Synchronous Online Lectures in Emergency Remote Teaching: The Role of Immersion, Social Scripts and Group Awareness

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Abstract: Switching to synchronous online lectures during the Covid-19 pandemic poses many challenges for teachers. On-site and online lectures are different in ways that may add new challenges for teachers and students and thus affect teaching quality. While there is a substantial amount of research on conducting online courses and fostering online communication and interaction, the specifics of lectures and the challenges imposed by the emergency shift to an online format are still understudied. Thus, in this contribution, we discuss three core aspects that need re-investigation when switching to an online format: the teaching context, the availability of social information and the social requirements of the learning scenario. The Learning Sciences are equipped to answer to such challenges by providing evidence-based information on requirements and (technological) support for social interaction processes within education.

Keywords: Synchronous Online Lectures, Immersion, Script Theory, Group Awareness

1. Emergency Shift to Synchronous Online Lectures

The Covid-19 pandemic forced many countries to impose social-distancing rules. As a result, educational institutions like universities had to drastically adjust their teaching structures and switched to emergency remote teaching (ERT), "a temporary shift of instructional delivery to an alternate mode due to crisis circumstances" (Reynolds & Chu, 2020, p. 233). A first goal was to provide emergency instruction and learning opportunities, but, as the crisis continues, teaching needs to exceed "emergency care". While education may not need to be restructured for good, challenges need to be faced to support teachers in providing high quality learning opportunities for students during the crisis and beyond.

In higher education, lectures are a central form of teaching. While they are traditionally teacher-centred and have been seen as rather passivating students in the past, they now integrate various resources, dialogue tools and interaction processes and are still one of the most frequently used forms of higher education teaching (Crook & Schofield, 2017). However, successful implementation of lectures depends on various factors, as they are a social situation that requires adequate social interaction between teachers and students. For students to benefit from lectures, teachers have to engage them and need to tailor their instruction to the students' needs. For teachers to know which behaviour is required of them, they require awareness of the social context and thus of their students. Although various forms of online teaching are available, many teachers may choose synchronous online lectures especially for large classes instead of more unfamiliar, less commonly used formats (e.g., flipped classrooms).

The ad-hoc shift to synchronous online lectures may affect various aspects impacting teaching quality. In the current paper, we focus on how teachers can be supported in this shift, so that they have the necessary tools to give and improve online lectures. One major distinction between virtual and on-site lectures is the physical distance between teachers and students, affecting the teaching context, perception of the social context, communication channels and modes of interaction. Teachers' awareness and thus their ability to choose the correct behaviour may be restricted during online lecturing. In the following, we describe three challenges arising from these changes and their impact on

teaching processes. Then, we provide examples of how the Learning Sciences are equipped to provide solutions and may even use this momentum to go beyond the possibilities of traditional on-site lectures.

2. Challenges in Synchronous Online Lectures

Altogether, teachers are facing various challenges while switching from on-site to synchronous online lectures. Three challenges in particular relate to the specific changes emerging from the need to stay physically distant. Teachers' awareness of the situation and their students is restricted by (1) the change in the physical and social context in which teachers are carrying out teaching activities, and (2) the reduction of channels through which social information about students can be transmitted to teachers. Hence, (3) a necessity arises for teachers to adapt internal scripts developed for on-site lecturing to the new situation of online lecturing. In the following, we will describe those challenges in more detail.

2.1 Teaching Context

While in on-site lectures teachers are situated in a context that is habitually connected to education and thus to the activity of teaching (e.g., a lecture hall), this is not the case for synchronous online lectures. The environment when teaching from home or even the office is not primarily associated with teaching. The communication technologies they use to be connected with their students try to replicate face-to-face lectures in a virtual environment (e.g., video conference software), but their physical environment does not match the teaching situation. This shows a clear mismatch between the physical context when teaching from home or the office and the computer-mediated teaching activities. Further, knowledge acquired in a physical environment connected to education may be situated and transferring it to another (non-educational) environment may be difficult for teachers (see Gruber, Law, Mandl, & Renkl, 1995). Additionally, the unusual physical context in this environment may lead to an uncertainty concerning expected behaviour, and also involve challenges due to the environment itself (e.g., distractions or unfamiliar behaviours like sitting during lecturing). In addition to this gap between teachers' physical context and their activity in the virtual computer environment, experiencing the social context in virtual lectures differs from face-to-face lectures. Social presence, the "sense of being with another" (Biocca, Harms, & Burgoon, 2003, p. 456), is influenced by representations of other humans in technological interfaces. From teacher and learner perspectives, lectures that are situated in an online setting can result in less classroom awareness and social presence than on-site lectures (Olsen, Faucon, & Dillenbourg, 2020). The social information that can be provided in an online lecture setting (e.g., black rectangles representing learners) may diminish teachers' sense of talking to real people and lead to a feeling of disconnectedness with their students. Establishing eye-contact with students to form a psychological connection and reduce distance, for example, is not possible with usual video conference systems. It is thus clear that both the physical and social context in which teachers operate when teaching from home differ from their usual context when lecturing in a co-located setting.

2.2 Availability of Social Information

Lecturing is basically a form of one-to-many communication. Successful communication requires the communicator to adapt their utterances to the recipient(s) to foster their understanding of the message content (audience design; Clark & Murphy, 1982). This requires awareness about the recipients' knowledge and expertise, but also current understanding and attention. Group awareness is an individual's salient perception of relevant information about the group or group members like their location, activities, cognitions or feelings (Bodemer & Dehler, 2011). In on-site lectures, teachers have a variety of auditive and visual information available that may give indications about the students' level of understanding, confusion or concentration, thus fostering group awareness. For example, head gestures like nodding, or facial expressions like raising or furrowing of brows, but also acoustic signals like rising background noise may tell a lot about the students' current mental state. In virtual lectures – while not completely absent – especially non-verbal feedback channels are severely restricted and mostly downscaled to fit a small screen. Without adequate information available, especially

inexperienced teachers may overestimate the similarity between their own level of understanding and capacity to understand the material and their students' by using their own knowledge as a default (Nickerson, 1999), thereby overestimating their students' ability to grasp complex concepts. Such biases may lead to inadequate instructional communication affecting the quality of teacher-student interaction. Research has repeatedly shown that tailoring explanations to learners' needs is important for facilitating student learning but requires teachers to access relevant information about the students (e.g., Wittwer, Nückles, & Renkl, 2010). The restricted communication channels in remote teaching hamper such efforts by making it harder to provide and receive non-verbal feedback. This may not only unsettle teachers, but may severely hamper the quality of lectures because adaptation to students' needs is the key to student-centred teaching and sets online-lectures apart from providing videotaped material.

2.3 Activation of a Social Script

What is happening between teacher and students during a lecture can be understood as a social process for which well aligned social scripts (i.e. cognitive schemas) needs to be activated in both teachers and students. The social script enables teachers and students to act reasonably in a reciprocal way and understand the actions of the respective others (Fischer, Kollar, Stegmann , & Wecker, 2013; Schank, 1999). Social scripts include knowledge about the roles teachers and students play in specific social situations and the sequence of activities carried out by individuals with different roles (Kollar, Fischer, & Hesse, 2006). Understanding the lecture as social learning scenario, teacher and students need to share an understanding of the sequence of activities, such as explaining, listening, providing feedback, and processing feedback reciprocally. However, different problems can emerge with the activation of the social script when the context of the lecture changes as it is the case for emergency online lectures. For both teachers and students, not being in the usual physical environment for lectures (e.g., lecture hall) might increase the likelihood for the activation of different social scripts than usually activated in lectures. Being in solitude, students might rather activate individual learning scripts not including social interactions such as asking questions for clarification. The same way, teachers might not activate their commonly activated social scripts for lectures, leading to being less open to students' request or rare attempts to communicate. The situation gets even worse when the social scripts activated by teachers and students do not fit together. If only one of them has activated a script that includes almost no interaction and will behave accordingly, even if teachers might try to apply a more interactive script, learning-beneficial mutual activities will fail (Kollar, Fischer, & Slotta, 2007). Another problem appears when students and teachers have the same social script activated, including interaction, but fail to provide and/or receive the awareness information necessary to enact the social script properly.

3. Supporting Synchronous Online Lectures

Psychologically informed technology and pedagogy may be used in a variety of ways to meet the challenges described above. Teachers' awareness of the social context can be supported so that it is more similar to or even better than in on-site lectures (1 and 2) and teachers can be supported in developing or adapting adequate lecture scripts suitable for online teaching (3). Research on immersive technology and social interaction (e.g., in CSCL) has developed various approaches to meet difficulties related to computer-supported social interaction processes. In the following, we will present examples of how this research may help with mastering the three described challenges.

3.1 Immersive Technology to Blend Contexts

Through the switch from an on-site lecture to an online lecture, the context changes for teachers. Their physical environment and their lecturing activities through a virtual platform do not match anymore. A solution for this may be to provide teachers with a virtual platform they can be fully psychologically immersed in, so that their physical environment fades into the background and the mismatch becomes less salient. Technologies that can deliver immersive experiences like virtual or augmented reality are

becoming more common in educational settings. Classrooms or even whole campuses can be replicated in virtual worlds where students and teachers can walk around as virtual avatars. Even without using fully immersive technologies like VR headsets and only desktop-based application to view a virtual, replicated lecture hall, a psychological immersion is possible (Robertson, Czerwinski, & van Dantzich, 1997). The additional mismatch between the representation of the social context in a virtual lecture setting and a lecture hall full of students may also be overcome using immersive virtual environments. In such an environment, the representation of students as individual avatars occupying individual seats within a virtual lecture may foster social presence to an extent comparable to an on-site lecture. Non-verbal signals conveyed through avatars can have an influence on the sense of social presence and interaction regulation in groups (Allmendinger, 2010) and this may also be transferable to teachers in online lecture settings. It needs to be examined how exactly the situational and social immersion of teachers into virtual lecture halls can be supported and how it can be used to support home-based teaching activities. As research in the Learning Sciences takes place at the intersection of psychology and technology in educational settings, it is equipped to bring insights for these questions.

3.2 Awareness Tools to Provide Social Information

The lack of group awareness and their support in interpersonal learning scenarios has been widely studied in computer-supported collaborative learning and work research (see Bodemer, Janssen, & Schnaubert, 2018). While it may seem reasonable to use immersive technology to re-build classroom-like virtual realities that merely mirror students' behaviour, by providing information that is not readily observable, tools to foster group awareness (i.e., group awareness tools) may even advance awareness beyond face-to-face settings (Buder, 2011). While mostly applied to equitable learning settings in which peers learn collaboratively, the tools developed may also be used to inform teachers and thus serve a function similar to teacher dashboards. However, designing group awareness tools is by no means a straightforward task and requires deliberate decisions about data selection, collection, transformation and presentation (Schnaubert, Harbarth, & Bodemer, 2020), each depending on the function and scenario of tool implementation. Thus, the key questions for including awareness tools into live lectures to support teachers are: (1) What information is most relevant for teachers when they conduct online lectures? (2) How can relevant live information about students be collected without interfering with their learning processes and protecting their privacy? (3) How does the data need to be transformed (e.g., simplified) to provide useful information to the teacher? And finally, (4) how can the data best be provided to the teacher without requiring much attention during lecturing? Learning Scientists are predestined to answer those questions as they concern psychological, educational and technological input and may not be solved by one discipline alone. For example with regard to data collection, face recognition software may be used to infer mental states from detecting facial expressions and tracking head gestures in real time (e.g., el Kaliouby & Robinson, 2005). Such information, pre-processed, aggregated and fed into an awareness tool, may provide a more complete picture than a glance into a full lecture hall and thus may even outperform information available in on-site lectures. While it is pertinent that the presentation of the information does not unnecessarily distract the teacher from the primary task of teaching, ambient displays, for example, are specifically designed to require minimal user attention (Mankoff et al., 2003) and thus information may be presented by unobtrusive means like illumination (e.g., Alavi & Dillenbourg, 2012).

3.3 External Scripts to Support Appropriate Script Activation

As internal social scripts are highly flexible, teachers and students have the ability to adapt in a way that makes the new situation with online lectures beneficial for learning. However, this adaptation does not always happen automatically, either because teachers and students might not be aware of the problems or what needs to be changed or because they lack knowledge about how to change their activities to overcome the obvious problems (Fischer et al., 2013). The problem with activation of inappropriate social scripts can be tackled by providing external scripts. These have been successfully applied to guide students through social learning scenarios (Vogel, Wecker, Kollar, & Fischer,

2017). Computer-supported or computer-mediated learning environments are particularly suitable for providing collaboration scripts. By just-in-time prompting, information about the sequence of learning beneficial activities and the social feedback required from teachers and students can be offered to both teachers and students (Radkowitsch, Vogel, & Fischer, 2020). These external scripts could either be designed by the teachers themselves to guide students through the activities needed in their pedagogical approach. But also, learning sciences approaches can be used to design more or less generic external scripts that can be used by both teachers and students. In recent times, the development of technology opened possibilities to integrate intelligent support to adapt external scripts to students' needs (Rummel, Walker, & Aleven, 2016). While research on external script so far has mostly focused student learning, the current situation taught us that shifting the focus on both students' and teachers' development of social scripts for different contexts of teaching and learning is a timely necessity.

4. The Role of the Learning Sciences in ERT and Beyond

This paper outlines challenges of online lectures during ERT and identifies three major challenges for teachers relating to (1) changes in the teaching context: lack of immersion and mismatch between context and activities, (2) changes in the availability of social information: lack of group awareness, and (3) changes in behavioural requirements: adaptation of internal lecture scripts. Additionally, based on immersion, group awareness and script research, it sketches possible ways to overcome these challenges. In this situation, teachers need institutional support informed by evidence-based research. It is a task for the Learning Sciences to not only provide such information but envision ways to go beyond the needs of the current situation and design sustainable learning and teaching environments adaptable to on-site and off-site teaching and learning alike based on interdisciplinary research. While online lectures are only one way of teaching large classes online, lectures are still one of most common teaching formats in higher education. It is thus important to support teachers in this form of online teaching. Furthermore, online lectures do not only bring new challenges but also new potentials. Immersive technologies offer the potential to integrate group awareness information into an immersive virtual environment by showing relevant non-verbal behaviour but also additional information about students' (cognitive and motivational) states not readily observable in face-to-face lectures. Automatically collected information (e.g., facial expressions, gestures) could be displayed directly as part of the students' avatars or collated to provide teachers with easy-to-process information on the whole course requiring minimal attention (e.g., via an ambient awareness tool like "Lantern"; Alavi & Dillenbourg, 2012). Also, students could supply information themselves and online lectures could be enriched by adding interactive activities, which can provide instructors with awareness information and also engage and activate students (Olsen, Faucon & Dillenbourg, 2020). Taking a sustainability perspective, developing such tools to support synchronous online lectures may also be brought into on-site lectures with the use of augmented reality technologies (e.g., like the application "Lumilo"; Holstein, McLaren, & Aleven, 2019) to advance educational practises on- and off-site. External scripts can be designed to support teachers in their efforts to acquire internal schemas for online lectures, but also to guide students through the social activities expected from the teacher and needed to benefit most from learning from online lectures (Radkowitsch et al., 2020). Integrating automated adaptation of external scripts based on students' input, behaviour, and provided personal data may be one way to go beyond the mere replication of face-to-face lectures in online learning environments. While online lectures are only one form of online teaching, they offer teaching that is similar to widely-used on-site lectures and may show benefits when teachers are sufficiently supported in the shift to online education. Learning Sciences' research could inform the effort to support teachers in and beyond online lectures.

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