Exploring Interactional Challenges in Digital Learning

M.M. Bangerl, F. Gürtl

Institute of Interactive Systems and Data Science, Graz University of Technology

Abstract. In our project, we explore interactional challenges experienced by students and teachers in higher education digital learning due to the COVID-19 crisis. For this purpose, we conducted qualitative interviews with Styrian university students, teachers and administrative staff. Our participants encountered five main interactional challenges in synthetic learning situations: Limited perception, reduced participation, a lack of appropriate technical equipment/infrastructure as well as necessary competencies and struggles related to different academic fields. Students, teachers and administrative staff may counteract these challenges by configuring the synthetic learning situation on three interrelated dimensions: The learning scenario, the underlying digital infrastructure and the interaction situation may be transformed by the different actors in alignment with their specific communicative needs. Therefore, programs aimed at improving techno-didactic competencies may be beneficial to both faculty and students. We conclude that negotiation processes among and between these groups will be crucial for the (future) success of interaction in digital learning.

1 Introduction

When universities around the world transitioned to learning and working remotely due to COVID-19 in March 2020, teachers, students and administrative staff had to develop new practices to maintain university operations of researching, teaching, learning and working (UNESCO 2020: 2). This proved challenging, as the transition to digital learning was accompanied by the loss of the shared physical space of the university campus, which aided the creation of a sense of community (see for e.g., Stichweh 2015; Turner et al. 2020: 85).

The experiences of these digital learning periods have sparked re-investigations of long-standing debates in microsociology. Collins (2020) examines how the restriction of face-to-face interaction due to social distancing measures affects various areas of public life and concludes that there are "micro-interactional difficulties of carrying out satisfactory social relationships remotely" (Collins 2020: 496). Similar questions arise for the particular case of university teaching. Previous studies have shown that in-class-interaction between faculty and students is crucial for students' learning outcomes and satisfaction in digital learning (Sun et al. 2018: 77f; for an overview, see Händel et al. 2020: 2). Likewise, Adnan/Anwar (2020: 49) found that students missed opportunities for face-to-face interaction during periods of digital learning, which also led to motivation issues. In their analysis of college students' experiences in different

digital learning scenarios, Gillis and Krull (2020: 296) observed that while students generally value interaction, the ways in which teachers specifically encourage interaction in class may be equally decisive.

In our paper, we aim to answer the following question: How do teachers and students experience interactional challenges in digital learning? In this context, we consider all situations in which two or more individuals may refer to each other via digital technologies as digital interaction situations (see section 2). By conducting qualitative interviews with university staff and students, we describe the interactional challenges experienced by our participants. In doing so, we trace how opportunities for interaction in digital learning may be enabled by specific techno-didactic measures.

Various concepts have been suggested to understand the rapid digitalization of university teaching and learning due to COVID-19, including distance learning, digital learning, online learning, and blended learning.[1] However, we argue that neither of these terms is fully suitable to describe the variety of learning scenarios encountered by our interviewees (e.g., video conferences, streams, recordings, texts, blended learning). Therefore, we use the term 'digital learning' to refer to learning situations which are characterized by the incorporation of and/or mediation by digital technologies, allowing the interactants to communicate synchronously or asynchronously. Thus, our understanding of 'digital learning' includes all scenarios commonly associated with distance, digital, online, and blended learning.

In the following section, we summarize selected theoretical concepts helpful for understanding digitally mediated interaction before giving an overview of our methods and sample (section 3). We then present five main interactional challenges identified in our data (section 4). Subsequently, we look at opportunities for different groups of actors to configure synthetic learning situations in order to overcome these challenges (section 5). Finally, we point out limitations of our research (section 6), summarize central points of our analysis and suggest some areas for further research (section 7).

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[1] Gašević et al. (2015) demonstrate that the conceptual understanding of the term 'online learning' has evolved and diversified since its first occurrence in the 1990s, while nevertheless remaining ambiguous. They define 'distance learning' as "teaching and planned learning where the teaching occurs in a different place from learning" (Gašević et al. 2015: 99) while understanding 'online learning' as "a form of distance education where technology mediates the learning process, teaching is delivered completely using the internet and students and instructors are not required to be available at the same time and place" (Gašević et al. 2015: 100). Finally, the term 'blended learning' is used to denote "practices that combine (or blend) traditional face-to-face instruction with online learning" (Gašević et al. 2015: 101).

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2 From Copresent Interaction Situations to Synthetic Learning Situations

Classical microsociological theories in the Goffmanian tradition generally assume a "face to face" or "body to body starting point" (Goffman 1983: 2) to define interaction situations. These interaction situations are characterized by the "response presence" (Goffman 1983: 2) of the interactants, allowing them "to share a joint focus of attention, perceive that they do so, and perceive this perceiving" (Goffman 1983: 3). The criterion of response presence is fulfilled in conventional on-site-teaching, as students and teachers share a physical location, enabling immediate and continuous mutual monitoring of the interaction partners. In contrast, in digital teaching and learning, opportunities for interaction are enabled by telecommunication technologies. It is via these technologies that the interactants may perceive and *refer* to each other. Thus, we may argue that *coreference* rather than *copresence* is fundamental for mutual perception and signaling meaning in interaction (Houben 2018: 14), which may be fulfilled in mediated interaction situations as well as "traditional" interaction situations.

Goffman considered technological artefacts primarily regarding their role in interaction situations, either as "interactional tools" or as "laminations of frames" (Klowait 2019: 606). Pinch (2019: 412) argues that Goffman's theories can also be read as a "hidden sociology of technology", describing the interactional importance of artefacts. During the material turn in STS, theorists increasingly focused on technological artefacts specifically: researchers investigated how the meaning of artefacts is generated resulting from negotiating processes between different groups of actors, which lead to an increased examination of the potential agency of artefacts and the historical contingencies enabling current interaction situations (Klowait 2019: 608). The increased occurrence of mediated communication formats encouraged endeavors to develop "framework extensions" (Klowait 2019: 608) allowing classical microsociological theories to conceptualize diverse interactional formats. Furthermore, theoretical perspectives offered by fields like actor network theory (Klowait 2019: 617) and presence studies (Hahn/Stempfhuber 2015: 8; Steuer 1992) have shown that a clear distinction between "mediated" and "non-mediated" interaction situations cannot be maintained.

Looking closer at mediated interaction situations, Knorr-Cetina's (2009: 69) conception of "synthetic situations" proves useful. Synthetic situations are interaction situations which are augmented and extended by scopic systems. Scopic systems allow their users to collect, observe and project different kinds of information relevant to interaction situations by using telecommunication technologies. The importance of scopic systems for enabling interaction can vary in different types of synthetic

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situations, ranging from situations with singular synthetic components to "telepresence arrangement[s]" (Knorr-Cetina 2009: 69), for example in video conferencing scenarios. Thus, digital learning can occur in varyingly synthesized situations. Because of their contingent and fluid nature, synthetic situations may be continuously rearranged by the interactants according to their specific communicative needs. For example, in synthetic learning situations, students may use video conferencing software to interact with their peers and teachers, while simultaneously taking notes digitally.

In all cases, successful interaction in synthetic situations is based on well-functioning technology. In this context, the material design and features of technologies *afford* the interactants specific ways of referring to each other (Davis/Chouinard 2016; Hutchby 2001; Pinch 2019: 421). For example, some video conferencing software applications allow their users to send chat messages or share their screen with the other participants, thereby providing additional ways of interacting.

When it comes to digital learning, co-reference in synthetic learning situations may be enabled by employing different kinds of techno-didactic learning scenarios. Following Matos (2014), we understand learning scenarios as "hypothetical situation[s] of teaching-learning [...] composed of a set of elements that (i) describe the context in which learning takes place, and (ii) structures the environment in which learning happens" (transl. by Pedro et al. 2019: 269f). The focus of this paper is on synchronous digital teaching via video conferencing software, as this learning scenario was experienced most frequently by our participants and therefore provides useful material for a differentiated analysis of interactional challenges. The exploration of these challenges as well as the strategies employed by our participants to address them may allow insights into how the interaction order of (digital) learning is being negotiated and potentially adapted to the characteristics of synthetic learning situations.

3 Methods and Sample

The concepts introduced in the previous section are useful to contextualize our participants' shared experiences during the COVID-19 pandemic. However, in this paper, we do not aim to provide a systematic theoretical framework due to the unprecedented circumstances and constantly changing pandemic conditions as well as the highly heterogeneous individual and organizational coping strategies. Rather, our research approach is data-driven, and aims to give an explorative overview over interactional challenges and possible solutions for providing opportunities for interaction in synthetic learning situations.

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3.1 Research Approach

All of the data analyzed in this paper has been gathered in the context of the ongoing research project "*Digitalisierungschancen der steirischen Universitäten*".[2] The project's goal is to monitor the COVID-19 induced digitalization practices in higher education by examining experiences of students, teachers and non-scientific university staff from four universities located in the Austrian federal state of Styria. The perceived potentials and challenges resulting from digital technologies and practices put into action due to the COVID-19 crisis may be used as a base for reflection to guide current and future digitalization processes in Styrian higher education. The project is scheduled to be completed by September 2021; therefore, all reported results must be understood as preliminary.

This project takes a qualitative approach in both data collection and analysis. Qualitative methods are well-suited to make sense of experiences, feelings, relationships, coping strategies and personal perspectives of interviewees (Strauss/Corbin 1996: 4f). Universities are places where several social groups operate and interact with each other. A qualitative approach can handle this diversity and the relations and interdependencies of these different fields and actors (Flick et al. 2017: 17). Finally, the flexibility and openness afforded by qualitative research is helpful to deal with the changing conditions for research due to the COVID-19 pandemic (Przyborski/Wohlrab-Sahr 2014: 118).

3.2 Sampling and Data Analysis

The data material for this project was collected by conducting guided, qualitative interviews with participants from four Styrian universities.[3] The project sample as of May 31st consists of 57 interviews total, including 18 interviews with students (undergraduate and graduate), 20 interviews with scientific staff/faculty (from pre-doctoral level to habilitated) and 19 interviews with non-scientific staff/key actors

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[2] The project team consists of researchers with a social science and computer science background from Graz University of Technology. Team members include Stefanie Lindstaedt, Bernhard Wieser, Viktoria Pammer-Schindler, Christian Dayé, Stefan Reichmann, Marion Rowies and Kübra Karatas, as well as Mia Bangerl and Franziska Gürtl. The current project "*Digitalisierungschancen der steirischen Universitäten*" is funded by the Styrian Department of Science and Research within the funding program "*Aus der Corona-Krise lernen!*". Part of the collected data was originally gathered for a similar predecessor project "*Reallabor - die eilige Digitalisierung*" and was included in the follow-up project with consent from the interviewees.

[3] Data collection so far has taken place in two time periods. The first period began in May 2020 and ended in September 2020, covering the final months and summer break of the first COVID-19 semester in Styrian universities. The second period stretched from January to March 2021, covering the final month of the second semester, the semester break and then the beginning of the third semester in distance mode.

(various organizational positions). In our sampling process we prioritized diversity and aimed to include participants from different academic disciplines, personal life circumstances (e.g., childcare responsibilities), seniority levels, and pre-pandemic experiences with digital teaching and learning technologies.

The interview transcripts and protocols[4] were analyzed qualitatively following Kuckartz's (2016: 101-111) guidelines for *content structuring qualitative content analysis*. This method of analysis allows the researcher to build analytical codes and subcodes both deductively and inductively (Kuckartz 2016: 101f). By coding the material, common perspectives, experiences and themes are identified and put in relation to each other, which facilitates the development of analytical models and frameworks (Kuckartz 2016: 117-121). At the early stages of our analysis, a basic coding system was inductively crafted from selected data segments and then extended and defined in detail in a systematic coding guideline. The changing pandemic circumstances, its consequences on higher education as well as increased digital competencies of university staff and students required us to revise and extend the original coding system and guidelines several times to suit all gathered data.

4 Interactional Challenges

When talking about their interaction experiences in synthetic learning situations, many of our participants described a feeling of something being lost in digital interaction or feeling *qualitatively different* compared to face-to-face interaction. These perceived differences were the starting point for our investigation exploring interactional challenges, which we will present in this section.

> "They [the teachers] say themselves that if I talk into the screen for an hour and a half, I can never provide the same information as in being present. Unfortunately, that's also a bit of a problem." (S1[5])

S1 compares their experience in digital learning to regular on-site teaching and states that the informational quality of the interaction feels different. Another student describes that they experienced a "barrier" in video conferencing and goes on to add that the perceived loss in interactional richness is less of a problem for course types that generally include little student-teacher interaction, such as lectures (S2). Some participants tended to idealize and romanticize teacher-student-interaction in on-site teaching due to their familiar interaction opportunities. Furthermore, the participants'

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[4] All quotes from the data in this paper have been translated to English from the original language, German.

[5] Numbered identifiers are used to refer to interviews in this paper: S denotes interviews with students, T denotes teachers, and A denotes key members of the university administration.

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reflection on recent digital learning experiences led to a re-evaluation of established didactic methods and formats. For example, both teachers and students explained that it is easier to deliver lectures digitally compared to seminars. This motivated some participants to comment on the "antiquated" nature of lecture-oriented classes, criticizing the "impersonal" and "outdated" didactic format due to its teacher centeredness (S2, T3, T6). In general, students as well as teachers are more likely to be satisfied with their learning/teaching experience in highly interactive classes (S13, T6, T7), consistent with the literature (Sun et al. 2018: 77f).[6]

Therefore, it is crucial to take a closer look at the "new sorts of interactional problems which interactants need to solve" (Pinch 2019: 422) in order to understand the apparent difficulties both teachers and students encountered in their digital learning experience.

As the COVID-19 pandemic affected all areas of life, students and faculty experienced additional barriers to digital learning, such as increased levels of stress and anxiety, challenges related to caring responsibilities, and income as well as housing insecurity, all of which are linked to the pandemic (see also Gillis/Krull 2020). Factors like the living situation (e.g., noise level) significantly influenced our participants' abilities to focus on and participate in digital learning. While it is essential to acknowledge these barriers, they will not be the focus of our analysis. Instead, the main barriers for interaction in digital learning settings we identify and discuss in the following section are linked to limitations in *perception*, increased struggles with *participation*, inadequate availability of both *technical equipment and infrastructure* as well as *competencies*, along with the communicative needs of specific *academic cultures and communities of practice*.

4.1 Perception

One key barrier for interaction in digital learning experienced by the interviewees is that it is difficult to grasp the interaction situation. This includes limited sensory perception of the interaction partners and their verbal and non-verbal communication signals. Consequently, it is challenging for teachers and students to assess the mood of the group:

"When I stand in the room, I perceive, I see, I hear, maybe I even smell something, I'm not sure. But I perceive how people are doing. The first person is perhaps bored, the second is worried, the third is looking for something, and I notice that. I don't need to be active. I don't need to look at them, it's just there. It gives me a sense for the mood in the room, of the group, which is essential to enable an exchange of

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[6] Various educational researchers have specifically examined interactional practices in face-to-face teaching. See for example Tyagunova's (2017) analysis of students' strategies to manage their engagement in seminars or Wenzl's (2010) study on school children's participatory practices and their socializing function.

information. Of course, that's missing when everyone is sitting in front of their screen. This overall feeling is gone." (T4)

Difficulties in perceiving the interaction partners may lead to feelings of uncertainty and exhaustion ("Zoom fatigue", see also Collins 2020: 495f) which may motivate the interaction partners to withdraw from the interaction situation, for example, by turning off their cameras. Students explained that they feel tempted to keep their cameras turned off in class, even though they are aware that this may lead to them not paying attention in class (S9, S11, S13). The students' hesitation to turn on their cameras is partly based on feelings of discomfort and shame associated with exposing private spaces. Turned-off cameras may therefore serve as "involvement shield[s]" (Goffman 1963, cited by Turner 2020: 78). In synthetic learning situations where the cameras were turned on, the interviewees reported that it was easier to get a feel for the joint interaction situation, which motivated students to engage in discussions.

For teachers, the lack of responses and reactions from students leads to an increasing feeling of 'talking into emptiness', which left some teachers demotivated and frustrated towards teaching in digital settings (T5, T9). This is why teachers appreciate it if students turn on their cameras, as the visual information provides additional "nonverbal, bodily feedback" (T9), allowing them to monitor if the students are continuously present in front of their screen at home and are able to comprehend the class content (T7, T9, T10). Over time, teachers devised several strategies for checking and maintaining the student's level of engagement.[7]

There are also some perceptual advantages in synthetic situations afforded by technical features of video conferencing software. Some interviewees noted that the well-organized layout of certain software facilitates identifying the current speaker, which makes it easier to assess the students' level of participation (T1, T3).

4.2 Participation

For students, opportunities to ask questions are an essential component of learning. In general, students found it more difficult to make a verbal contribution or ask questions in synthetic learning situations compared to face-to-face teaching (S13), matching the observations of Turner et al. (2020: 81).

One reason for the students' reluctance to speak up in digital classes was that they found it challenging to anticipate how their verbal contribution would be interpreted by the other students and judged by the class teacher. Therefore, students sometimes

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[7] However, as Collins (2020: 488) notes, "[w]e cannot assume that F2F classrooms are automatically successful Interaction Rituals". Muhle (2021) has shown that students use various strategies to stage presence and non-presence in seminar classrooms. Thus, it would be insightful to investigate how students may adapt their interactional strategies to different digital learning scenarios.

hesitated to ask questions in class because they were afraid of exposing knowledge gaps or of asking "dumb questions":

> "And sometimes you can't be sure how dumb your question really is. And if it is a small group and the teacher approximately knows your names, you don't want to ask extremely obvious questions. Maybe this completely anonymous thing. [...] I think, we don't have any teachers who are that vindictive, but still, you don't want to look stupid." (S12)

This insecurity was amplified in synthetic learning situations, as some students were having difficulties to remain attentive and were thus afraid of asking questions (S9, S12). Interestingly, students reported that they feel more comfortable asking questions in a regular lecture hall where they feel more anonymous and can evaluate the reactions of their interaction partners more easily (S4). Because of this insecurity, students would appreciate opportunities to ask questions anonymously in synthetic learning situations (S4, S12).

Another reason for decreased levels of participation in digital classes is that verbal contributions must be well-coordinated regarding timing and an adequate handling of telecommunication technologies to avoid awkwardness. For instance, students and teachers tried to wait for the right moment to unmute their microphones. This is difficult because regular turn-taking-strategies such as monitoring non-verbal cues cannot be applied easily in synthetic learning situations. Alternative forms of communicating like the chat function also require specific time-sensitive considerations, as composing a question in writing usually takes more time (T9, S13).

Other factors that influence the level of participation in synthetic learning situations are individual motivation and interest in the course subject. Also, teachers as well as students explained that the students' motivation to participate is higher in small groups or break-out-sessions. Hence, while teachers and students found ways of interacting strategically in synthetic learning situations, they experienced a lack of spontaneous interaction compared to face-to-face teaching (see also Turner 2020: 92).

4.3 Technical Equipment and Infrastructure

During the COVID-19 pandemic, the organizational or personal ownership of adequate and well-functioning technological infrastructure was a necessary requirement for any learning situation (Gillis/Krull 2020: 295f). Therefore, digital learning was often not achievable in regions located on the lower spectrum of the digital divide (Adnan/Anwar 2020: 49), in contrast to countries like Germany, where Händel et al. (2020: 5f) found that students were generally well-equipped for digital learning.

Internet bandwidth and performance substantially influenced how both university students and teachers were able to initiate and participate in interaction situations. Owning a webcam or headset of sufficient quality were also crucial to be able to

participate in synthetic learning situations successfully. This challenge was recognized by both students and teachers as well as universities boards and departments. Despite university administration's financial efforts, a large number of teachers and students had to invest personal means to upgrade their equipment in order to teach and attend their classes.

If students encountered technological difficulties, they were not only less able, but also less willing to participate in interaction opportunities.

"During the very first lockdown I had problems with my laptop and my audio never worked properly and then I used my phone for everything. So, I used my phone for all the online stuff. And then I always felt like, somehow, I didn't really want to say anything, because sometimes the audio wasn't working properly again, and nobody could understand me. And this is so arduous somehow." (S9)

Also, it must be mentioned that even under ideal circumstances, the digital technologies available for teaching and learning are not (yet) able to fully accommodate all communicative needs of academic learning scenarios (see section 4.5). Burgstahler et al. (2004: 244) also point out that barrier-free technology-design is crucial for ensuring accessibility and inclusivity for both students and teachers with disabilities in digital learning. While technological improvements are to be expected, at the moment, technologies are not only enriching, but also constraining, teaching and learning.

4.4 Competencies

Besides technological requirements, digital learning also requires a set of competencies to be able to enter, manipulate and interact in synthetic learning situations. However, not all teachers and students could draw on these competencies to enable a successful transition to digital learning (Zawacki-Richter 2020: 218f; Turner et al. 2020: 84).

First and foremost, this concerns skills in operating technology—both the digital learning software chosen by the university or teacher and the necessary hardware (e.g., computer, headset) for running and accessing these programs to be able to access the benefits of their communicative affordances (e.g., muting and unmuting, screen sharing, creating breakout-rooms, etc.; see also Hutchby 2001: 448).

According to employees of university IT and media departments, vast differences in these competencies became visible once the COVID-19-induced digital transformation of the universities started. Some teachers were already experienced in digital learning and encountered little to no trouble in learning to work with these mostly unfamiliar digital technologies. Others were able to convert their classes to digital formats but would have liked more support from the university. Some teachers struggled hard with teaching digitally due to their lack of technological skills. For them, teaching became

frustrating, and some decided to stop all teaching activity and wait out the pandemic until they could teach on-site again.

Also, even though most students were able to participate in their digital classes relatively easily, the competencies necessary to interact in fully synthesized learning situations are not limited to technology, but also include the skills to concentrate and participate without the familiar on-site infrastructure (A1, see also Turner et al. 2020: 96). Moreover, teachers need competencies for planning and carrying out digital classes to be able to access the benefits and enrichments of digital technologies, rather than being constrained by the limitations.

Both teachers and students agreed that digital learning is characterized by different dynamics and demands different didactic concepts than on-site classes.

> "If I want to produce a good video on YouTube, I won't film myself standing at the blackboard [...] but I may use visualizations or videos. Yes, I don't know. But in this direction, by all means. So, you have to change the teaching, the way of lecturing. And not just record it like it was before." (S3).

In general, overcoming interactional challenges in digital learning might need further discourse and coordination among and between parties about questions of responsibility (see section 5.2). Among our interviewees, university further (digital) education offers were mainly valued and attended by teachers who had always been striving to improve their teaching (T4, T6, T10). Therefore, generating personal and professional interest in improving teaching is a crucial step towards improving digitally mediated interaction in university classes.

4.5 Academic Cultures and Communities of Practice

As some academic disciplines pose special challenges for digitally mediated interaction, we strived to interview participants from various academic disciplines in our data sample. In doing so, we identified three main interactional challenges that are related to the specific practices of different academic cultures.

Firstly, these challenges are often related to the necessity of working with specific on-site equipment. This is the case for many natural sciences as well as technical disciplines where students learn practical skills in laboratories and workshops. Other examples include rehearsing with heavy or rare instruments (e.g., church organ) or using physical infrastructure providing collective knowledge (e.g., libraries, archives).

Secondly, some challenges are connected to collaborative work. This is especially relevant for artistic disciplines such as music and performing arts because successful collaboration in these subjects depends on exact synchronicity, high audio quality and visibility. For example, even a minimal delay is highly disruptive to a chamber music ensemble rehearsing digitally. The reduced sensory perception in digitally mediated

interaction (see section 4.1) is an equally great obstacle for acting lessons, because it disables the students from fully perceiving gestures and facial expressions (S7).

Finally, physical spaces are often tightly connected to specific social infrastructure. When lacking the familiar physical spaces, social communities can struggle to adjust and adapt their routines, practices, and rituals in digital spaces. One example for this challenge are practicums in school classrooms for students in education studies. Affected interviewees reported that digital teaching practicums were very different to their previous on-site experiences (S9, A9). Another example is the interaction between performers and their audience in music and performing arts classes.

5 Configuring Synthetic Learning Situations

5.1 Conceptual Framework: Synthetic Learning Situations

We have shown that there are various interactional challenges in synthetic learning situations that often influence and amplify each other. The interactional challenges experienced by students and teachers can be organized in three interrelated dimensions (learning scenario, digital infrastructure, interaction situation). What follows is a brief outline of how the three dimensions influence the configuration of the synthetic learning interaction situation (see figure 1). In the next section, we argue that the configuration of the three dimensions can be manipulated situationally or structurally by different actors according to their specific communicative needs.

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Fig. 1. Configuration of synthetic learning situations (Source: compiled by the authors)
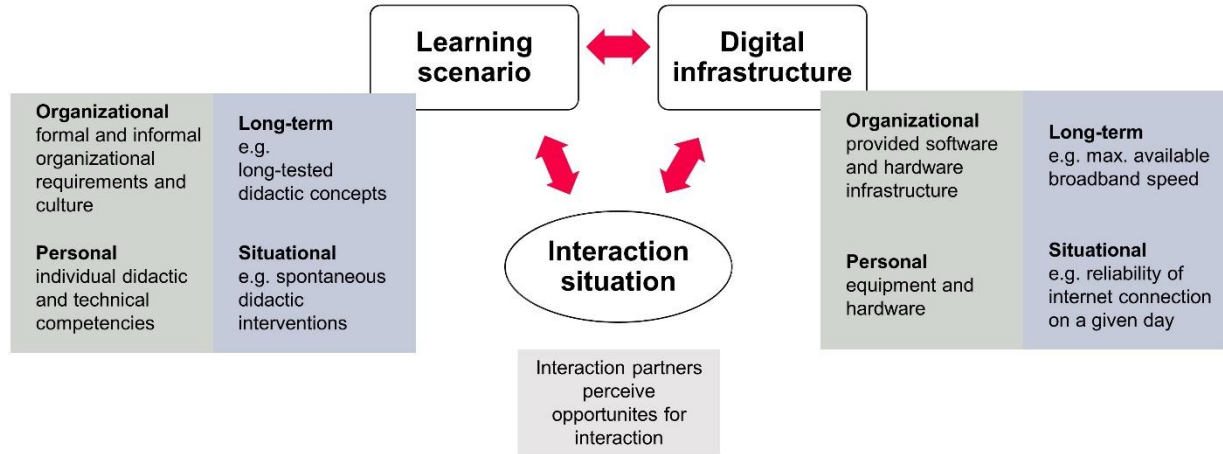
5.1.1 Learning scenario

Firstly, the design of a specific learning scenario is determined by organizational factors such as formal requirements and informal organizational expectations, for example concerning course and exam type. In addition, the teachers' personal didactic and technical competencies and preferences influence how learning scenarios are conceptualized by teachers. Furthermore, the teachers' didactic experiences as well as spontaneous situational interventions (e.g., encouraging students to ask questions in class) impact how students and teachers may refer to each other in class. While long-term planning helps to create effective learning scenarios, situational flexibility is crucial in digital learning during a pandemic, and the specific situational implementation of the learning scenario may be equally decisive as the overall didactic design (Gillis/Krull 2020: 296).

5.1.2 Digital infrastructure

Secondly, the digital infrastructure provided by higher education institutions has a major influence on how learning scenarios may be implemented. Many teachers have also supplemented the institutionally provided equipment with personal hardware and software. Moreover, the long-term availability and situational reliability of the infrastructure is crucial for interference-free synthetic interaction situations. In all cases, specific technical features afford and constrain specific forms of interaction in digital learning scenarios (Pinch 2019: 421; Hutchby 2001). Thus, technical affordances may enable, stimulate, obstruct and prevent interaction (Davis/Chouinard 2016).

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5.1.3 Interaction situation

Thirdly, students and teachers perceive opportunities for interaction in synthetic learning situations.[8] At this point, all the previously mentioned interactional challenges are relevant: Besides technical challenges and competencies, factors like the difficulty to monitor verbal and non-verbal cues of the interaction partners, *Zoom fatigue* (Collins 2020: 490f), the class size, the affective state of the interactants as well as personal interest and preferences all affect the interactants' inclination to contribute to the in-class-conversation. Also, feelings of invisibility due to switched off cameras may lead to disengagement (Turner 2020: 85). Moreover, in digital learning, multicommunication practices pose a special challenge, as the interactants may engage in multiple conversations simultaneously, which requires interactants to employ various strategies to "engage the attention of their audience before they can start a conversation" (Turner et al. 2020: 79).

5.2 Configuring the Synthetic Learning Situation

We have seen that there are some prerequisites for creating synthetic interaction situations and for participating and interacting successfully (see section 4). There are three main groups of actors that can affect the configuration of the interaction situation: Teachers, students and key members of the university administration (e.g., IT-administrators, administrative decision-makers, etc.). The different actors may be limited individually in their scope of action according to their organizational status.

   In this section, some of the solutions developed by these groups of actors in response to the interactional challenges will be described. As we will show, some of the devised strategies are the result of negotiating processes between different groups of actors.

5.2.1 Students

Students have developed various strategies to deal with the specificities of interacting in digital learning environments. For example, they decided to ask their peers for help if there were no opportunities to interact with the class teacher (S5). While students enjoyed the flexibility of controlling their level of engagement by choosing whether to turn on their cameras in class, they were also aware of a certain ambivalence (S8, S9). Both students and teachers know that it is easier for students to withdraw from synthetic learning situations completely compared to on-site teaching, as students can always decide to turn off their microphones and cameras and not participate at all (T6).

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[8] Here, an extended analysis of suitable data (e.g., ethnography) could look closer at the organizational, personal, situational, and long-term parameters of the interaction situation and thereby elaborate on the interactants' bodily and affective states.

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Because of the temptation to disengage from class, some students would like their teachers to take care of the arrangement of the synthetic learning situation, for example, by providing explicit behavioral guidelines like a camera requirement (S3, S6, S9; see also Turner 2020: 93):

"But if somehow the camera requirement is not there, then I have the feeling, you can forget it anyway. Because we all know each other. So, if we are somehow not observed during a lecture, then everyone just does something else. […] So, when I don't have my camera switched on, I always let myself be a bit distracted. But when you have the camera, you're more involved in the course. So, if I were a professor, I would introduce the camera requirement." (S9)

However, some teachers were reluctant to enforce a camera-rule due to privacy concerns (T6). Students also appreciated it if they were encouraged to respond to teachers' questions or obliged to ask questions themselves to stimulate discussion (S10, S11). Finally, students welcomed opportunities to ask (anonymous) questions about class content (synchronously or asynchronously, during class time or in dedicated "question hours").

In summary, consistent with results from Turner et al. (2020), the participants expect teachers to develop learning scenarios which are tailored to the characteristics of synthetic learning situations and provide clear information on class requirements.

5.2.2 Teachers

Among our participants, teachers implemented a number of strategies to promote interaction in synthetic learning situations.

Firstly, they had to decide on specific digital infrastructures to fit their preferred digital learning scenario. This could be challenging, because optimally, teachers wanted to fit the digital technologies to their preferred learning scenario. However, the available teaching software-infrastructure was organizationally limited due to IT-support capacities and their university's data protection policy. To promote interaction, teachers especially valued video conference formats, affording verbal communication opportunities. Naturally, these steps and decisions required teachers to test, research and learn about multiple digital teaching tools, which was time-consuming and could be challenging for some, as we explained in section 4.4.

Secondly, to ensure interaction opportunities, the teachers planned and conceptualized their teaching sessions according to their didactic strategies and principles (see also Gillis/Krull 2020: 284f). Many of those strategies were similar to on-site teaching (e.g., creating feedback opportunities for students), but played out differently in fully digital scenarios (e.g., using a digital feedback tool instead of writing on paper). Additionally, some didactic planning steps seem to be especially beneficial to digital scenarios. This includes, for example, structuring classes in designated

components (lecture, practical tasks, revision, discussion, etc.), to be able to choose a suitable techno-didactic implementation for each component (T2, T6). Another example is the provision of a netiquette, a clear guideline for behavior and interaction in digital learning scenarios (e.g., obligation to switch on the camera).

Finally, the university teachers repeatedly pointed out that specific attitudes and behaviors can stimulate interaction with and among students. This also applies to non-digital scenarios, but even more so to digital learning scenarios, due to the limited possibilities of perceiving and assessing the situation (see section 4.1). Therefore, teachers tried to provide a comfortable learning atmosphere by gesturally, mimically and verbally encouraging students to ask questions, engage in discussions and generally use all available interaction opportunities.

This also raises questions about the self-image of teachers. When it comes to interaction in class, some teachers believe that "if someone doesn't want to engage, I can't force them" (T8). But others feel that it is part of their job to activate and motivate the students to participate in class. For them, teaching is not only a job, but also a mission:

> "This is our youth; this is our future. We have the chance to be with them, to develop them and accompany them with knowledge and love for research, and ignite the spark with love, with empathy, with wit and community and enthusiasm." (T5)

5.2.3 Technical Administrators and Key Actors

As we established in section 5.2, different groups of actors can manipulate synthetic learning situations according to their respective area of activity and organizational position. However, it is important to keep in mind that technological design and organizational availability of technologies are the result of negotiating processes and choices made by various actors within universities. This is why we decided to include technical administrators, experts in digital teaching and high-ranking university officials in our data sample.

During the past COVID-19 semesters, these actors put a lot of effort into devising coping strategies for pandemic related challenges. Because most teachers and students had little to no experience in digital learning and teaching prior to the pandemic, university administrative staff were occupied with supporting and equipping those in need of immediate help.

Administrative staff agreed that digital learning and teaching offers benefits for higher education beyond pandemic digital learning periods (A1–A8). In order to maximize these benefits, university officials and key actors discussed strategies to equip university staff with suitable technological devices. Moreover, efforts were aimed at informing both staff and students about the usage and qualities of selected digital technologies and at supporting the development of technical and didactic

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competencies for digital learning and teaching. IT-services employees and digital teaching experts also strived to stay informed about current developments in digital technologies in order to select and support appropriate tools for their university's pool of technologies and services complying to data protection guidelines (A1, A3, A4, A5).

Furthermore, a need for better communication between groups of actors was recognized and a wish for designated feedback channels between the university and its faculty and students was expressed (A1, A2, A9, A10).

The interviewees also commented on the general importance of digital technologies in university teaching and learning. To them, it was crucial to make teachers and students realize that digital technologies are already present in everyday life and should therefore also be a part of higher education curricula (see also Adnan/Anwar 2020: 49). However, they did not see digital learning as a replacement, but rather as an enrichment for on-site teaching and learning. For them, the university of the future should make use of digital learning infrastructure where it is deemed beneficial:

> "It is and was always our goal to return to on-campus teaching and working. Technology should complement, not replace, or else we can turn into a distance university altogether and only do distance learning." (A8)

6. Limitations

Acknowledging some of the limitations of our research, we want to note once more that all of our results are preliminary and data collection is still ongoing. Also, our sample only contains data collected at Styrian universities. The ways in which synthetic learning situations affect interactional challenges may vary in different higher education contexts according to students' and teachers' expectations. Finally, the general setting of our research in the context of the COVID-19 pandemic affects how our participants make sense of their recent experiences in digital learning. Nevertheless, the pandemic experiences can be interpreted as a test phase for intensified digital learning which provides a useful basis for reflecting on the future of higher education. These results can help in imagining future potentials and challenges of incorporating digital technologies into higher education teaching and learning.

7. Conclusion

In this study, we set out to explore interactional challenges in digital learning. By looking at digital teaching and learning experiences from multiple perspectives, we identified several interactional problems. Interactional problems in digital learning are linked to the mutual perception of the interactants, participatory commitment, technical affordances, competencies, and specific challenges related to communicative

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demands of different academic disciplines. In addition, it has become clear that the use of digital technologies also offers potential for new forms of participation and learning.

We have seen that the configuration of synthetic learning situations may be shaped by different groups of actors (students, teachers, key actors) according to their specific communicative needs within their respective scope of action. Moreover, the configuration of the synthetic learning situation may be affected on a situational or a transsituational level. For example, students may control their level of engagement in digital classes by deliberately turning their cameras on or off in a particular class. Teachers may decide to alter their didactic concept spontaneously to respond to situational interactional needs. However, in most cases, only technical administrators can adapt existing digital teaching tools on a structural level by adding or removing features. In all cases, digital teaching tools can enhance digital learning if their affordances correspond to the communicative needs of the interactants to enable reliable coreference. Furthermore, both faculty and students can benefit from training programs aimed at improving didactic and digital competencies (see also Händel et al. 2020: 10).

In many cases, the configuration of the synthetic learning situation is shaped by negotiating processes between different groups of actors: For instance, teachers and students may agree on clear rules of conduct for digital learning to facilitate interaction in digital classes and thereby "co-creat[e]" (Turner et al. 2020: 95) interactional expectations for synthetic learning situations. Key members of the university administration may allow faculty and students to engage in participatory decision-making processes to decide on the available technological infrastructure and the development of a digitalization strategy aligned with the university's long-term development goals.

Pinch (2019: 423) calls for future research to address "technological choices specifically, and how they are negotiated as part of the interaction order". In our paper, we tried to hint at what an analysis of this kind might look like, as we have shown which kinds of interactional challenges may occur in digital learning that interactants need to address by appropriately configuring synthetic learning situations.

However, when thinking about the future of higher education and the long-term role of digital technologies, a critical perspective should be applied. In this context, it is essential to investigate which actors are involved in decision-making processes and which individuals and corporations may benefit from an increasing corporation of digital technologies into higher education. Particularly, questions related to digital inequality, personal data protection and security, privacy, digital discrimination and ethics, digital didactics and technological innovation offer diverse opportunities for future research.

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