ed.), *Evolutionary psychology in the business sciences* (pp. 339–363). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-540-92784-6_13
- Hommel, J., Rienties, B., de Grave, W., Bos, G., Schuwirth, L., & Scherpbier, A. (2012). Visualising the invisible: A network approach to reveal the informal social side of student learning. *Advances in Health Sciences Education*, 17(5), 743–757.
- Kivunja, C. (2015). Exploring the pedagogical meaning and implications of the 4Cs “super skills” for the 21st century through Bruner’s 5E lenses of knowledge construction to improve pedagogies of the new learning paradigm. *Creative Education*, 6, 224–39. <http://dx.doi.org/10.4236/ce.2015.62021>
- Kock, N. (2005). Compensatory adaptation to media obstacles: An experimental study of process redesign dyads. *Information Resources Management Journal (IRMJ)*, 18(2), 41–67. <http://doi.org/10.4018/irmj.2005040103>
- Kock, N., & Garza, V. (2011). Media naturalness reduction and compensatory channel expansion: A study of online and face-to-face sections of the same course. *International Journal of Distance Education Technologies*, 9(2), 1–12.
- Kolb, A. Y. & Kolb D. A. (2017). Learning styles and learning spaces: Enhancing experiential learning in higher education. *Academy of Management Learning & Education*, 4(2), 193–212. <https://doi.org/10.5465/amle.2005.17268566>
- Kreijns, K., F. Van Acker, M. Vermeulen, and H. Van Buuren. 2014. Community of inquiry: Social presence revisited. *E-learning and Digital Media*, 11(1): 5–18.

- Lee, K. M. 2004. Why presence occurs: Evolutionary psychology, media equation, and presence. *Presence: Teleoperators and Virtual Environments*, 13(4): 494–505.
- Lessiter, J., Freeman, J., & Davidoff, J. (2001, May, 21–23). *Really hear? The effects of audio quality on presence*. [Conference Paper] Presence 2001, Philadelphia, PA. http://www.temple.edu/ispr/prev_conferences/proceedings/2001/Lessiter.pdf
- Lillejord, S., Børte, K., Nesje, K., & Ruud, E. (2017). *Campusutforming for undervisning, forskning, samarbeid og læring – en systematisk kunnskapsoversikt*. [Campus design for teaching, research, collaboration and learning – a systematic knowledge overview] Knowledge Center for Education. <https://www.regjeringen.no/contentassets/54e657ffe528433aa23f4eee77281ab6/lillejord-m-fl.-2017-campusutforming-002.pdf>
- Lillejord, S., Børte, K., Nesje, K., & Ruud, E. (2018). *Learning and teaching with technology in higher education – A systematic review*. Knowledge Center for Education. <https://www.forskningsradet.no/siteassets/publikasjoner/1254035532334.pdf>
- Lombard, M., & Ditton, T. (1997). At the heart of it all: The concept of presence. *Journal of Computer-Mediated Communication*, 3(2). <https://onlinelibrary.wiley.com/doi/10.1111/j.1083-6101.1997.tb00072.x>
- Lowenthal, P. R. (2010a). Social presence. In S. Dasgupta (Ed.), *Social computing: Concepts, methodologies, tools, and applications* (pp. 129–136). IGI Global.
- Lowenthal, P. R. (2010b). The evolution and influence of social presence theory on online learning. In S. Dasgupta (Ed.), *Social computing: Concepts, methodologies, tools, and applications* (pp. 113–128). IGI Global.
- Michaelsen, L. K., Knight, A. B., & Fink, L. D. (2004). *Team-based learning: A transformative use of small groups in college teaching*. Centers for Teaching and Technology – Book Library.
- Miranda, S. M., & Saunders, C. S. (2003). The social construction of meaning: An alternative perspective on information sharing. *Information Systems Research*, 14(1), 87–106.
- Ministry of Education and Research (n.d.). *Seminar om campusutvikling [Seminar on campus development]* [Video]. Regjeringen. https://regjeringen_live.23video.com/v.ihtml/player.html?live_id=38658869&source=site&autoplay=1
- Ministry of Education and Research (2018, February 19). *Digitalisation strategy for the higher education sector 2017–2021* [Report]. Regjeringen. <https://www.regjeringen.no/en/dokumenter/digitalisation-strategy-for-the-higher-education-sector-2017-2021/id2571085/>
- Ministry of Local Government and Modernisation. (2016, May 9). *Digital agenda for Norway in brief* [Report]. Regjeringen. <https://www.regjeringen.no/en/dokumenter/digital-agenda-for-norway-in-brief/id2499897/>

- Morgan, K., Morgan, M., Johansson, L., & Ruud, E. (2016). *A systematic mapping of the effects of ICT on learning outcomes*. Knowledge Center for Education. <https://www.forskningsradet.no/siteassets/publikasjoner/1254026325690.pdf>
- Nash, E. B., Edwards, G. W., Thompson, J. A., & Barfield, W. (2000). A review of presence and performance in virtual environments. *International Journal of Human-Computer Interaction*, 12(1), 1–41.
- NTNU (n.d.). *NTNU Teaching Excellence*. NTNU. Retrieved June 26, 2020, from <https://www.ntnu.edu/teaching-excellence>
- O'Neill, K. (2018). *Tech humanist: How you can make technology better for business and better for humans*. Independently published.
- Pentland, A. (2010). To signal is human: Real-Time data mining unmasks the power of imitation, kith and charisma in our face-to-face social networks. *American Scientist*, 98(3), 204–211.
- Perrin, A.-F., Řeřábek, M., & Ebrahimi, T. (2016). Towards prediction of sense of presence in immersive audiovisual communications. *Electronic Imaging*, 2016(16), 1–8.
- Rainie, H., & Wellman, B. (2012). *Networked: The new social operating system*. The MIT Press.
- Reeves, B., & Nass, C. (1996). *The media equation: How people treat computers, television, and new media like real people and places*. Cambridge University Press.
- Rice, R. E. (1993). Media appropriateness. *Human Communication Research*, 19(4), 451–484.
- Schubert, T., Friedmann, F. & Regenbrecht H. (2001). The experience of presence: Factor analytic insights. *Presence: Teleoperators and Virtual Environments*, 10(3): 266–281.
- Schwab, K. (2017). *The fourth industrial revolution*. Crown.
- Støckert, R. (n.d.). *SALTO: Student-active learning in a two-campus organization*. NTNU. Retrieved June 18, 2020, from <https://www.ntnu.edu/salto>
- Støckert, R., Bergsland, A., Fasciani, S. & Jensenius, A. R. (2020). Student active learning in a two campus organisation. In I. Roceanu (Ed.), *Proceedings of 16th international conference on elearning & software for education* (pp. 612–620). Carol I National Defence University Publishing House
- Støckert, R., Jensenius, A. R., & Saue, S. (2017). Framework for a novel two-campus Master's Programme in Music, Communication and Technology between the University of Oslo and the Norwegian University of Science and Technology in Trondheim. In L. Gómez Chova, A. López Martínez, I. Candel Torres (Eds.), *Proceedings of 10th international conference of education, research and innovation, ICERI2017* (pp. 5831–5840). IATED Academy.

- Stöckert, R., Jensenius, A. R., Xambó, A. & Brandtsegg, Ø. (2019a). A case study in learning spaces for physical-virtual two-campus interaction. *European Journal of Higher Education IT*, 2019(1).
- Stöckert, R. & Stoica, A. S. (2018). Finding the right pedagogy and related prerequisites for a two-campus learning environment. In I. Roceanu (Ed.), *Proceedings of 14th international conference on elearning & software for education* (pp.219–228). Advanced Distributed Learning Association.
- Stöckert, R., Van der Zanden, P., & Peberdy, D. (2019b). Finding general guidelines for redesign of learning spaces. In I. Roceanu (Ed.), *Proceedings of 15th international conference on elearning & software for education* (pp.383–392). Carol I National Defence University Publishing House.
- Tu, C. H. (2000). On-line learning migration: From social learning theory to social presence theory in a CMC environment. *Journal of Network and Computer Applications*, 23(1), 27–37.
- Weitze, C. L., Ørngreen, R., & Levinsen, K. (2013). The global classroom videoconferencing model and first evaluations. In M. Ciussi, & M. Augier (Eds.), *Proceedings of the 12th European conference on elearning* (pp. 503–510). Academic Conferences and Publishing International.
- Witmer, B. G, & Singer, M. J. (1998). Measuring presence in virtual environments: A presence questionnaire. *Presence: Teleoperators and Virtual Environments*, 7(3): 225–240.
- Xambó, A., Stöckert, R., Jensenius, A. R., & Saue, S. (2019a). Facilitating team-based programming learning with web audio. In A. Xambó, S. R. Martín, and G. Roma, *Proceedings of the Web audio conference 2019* (pp. 2–7). NTNU. <http://webaudioconf.com/proceedings/>
- Xambó, A., Saue, S., Jensenius, A. R., Stöckert, R., & Brandtsegg, Ø. (2019b). NIME prototyping in teams: A participatory approach to teaching physical computing. In M. Queiroz & A. Xambó (Eds.), *Proceedings of the New interfaces for musical expression* (pp. 216–221). Universidade Federal do Rio Grande do Sul Porto Alegre. <https://ntnuopen.ntnu.no/ntnu-xmlui/handle/11250/2611637>
- Yu, S., Ally, M, & Tsinakos, A. (Eds.). (2020). *Emerging technologies and pedagogies in the curriculum*. Springer. <https://doi.org/10.1007/978-981-15-0618-5>
- Zydney, J. M., McKimmy, P., Lindberg, R., & Schmidt, M. (2019). Here or there instruction: Lessons learned in implementing innovative approaches to blended synchronous learning. *TechTrends*, 63(2), 123–132. <https://doi.org/10.1007/s11528-018-0344-z>

Appendix A

Questionnaire

These were the questions presented in Part 2:

- 3/4 When you are in class in the Portal, to what extent do you perceive that your fellow students at **the remote/local side** of the Portal are present and that they are able to perceive you?
- 5/6 When you are in class in the Portal, to what extent do you experience that you share a common social space with your fellow students at **the remote/local side** of the Portal?
- 7/8 When you are in class in the Portal attending a presentation by a professor or a fellow student at **the remote/local side** of the Portal, to what degree do you experience that you can direct your attention toward the content of the presentation?
- 9/10 When you are in class in the Portal in an open discussion of a topic, to what degree do you experience that you get engaged in what is said at **the remote/local side** of the Portal?
- 11/12 When you are in class in the Portal, to what degree do you experience that you interact with the teacher or the students at **the remote/local side** of the Portal?
- 13/14 When you are working individually alongside your fellow students in the Portal, to what degree do you experience that you are present together with the students at **the remote/local side** of the Portal?

The questions in Part 3 focused more on issues related to the technologies in the Portal. The first five questions focused on a certain technological aspect that could potentially affect the engagement with students and teachers on the remote side of the Portal, while the two final questions asked about the modification of behavior of self or others on the remote side of the Portal:

- 15. To what extent do you experience that audio quality affects your engagement with students and teachers at **the remote side** of the Portal?
- 16. To what degree do you experience that the audio level affects your engagement with students and teachers at **the remote side** of the Portal?

17. To what degree do you experience that the video image quality affects your engagement with students and teachers at **the remote side** of the Portal?
18. To what degree do you experience that the video image size affects your engagement with students and teachers at **the remote side** of the Portal?
19. To what degree do you experience that the video image perspective and camera placement at **the remote side** of the portal affects your engagement with students and teachers at the remote side of the Portal?
20. To what degree do you experience that the video image perspective and camera placement at **the local side** of the portal affects your engagement with students and teachers at the remote side of the Portal?
21. During class, how often do you experience that you have to modify your behavior, e.g. by turning your head toward the microphone or camera, talking louder or articulating more clearly, etc. to appear more present to students and the teacher/facilitator on the remote side of the Portal?
22. During class, how often do you experience that you would like your fellow students or the teacher at **the remote side** of the Portal to modify their behavior, e.g. by turning their heads toward the microphone or camera, talking louder or articulating more clearly, etc., to appear more present to you?

Three of the questions in the fourth and last part of the questionnaire with free text answers were directly related to presence. Two had a positive angle and one had a negative angle:

23. What factors do you think are the most important in making teachers and students at **the remote side** of the Portal appear more present and engaging to you?
24. Do you have any comments about negative/disruptive/improvable experiences regarding presence in the Portal?
25. Do you have any comments about positive/unique experiences regarding presence in the Portal?

Appendix B

Tables with Results

Table 1: Average Rating with Standard Deviations for Questions 3-22.

Question #	3	4	5	6	7	8	9	10	11	12
M	2.94	4.31	2.69	4.25	3.50	4.31	3.38	4.19	3.00	4.31
SD	0.43	0.77	0.68	0.83	0.71	0.58	0.70	0.73	0.61	0.58
Question #	13	14	15	16	17	18	19	20	21	22
M	2.63	4.00	4.00	3.75	3.25	3.38	3.06	2.75	3.63	3.81
SD	0.93	0.87	1.22	1.39	1.20	1.27	1.39	1.30	1.11	1.13

Table 2: Local and Remote Average Values and the Differences Between Them for Questions 3-14.

Remote			Local			
Question #	M	SD	Question #	M	SD	Diff
3	2.94	0.43	4	4.31	0.77	1.38
5	2.69	0.68	6	4.25	0.83	1.56
7	3.50	0.71	8	4.31	0.58	0.81
9	3.38	0.70	10	4.19	0.73	0.81
11	3.00	0.61	12	4.31	0.58	1.31
13	2.63	0.93	14	4.00	0.87	1.38
Avg.	3.02	0.68		4.23	0.73	1.21

Table 3: Average Values for Questions 15-19 about Audio and Video Aspects.

Audio		
Question #	M	SD
15	4.00	1.22
16	3.75	1.39
Q15-16	3.88	1.31

Video		
Question #	M	SD
17	3.25	1.20
18	3.38	1.27
19	3.06	1.39
Q17-19	3.23	1.29
Q15-19	3.29	1.29

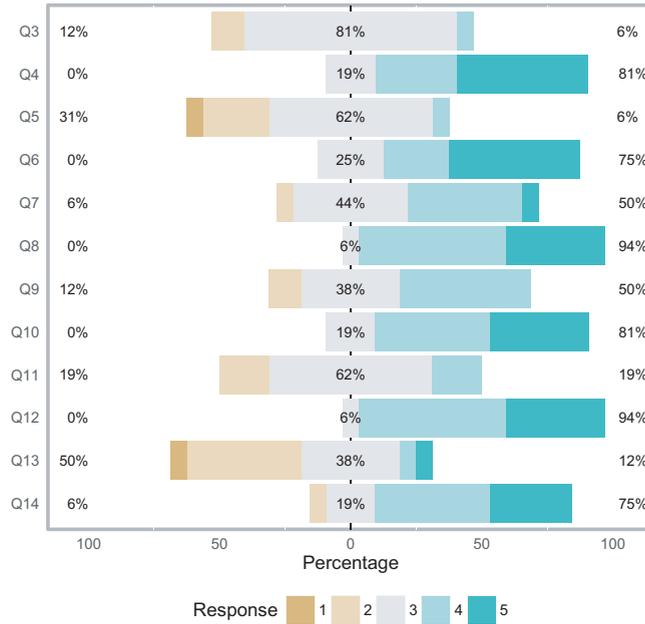


Figure 1: Bar Plot for the Results of Twelve (Q3-Q14) Five Point Likert Item Questions (n = 16).

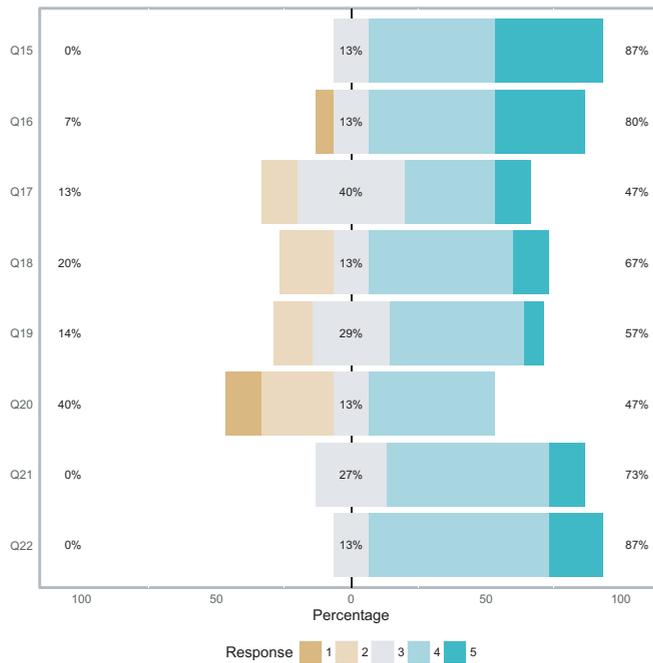


Figure 2: Bar Plot for the Results of Eight (Q15-Q22) Five Point Likert Item Questions about Technological Factors (n = 16).

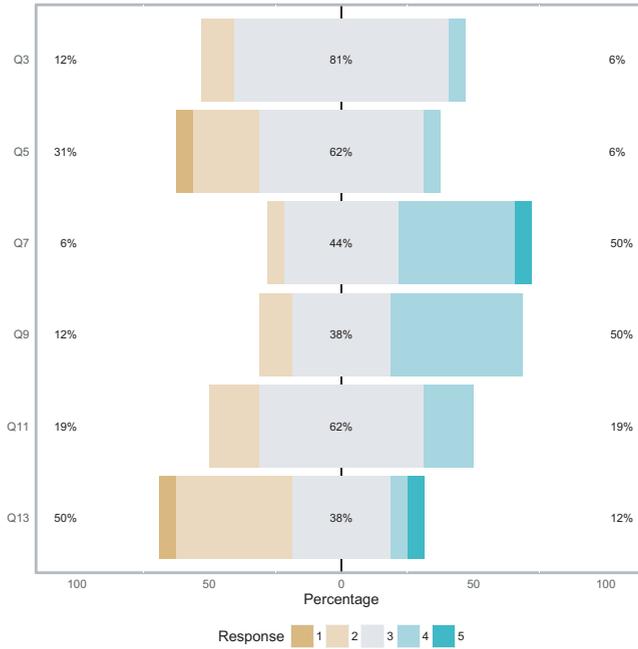


Figure 3: Bar Plot for the Results of Six (Q3, Q5, Q7, Q9, Q11, Q13) Five Point Likert Item Questions for the Remote Condition (n = 16).

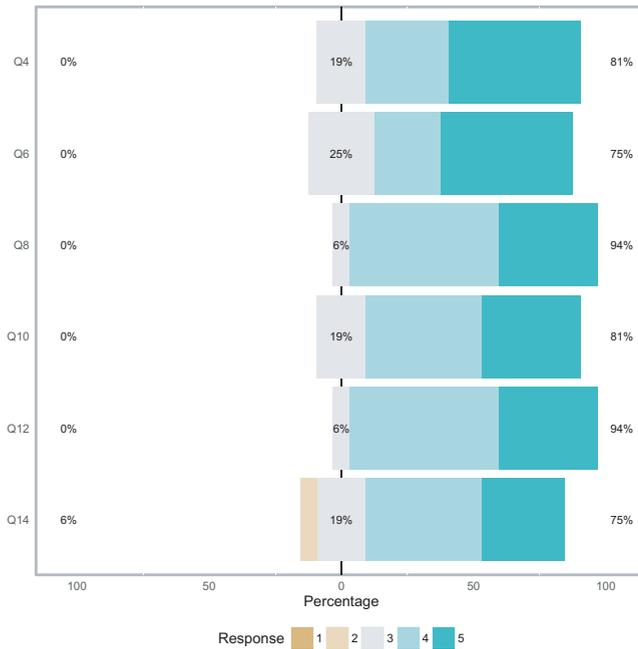


Figure 4: Bar Plot for the Results of Six (Q4, Q6, Q8, Q10, Q12, Q14) Five Point Likert Item Questions for the Local Condition (n = 16).