“Generation invisible“. Higher education students’ (non)use of webcams in synchronous
online learning

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Abstract

The Spring term 2020 saw a global switch to emergency remote teaching in higher education due to the COVID-19 pandemic. Alongside asynchronous online learning activities, students were called to participate in synchronous videoconferencing sessions, substituting the traditional on-campus face-to-face courses. Given the preponderance of students to avoid using webcams, this study sought to investigate usage behavior, as well as potentially related course variables and individual characteristics. 3,527 students from across all institutional faculties of a comprehensive German university took part in an online survey. Students’ webcam usage behavior was related to personal thoughts and feelings (e.g., privacy), to course characteristics (e.g., group cohesion), and it differed due to specific groups (gender, study degree). Results of this research shed light on a globally present phenomenon and provide a foundation for further investigation.

Keywords: webcam use, COVID-19 pandemic, social presence, individual differences

1. Introduction

The Spring term 2020 was globally characterized through higher education institutions switching to *emergency remote teaching* (Hodges et al., 2020), due to the COVID-19 pandemic. In order to provide synchronous interaction and learning activities as part of their online teaching, educators used a range of videoconferencing tools (Correia et al., 2020; Al Samarraie, 2019), leading to a globally unprecedented surge of this interaction form. In contrast to the assumed outcome that making oneself visible and seeing others would enhance feelings of group membership and thus would be perceived as an easy means to foster social presence (e.g. Lowenthal & Snelson, 2017), first (informal) explorations over the course of the Spring term indicated that students often from using their webcams during videoconferencing sessions (Eng, 2020; Loviscach, 2020). The current study delves further into this topic, aiming to contribute to this emerging discussion, rooted in instructors' and students' currently lived experience in higher education teaching and learning. One impact of the COVID-19 pandemic might be the further reliance on both synchronous and asynchronous online learning as an integral part of higher education—for example, the second semester after COVID-19 is planned to be offered in a hybrid format and it can be assumed that successful aspects of digital learning will continue beyond the corona crisis. Hence, the present study investigates this currently observed phenomenon based on responses of a large student sample ($N = 3,527$) at a German comprehensive university. It aims to provide insights into the student perspective on webcam use, how course-related factors influence use and how frequency of webcam use is related to student characteristics. It asks educators to cautiously keep in mind the various reasons students have for remaining 'invisible' in class and provides the foundation to conduct further research into this topic.

2. Theoretical Lenses and Literature Review

In the context of (online) distance education, concepts such as the Community of Inquiry model (Garrison et al., 1999; Garrison, 2007) and the theory of transactional distance

(Moore, 1991, 1993) provide important lenses to understand the social dynamics evolving within the distance teaching and learning setting. Next to cognitive and teaching presence, the Community of Inquiry model encompasses social presence, meaning “the ability of participants in the Community of Inquiry to project their personal characteristics into the community, thereby presenting themselves to the other participants as ‘real people’” (Garrison et al., 1999, p. 89). Establishing this sense of belonging to the group and interacting with other learners is an important ingredient for students’ achievement and their overall engagement in online learning scenarios (Joksimović et al., 2015; Tomas et al., 2015). As part of social presence (e.g. Lowenthal & Snelson, 2017), students need the feeling of belonging—which can, however, be a challenge, considering that it might be difficult for students to both create and perceive social presence in an online learning setting (Joksimović et al., 2015). The theory of transactional distance (Moore, 1993) emphasizes the geographical separation between students and instructor in distance education settings and in doing so, adds to understanding the complexity arising for communication. The theory argues that this distance causes a “psychological and communications gap” (Moore, 1991, p. 2), within which “a space of potential misunderstanding between the inputs of instructor and those of the learner” (p. 2) exists. Moore’s (1993) theory revolves around the three concepts of the course structure, dialogue between learner and instructor, and the autonomy of the learner.

Potentially, the use of videoconferencing—specifically webcams—provides one helpful means to allow for direct interaction and dialogue within an online course (Al Samarraie, 2019; Giesbers et al., 2013; Gillies, 2008). However, previous research highlights different aspects related to its use, showing mixed results (e.g. Lawson et al., 2010).

Using videoconferencing was largely evaluated positively by students for the purposes of following a presentation (Candarli & Yuksel, 2012). The study by Giesbers et al. (2013) additionally showed that regular participation in videoconferences and the use of richer available tools within the videoconference (i.e. chat, video, audio) resulted in higher

participation and subsequently in better test performance by students. Focusing on the use of webcams as part of the videoconferencing setting, Olson et al. (2012) found that, for virtual teams—in this case faculty collaborating remotely in research projects—enjoyment, connection to the group and trust increased over time, as did focus on the meeting. Using webcams in student to student dyadic foreign language practice emerged as crucial for the creation of an informal and credible communication situation; it also aided finding creative ways of showing each other objects and providing a glimpse into the respective partners' surroundings (Telles, 2010). This is similarly concluded by Develotte et al. (2010) who stress in their study on preservice language teachers, the social aspects of relationships as aided through webcam use: "Webcamming creates presence at a distance, installs an obvious connection between the participants and, furthermore, develops the quality of the pedagogical relationship [...]" (p. 309).

Whereas these studies illustrate primarily the potential that the use of webcam has for social and pedagogical interaction, others identify critical issues as well. Themes elicited in Kozar's (2016) study on instructor and student perspectives on webcam use in dyadic language practice session show that using a webcam has value in the beginning of a class, but that using a webcam can also be perceived as tiring and constitutes an intrusion into privacy. In addition, self-reported shyness in students seems related to less self-disclosure in online interaction using webcams but not in online interaction without webcams (Brunet & Schmidt, 2007).

One instructor in Wunder's (2017) study, deliberately refrained from using a webcam in order to avoid stereotyping of her person; whereas another instructor reported only using the webcam at the beginning and end of a session and did not find it "that important" (p. 117). The study by Nilsen et al. (2013) shows mixed results, as students reported being more aware of their pose and conduct since "broadcasting with your own web camera also makes you feel more visible" (p. 97). However, they were more comfortable with their webcams turned off.

This is reiterated in Kozar's (2016) study, in which students equally confirmed that "webcams are uncomfortable" (p. 6). Students in the Nilsen et al. (2013) study also raised the point that in a lecture situation without active student involvement being fostered, they did not see meaning in turning on their webcam. The authors conclude that "Allowing your face to be viewed via a web camera implies a completely different awareness of the learning situation, and renders you more mentally present than if you sit in an auditorium looking at the back of a fellow student in front of you" (p. 101). Codreanu and Combe Celik (2013) show that the tutors can, through their framing of gestures, mimics and eye contact when using a webcam in videoconferencing, set the scene for how well students feel included in the learning situation and how they mirror the tutors behavior.

What emerges from the literature is that a set of different reasons exists for students to use or not use a webcam, ranging from questions related to feeling disturbed in their privacy as indicated in Kozar (2016), levels of shyness and self-disclosure (Brunet & Schmidt, 2007) or simply lack of perceived reason to use webcams (Nilsen et al., 2013). However, it also becomes evident that students' usage patterns in terms of actual frequency is not yet comprehensively investigated. The same applies to the educational setting and situation, in which webcams are being employed. Whereas several of the reviewed studies relate to specific dyadic settings in the context of language learning or have a focus on the webcam use of the instructor or tutor, a perceived research gap exists when it comes to investigating webcam use on the level of entire courses and from the perspective of students.

3. Research Questions

Due to the COVID-19 pandemic, students across all fields of study participated in online courses, which often included synchronous videoconferencing sessions. To understand students' webcam using behavior in higher education courses, and to investigate potential concepts related to webcam use, this study investigated four main research questions.

Firstly, the study aimed to provide a quantitative base to display students' webcam using frequency.

Q1: How frequently do higher education students use their webcam in videoconferencing sessions?

Secondly, the study focused on students' perceptions when using webcams in higher education courses.

Q2: How do higher education students perceive webcam use and do their perceptions differ with regard to their usage frequency?

Thirdly, with reference to the Community of Inquiry model, the study investigated whether using webcams in online higher education courses was related to how students perceived their courses with regard to peer and student-teacher relationships.

Q3: How are course-related characteristics (i.e. group cohesion, communication, lecturer-student relationships) related to webcam use?

Lastly, to provide a comprehensive overview on webcam use, the study investigated whether webcam use differed due to individual characteristics (gender, field of study, study degree, or migration background).

Q4: What student characteristics are related to the frequency of webcam use?

4. Method

4.1 Procedure

The current research is part of a longitudinal study during the Spring term 2020 in Germany. The study was conducted as an online survey with three measurements. Directly before, during, and after the summer term 2020, all students enrolled at one German university were invited via E-Mail to participate in an online survey. They were informed about each participation taking approximately 20 minutes and the topic being digital learning. The online survey was carried out in the German language and administered via Unipark Questback EFS (<https://ww2.unipark.de/>). In accordance with the institutional commissioner for data protection, participants' privacy was protected, all data anonymized, and students

were not disadvantaged due to non-participation. Informed consent of the participants was obtained by virtue of survey completion. In the following, we focus on the third assessment at the end of the term, when all courses were finished and students could report on their experiences.

4.2 Sample

Participating students were recruited from one large comprehensive German university with a student body of about 38,500. The third measurement of the online survey, to which we are referring in this study, was completed by 3,527 students. Their mean age was 23.6 years ($SD = 4.7$). Of students who reported their gender ($n = 3,049$), 54.5% were female. Data on migration background was available from an earlier measurement (with $n = 1,578$ students participating in both assessments) and indicate a proportion of 9.6% of students with migration background (born outside Germany and/or non-German native language). Across all five faculties of the university, students participated voluntarily in the survey (Faculty of Humanities, Social Sciences, and Theology: $n = 952$; Faculty of Sciences: $n = 482$; Faculty of Business, Economics, and Law: $n = 721$; Faculty of Engineering: $n = 866$; Faculty of Medicine: $n = 495$). Similarly, students at different study levels participated in the online survey (Bachelor: $n = 1,302$; Masters: $n = 962$; first state examination: $n = 1,095$; Doctoral degree: $n = 75$; other: $n = 48$).

4.3 Instruments

All items were presented in the German language. Firstly, questions regarding socio-economic aspects (age, gender, migration background) were addressed. Students were asked to provide information about their current semester, their faculty depending on their study course (one out of five faculties of the university), and their intended degree (Bachelor, Masters, state examination, Doctoral degree, or other). To assess whether students feel competent with online communication, we assessed their self-reported skills to share information online (subscale information sharing behavior of the questionnaire on digital

readiness for academic engagement – DRAE, Hong & Kim, 2018). The four item scale was internally consistent ($\alpha = .84$, sample item “I can interact with classmates using real-time communication tools, for example, video conferencing tools or messengers”).

Webcam use and associated perceptions were assessed via five self-constructed items. Webcam use was assessed via one item (“How often do you use the webcam in webinars?”). Students could answer the question on a five-point Likert scale: *never* (1), *seldom* (2), *sometimes* (3), *often* (4), or *always* (5). Students were then asked what they think about and how they feel using a webcam via four items. All individual items of the questionnaire scales described below were answered on a six-level Likert scale ranging from *not at all correct* (1) to *completely correct* (6). Students rated their technical equipment for participating in online discussions: “My technical equipment was not sufficient (e.g. webcam or internet quality; participation only via smartphone)”. Regarding privacy, we implemented the following item: “It bothered me that others can see into my privacy (e.g. room furnishings, possibly other people in the room)”. We asked students how they feel when using a webcam: “I was uncomfortable being connected via webcam (e.g. shyness; unfamiliarity with seeing my own picture; unsuitable outfit)”. Finally, we assessed their usage behavior with regard to conformity aspects: “I adapted my webcam use to the community (e.g. only turned it on when most of my fellow students have done so)”.

Teacher-student relationship was assessed via an established three item scale (Kauper et al. 2012; sample item: “The lecturers were friendly and respectful towards me”, $\alpha = .89$). Furthermore, two subscales of the Community of Inquiry model survey were used to assess social presence (Díaz, et al., 2010). Each three items were used to assess group cohesion (sample item: “I felt that my point of view was acknowledged by other course participants”, $\alpha = .73$) and open communication (sample item: “I felt comfortable conversing through the online medium”, $\alpha = .86$).

4.4 Data Analysis

To answer research questions Q1 (frequency of webcam use), Q2 (perceptions of webcam use), and Q3 (relationships of webcam use and course-related characteristics), we performed descriptive and correlative analyses. To understand whether there are groups of students showing characteristic webcam use, we performed multivariate analyses of (co-)variance with gender, belonging, faculty, study degree, and migration background as independent variables and webcam use as a dependent variable. Partial eta squared was reported as measure of effect sizes. All analyses were performed using SPSS, version 26.

5. Results

Students in the current sample seem to feel quite competent in communicating and sharing information online ($M = 5.30$, $SD = 0.82$). Table 1 provides descriptive statistics and correlations of all variables of the current study. Teacher-student interaction was rated high, while open communication and group cohesion were lower but still above scale mean average.

5.1 Webcam Use and Associated Perceptions

Regarding webcam use (that is, research question Q1), students scored at the scale mean, which corresponds to using the webcam in synchronous online courses “seldom” to “sometimes”. While more than 22% of students indicated not using their webcam at all, only about 7% of students used it on any occasion. The other 70% of students varied in their webcam use from seldom to often (compare Figure 1).

Figure 1. Number of students using webcams in a varying degree.

Table 1 furthermore reports descriptive statistics regarding students' experiences with webcam use (Q2). Descriptively comparing mean values, students' technical equipment to participate in online courses via webcam seemed satisfying. To an average degree, students were embarrassed that other course participants had insight into their private space. Similarly, on average, students were not very comfortable to present themselves online. Interestingly, students' usage behavior seemed to depend fairly on those of others (that is, webcam use was in compliance with others). Correlations within the set of variables assessing students' perceptions of webcam use indicate that those variables measured separate aspects (except having privacy concerns and feeling uncomfortable, which were strongly related).

Table 1

Descriptive Statistics (M, SD) and Correlation Results (Pearson 'r) of all Variables Under Consideration

	<i>M (SD)</i>	Having technical problems	Having privacy concerns	Feeling uncomfortable	Use in compliance with others	Teacher-student interaction	Open communication	Group cohesion
Webcam use	2.65 (1.22)	-.16***	-.35***	-.42***	.08***	.20***	.23***	.23***
Having technical problems	2.47 (1.53)		.15***	.13***	-.08***	-.15***	-.12***	-.13***
Having privacy concerns	3.51 (1.58)			.61***	-.04**	-.22***	-.29***	-.28***
Feeling uncomfortable	3.56 (1.59)				.06***	-.20***	-.39***	-.34***
Use in compliance with others	4.30 (1.59)					.04*	-.03	.00
Teacher-student interaction	5.00 (0.81)						.36***	.37***
Open communication	3.95 (1.05)							.82***
Group cohesion	3.84 (0.97)							—

Note. All variables are ranging from 1 to 6, except webcam use (1–5). * $p < .05$. ** $p < .01$. *** $p < .001$.

In addition, we were interested in the question whether the frequency of webcam use was related to the perceptions made with it (Q2). Correlational analyses in Table 1 indicate small (technical problems, compliance) and moderate correlations (privacy concerns, feeling uncomfortable). To better understand these correlations, Figure 1 illustrates perceptions for each frequency of webcam use. It shows how having technical problems, privacy concerns, and feeling uncomfortable related to frequency of webcam use. Namely, with less frequent use, students reported higher concerns or problems. A different distribution is shown for the question whether webcam was used in compliance with peers. The two extreme groups of students who never or always used webcams in synchronous online courses, showed an individual usage behavior, while those students who varied in webcam use (seldom, sometimes, or often) seemed to vary it to a stronger degree in line with their peers, which explains the low correlation.

Figure 2. Students' perceptions of webcam use, separately displayed for students of varying webcam use. Error bars indicate 95% confidence intervals.

5.2 Webcam Use and Relationship with Course-Related Characteristics

To understand how course-related characteristics (i.e. teacher-student relationship, communication, and group cohesion) are related to webcam use (Q3), we considered the correlations displayed in Table 1. Results indicate that webcam use itself was positively correlated with experiences during the course. That is, students who felt that they were respected by their teachers, that they could communicate openly, and that group cohesion was high used their webcam more often (small to medium correlations). More privacy concerns or feelings of being uncomfortable were reported by students whose relationship with their teacher was worse and those who reported less open communication and less group cohesion. Experiencing technical problems and complying with others in webcam use weakly (or even non-significantly) related to teacher-student relationship, open communication, or group cohesion.

5.3 Group Differences in Webcam Use

Results of analyses of (co-)variance are presented to understand whether students differed in their webcam use with regard to gender, faculty, study degree, or migration background (Q4).

Firstly, regarding gender, a significant but small effect was found, $F(1, 3022) = 50.70$, $p < .001$, $\eta^2 = .02$. Female students reported using their webcams in synchronous online communication more often ($M = 2.80$, $SD = 1.22$) than male students ($M = 2.46$, $SD = 1.21$).

When investigating differences between students enrolled in different faculties, we accordingly controlled for gender (especially as students of different genders are, for example, more often enrolled in humanities programs than in engineering study programs). A significant and large effect could be found, $F(4, 3012) = 133.07$, $p < .001$, $\eta^2 = .15$. Descriptive values in Table 2 indicate that students of the Faculty of Humanities, Social Sciences, and Theology reported most frequent webcam use in synchronous online communication (between sometimes and often) while engineering students made use of webcams in synchronous online communication only seldom.

Table 2

Descriptive Statistics (M, SD) of Webcam Use for Students Enrolled in Study Programs at Different Faculties

Faculty	<i>M</i>	<i>SD</i>
Humanities, Social Sciences, and Theology	3.38	1.16
Sciences	2.46	1.16
Business, Economics, and Law	2.50	1.16
Engineering	2.06	1.03
Medicine	2.80	1.09

To investigate whether students of varying study degrees differed in webcam use, we focused on the group of Bachelor and Masters programs because those programs provide information of whether students have already completed a higher education degree and therefore are experienced in higher education or not. We found a significant but small effect, indicating that students of a Masters program ($n = 962$, $M = 2.68$, $SD = 1.24$) slightly more often use their webcam than students of a Bachelor program ($n = 1302$, $M = 2.42$, $SD = 1.20$; $F(1, 2262) = 25.98$, $p < .001$, $\eta^2 = .01$).

Finally, no significant effect with regard to migration background was found, $F(1, 1576) = 0.68$, $p = .41$, $\eta^2 = .00$.

6. Discussion

The present study surveyed students' webcam usage behaviour in a large sample of students at a comprehensive German university. It adds to the comparatively small body of research into (online) course technology as well as to the established body of online learners (Martin et al., 2020). Overall, higher education students in the current sample felt ready to share information online, that is, they seemed to be able to interact in synchronous learning. Still, a remarkable amount of students indeed remained invisible in online higher education in 2020 (Q1). An explanation for absent webcam use might be that the audio part in webinars was sufficient while the video part served rather as an enrichment not necessary for

understanding (see Olson et al., 2012). However, online communication that is enhanced by video is also considered a helpful means to emotionally establish the grounds for ensuing pedagogical interaction (Gillies, 2008); showing that online course communication follows different patterns than it does face-to-face. However, the choice of not using a webcam potentially reduces students' means for developing a social presence in webconferencing sessions or the course altogether (Develotte et al., 2010). Actually, the frequency of webcam use was only slightly related to technical issues but moderately related to privacy concerns and personal feelings, which confirms prior research (Q2; Brunet & Schmidt, 2007; Kozar, 2016). Therefore, instructors might consider their own webcam behaviour, for example not only using it in the beginning and end of a session as one instructor in Wunder's (2017) study reported to do. Instead, openly addressing this topic (Eng, 2020), and integrating small activities to foster webcam use are means that instructors can employ. Furthermore, in setting an example in allowing students to see them as well, instructors can actively work towards more student webcam use.

Further results indicated that webcam usage and experiences expressed from it were significantly related to the perception of course characteristics (Q3). Nilsen et al. (2013) found that students did not use their webcam because they felt more comfortable doing so or the session did not require an active part on their behalf. Still, the results reported here point in direction of personal relationships and open communication, which are both vital for establishing social presence (Garrison et al, 1999; Lowenthal & Snelson, 2017).

This study found groups of students reporting more frequent use than others (Q4). Specifically, female students, students of humanities, and Masters program students reported having used their webcam in synchronous online communication more often than male students, students of other faculties, or Bachelor program students. An explanation for the differences between Bachelor and Masters students might be that students who are familiar with higher education itself may be more willing to engage in online study with the

appropriate tools. Hence, regarding upcoming digital or hybrid semesters, first semester students may find webinars particularly challenging. Cultural differences, however, do not seem to play a major role, as migration background was not meaningfully related to webcam use (at least for this sample at a German university). When referring to webcam use in synchronous online communication in this study, one needs to keep in mind that it is the self-reported use across all synchronous online courses with the option to use webcams. That is, when referring to differences in webcam use between faculties or study degree, this does not mean that those study programs offered more or less online courses. Quite to the contrary, it means that across all courses students participated in, they reported a varying degree of webcam use. Moore (1991) stresses that a specific program or course structure can rarely accommodate the needs of all learners or learning types alike, which might also be applicable to subgroups in this study.

7. Limitations

The current study used a broad sample of students of a variety of study subjects and types of courses. However, due to its comprehensive investigation of webcam use, the study did not control for specific characteristics of synchronous courses (i.e., course size, level of student activation, for example via teacher-student or student-student interactions, giving presentation etc.; see Nilsen et al., 2013). In addition, webcam use was assessed via self-report. That is, we did not track students' actual usage times. Hence, students report might be influenced by their personal interpretation of what “seldom”, “sometimes”, or “often” means (while “never” and “always” should be quite clear). In addition, the study did not control for potential teacher influences and hence, those self-reports furthermore might be biased. Namely, some lecturers might have specifically emphasized webcam use while others might not have, which potentially might have altered students perceptions of webcam use. Moreover, our study design does not inform about causal relationships. That is, regarding course characteristics, it might be that group cohesion was lower due to fewer students using

webcams or that students used their webcams less often because they experiences low group cohesion. Finally, as this study was established in reaction to the sudden shift to online learning, no established questionnaire scales on students' perceptions of using webcams were available. Hence, the study assessed students' perception only via single items and might not comprehensively display all facets of students' webcam usage.

8. Conclusion

The moderate to strong correlation between webcam usage and feeling uncomfortable points to the differences between face-to-face course settings (where students are by definition present) and online course settings. Possibly, students might feel uncomfortable because they cannot see or feel who is looking at them or because they can see themselves which is unusual and not the case in face-to-face communication. This is suggested in the study by Miller et al. (2017) on video chat. They conclude “that participants were more concerned about how others perceive them when they could see themselves” (p. 5278). Hence, the current results might promote the development of videoconferencing settings to derive in communication as natural as possible. Another aspect concerns the relationship with students' peers. Due to limited communication possibilities and distance, the quality of the social relationship is perceived as diffuse. Students may perceive less social support in online course settings and be less willing to engage in social relationships. Since some findings underline the importance of social support and social engagement for learning success, further intervention measures could be taken at this point (Hsu et al., 2018).

Although it was not within the scope of the study, the “space of potential misunderstanding between the inputs of instructor and those of the learner” (Moore, 1991, pp. 2) due to the physical separation of learners and instructors and the mediation of webcams is exemplified in this study—with students having distinct reasons not to use their camera, which are, however, unknown to the instructor and thus leave room for possible misinterpretation. Hence, future research that details webcam use in different educational

course settings, investigates its potential outcomes, and combines student and instructor perspectives is needed to derive conclusions for educational practice.

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