



# Cameras Optional? Examining Student Camera Use from a Learner-Centered Perspective

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## Abstract

In this paper, we offer a holistic look at undergraduate and graduate students' experiences with using cameras for synchronous online learning via Zoom. Analysis of the data using the American Psychological Association's learner-centered psychological principles revealed that social, cognitive, metacognitive, motivational, affective, and individual difference factors influenced student camera use and the level of influence of each of these factors varied from student to student, time to time, and space to space within a class. Findings suggest that there is a multifaceted, dynamic relationship between the student, video conferencing technology, and instructor's pedagogical actions that shapes camera use. Based on the findings, we offer suggestions for online synchronous course design, teaching, and research.

**Keywords** Online course design · Online teaching · Online learning · Zoom · Webcam · Teaching with technology

Although many college instructors and students had their first experiences with video conferencing technology in Spring 2020 during pandemic-induced emergency remote teaching (Hodges et al., 2020), video conferencing technology has been around since the 1960's (Sondak & Sondak, 1995). Video conferencing technology allows users from two or more geographic sites to communicate synchronously using audio and video (Krutka & Carano, 2016). As the quality and availability of video conferencing technology has improved, it has become a popular tool for synchronous online teaching and learning (Al-Samarraie, 2019).

However, the rapid adoption of video conferencing technologies for emergency remote teaching illuminated critical issues related to the use of these tools in education, including issues related to student privacy, mental health, engagement and safety. The issues raised by students and educators alike indicated a need for a critical and holistic approach to examining the use of these tools in educational settings (Krutka et al., 2020). For this study,

we used the American Psychological Association's (1997) learner-centered psychological principles as a means of understanding students' use of cameras on Zoom - a video conferencing technology - holistically across physical, psychological, cognitive, social and emotional factors. The purpose of the study is to present findings that can inform teaching and learning practices, guide course design and facilitation strategies and showcase how to use a learner-centered lens to understand the multifaceted nature of student camera use with video conferencing technologies.

## Review of the Literature

### Video Conferencing Technology

Proponents argue that video conferencing can bridge the physical and psychological gaps created by distance learning by bringing students and teachers "face-to-face virtually" in ways that other technologies cannot (Martin, 2005, p. 398). Additionally, newer video conferencing tools have text-based communication features (i.e., chat box) that can facilitate more transformative question asking and promote higher engagement by students in online synchronous settings compared to in-person learning settings (Caton et al., 2021). During the global COVID-19 pandemic, students found video conferencing tools to be easy to use, useful and helpful to

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achieve course learning outcomes while learning at a distance (Camilleri & Camilleri, 2022). However, recent studies have shown that courses facilitated through video conferencing can negatively impact students' satisfaction and grades (Roth et al., 2020). Course instructors have reported mixed perceptions of video conferencing tools – citing flexibility and convenience as positive qualities and overuse, fatigue, lack of engagement, distractions and technical issues as negative qualities (Lowenthal et al., 2021).

## Zoom

Zoom is a video conferencing tool that launched in 2011. Its use skyrocketed to more than 300 million daily meeting participants at the onset of the COVID-19 pandemic in the United States (Warren, 2020). When compared to several other popular video conferencing tools in 2020, Zoom had the most learning-related features, such as text-based chat, live transcript, breakout rooms, screen sharing, annotation tools, polling tools, virtual hand raising, recording and playback and instant emoji reactions (Correia et al., 2020). However, Zoom also has several drawbacks. It forces users to confront their own visibility via the “self-view” feature, which increases distraction (Caines, 2020a) and creates “mirror anxiety” – an increased feeling of self-consciousness (Fauville et al., 2021). Zoom users see one another up close in a way that makes it feel like they are being watched - this is referred to as “Zoom gaze” (Caines, 2020b). Zoom can cause an increased sense of exhaustion compared to being in person (Bailenson, 2021) and this has been found to disproportionately affect women (Fauville et al., 2021). Videoconferencing on Zoom limits mobility since users have to stay within a certain area in order to be seen on camera (Bailenson, 2021). Additionally, since Zoom requires a high-speed, consistent Internet connection, the use of this tool can increase the digital divide for communities and individuals that do not have access to broadband Internet (Boerngen & Rickard, 2021) and it might lead teachers to privilege students who have faster bandwidth, nicer cameras and better microphones (Caines, 2020a). While the research on Zoom is growing, recent studies regarding the use of Zoom as a video conferencing tool for synchronous online learning have tended to focus on student and faculty attitudes toward Zoom (Serhan, 2020; Vandenberg & Magnuson, 2021), Zoom fatigue (Peper et al., 2021) and comparing Zoom to other video conferencing platforms (Correia et al., 2020).

## Student Camera Use

Until recently, few studies have focused explicitly on student camera use with video conferencing technology. These studies have shown that students turn their cameras off when using video conferencing technology in educational settings due to concerns about personal appearance, physical surroundings,

social norms, feelings of distraction and level of engagement (Castelli & Sarvary, 2021; Schwenck & Pryor, 2021) and they turn their cameras on for cooperation, self-discipline, social presence, rapport-building and self-control (Sederevičiūtė-Pačiauskienė et al., 2022). Maimaiti et al. (2021) found contradictions in student camera experiences – some students felt that using their camera was distracting, while others felt that not using their camera increased feelings of distraction.

While many educators have argued that requiring students to turn on cameras in online synchronous learning settings is essential for engagement and learning, Maimaiti et al. (2021) found that instructor pedagogical skill and the use of the video conferencing technology were the most influential factors shaping student engagement in an online class. Additionally, Houlden and Veletsianos (2022) pointed out that requiring students to be on camera “may not be well attuned to the reality of students learning in spaces that bring the private into a version of the public in ways that may not be healthy, sustainable or welcome” (p. 12).

Ultimately, scholars have only recently begun to examine the reasons why students choose to use or not use their cameras for video conferencing in synchronous online classes, with several of these studies designed to identify ways to get students to turn their cameras on (see “Student perspectives on camera usage to engage and connect in foundational education classes: *It's time to turn your cameras on*” [emphasis added] by Schwenck and Pryor). To date, no research has been done to holistically examine students' experiences with and decisions about, camera use across the space and time of a synchronous online class session from a learner-centered perspective – a gap that this study aims to fill.

## Theoretical Framework

For this study, we chose to use the American Psychological Association's (APA, 1997) learner-centered psychological principles as a lens for understanding how factors across various domains of the human experience influenced student camera use in online synchronous learning settings. The principles are grouped into four core categories: 1) cognitive and metacognitive factors; 2) motivational and affective factors; 3) developmental and social factors; and 4) individual differences factors. In this study, we utilized these categories as a means of adopting a holistic understanding of student camera use – one that recognizes the equal importance of the cognitive, affective and social domains of learning. To that end, this study is guided by the following research questions:

1. What factors influenced students' use of cameras in synchronous online Zoom classes?
2. How do these factors change within and across the spatial and temporal contexts of a class?

**Table 1** Structure of online synchronous zoom classes

Class Components	Description
Start of Class	The instructor welcomed students to the class, asked students to complete a wellness check-in, and shared information that was relevant to students (e.g., campus events, recent news related to the class topic, and tips for success).
Instructor Speaking	The instructor would give a recap of the previous week's class and then give a mini-lecture about the current topic of the class.
Breakout Room Mini-Activities	The instructor opened breakout rooms for students to collaboratively complete mini-activities, which were short in duration (~10–30 minutes) and happened in-between mini-lectures.
Breakout Room Design Projects	The instructor opened breakout rooms for students to collaboratively complete a design project, which was longer in duration (30+ minutes) and served as a way for students to apply what they learned during the mini-lectures.
End of Class	The instructor would ask students to return to the main Zoom room at the end of class to go over the homework for the week and provide additional information related to the class topic or design project.

## Methods

In this exploratory qualitative research study, we collected and analyzed post-course survey data from undergraduate and graduate students enrolled in one of two courses taught by the lead author during 2021. Both courses were held online via a weekly 2.5-hour synchronous Zoom class and took place within the context of emergency remote teaching during the COVID-19 pandemic. While the courses explored different aspects of educational technology, the structure of the weekly classes was similar (see Table 1). Additionally, during the first week of each course, the instructor presented a slide (see Fig. 1) to set the class expectations regarding camera use. In both of these courses, students could choose if and when they turned their camera on and they were encouraged to turn their cameras on for breakout room activities.

## Data Collection


The lead author drafted a survey to learn about students' experiences related to camera use for synchronous online learning. The survey featured demographic questions related to gender, race/ethnicity and academic standing, grid questions about the variables that influenced student camera use and five open-ended prompts about why students had their camera on or off: (1) at the start of class, (2) when the instructor was speaking, (3) in breakout rooms for mini-activities, (4) in breakout rooms for design projects and (5) at the end of class. The options for the grid questions were adapted from Castelli and Sarvary's (2021) "Reasons for not turning on camera" survey. Once Institutional Review Board approval was obtained at the lead author's university, a survey was created using the Qualtrics platform and shared with students during the last class of the semester. Students

**Fig. 1** Video/Audio requirements slide

## Video/Audio Requirements

- You are not required to be on camera
  - However, being on camera during breakout group activities can improve interactions, support social learning, and foster community building.
  - Make sure you are still demonstrating engagement!
- You are required to have a microphone
  - You do not need to use your microphone when the instructor or TA is presenting. Instead, you can use the text chat to demonstrate engagement.
  - You are strongly encouraged to use your microphone during breakout groups to facilitate high-quality conversations and interactions.

"why isn't your camera on"  
Me:



were asked to review the informed consent form and agree to participate in the study before completing the survey.

## Participants

Participants were students enrolled in one of two education technology courses taught by the lead author during 2021. Each course was 13 weeks long (the required length of the semester at the university) and served several different populations of students. The courses were part of the College of Education at a large public land-grant research institution located in the northeastern United States.

The spring 2021 course (Digital Tools and Apps for 21st Century Students) had 71 students enrolled, and 64 (90%) completed the survey. This course served as a required class for undergraduate students in the Community Education and Social Change (CESC) major in the College of Education; however, it was open to enrollment from students in any program at the university. Only 25 out of the 52 undergraduates enrolled in the spring 2021 course were part of the CESC major. The rest of the undergraduate students hailed from a variety of programs, including psychology, communication disorders, sociology, communication, legal studies, mathematics, art, linguistics, finance and women, gender and sexuality studies. The course also served as an elective for graduate students in the Learning, Media, and Technology master's degree program, with 8 of the 19 graduate students in this course being part of this program. The rest of the graduate students were enrolled in certificate, master's, or doctoral programs in Education ( $n = 9$ ) or doctoral programs in nursing ( $n = 1$ ) or communication disorders ( $n = 1$ ). The undergraduate and graduate sections of the course were run together at the same time, with all 71 students joining together in the synchronous Zoom sessions each week.

The fall 2021 course (Teaching and Learning with Technology) had 20 students enrolled, and 6 (30%) completed the survey. This course served as an elective for the CESC major and education minor within the College of Education as well as the information technology minor at the university. Slightly more than half of the students enrolled in the fall 2021 course ( $n = 11$ ) were part of the CESC major, the remainder were from several different undergraduate programs, including history, art, communication, music, psychology and mathematics.

Participants in the study were a mix of undergraduate ( $n = 39$ ; 57%), graduate ( $n = 25$ ; 36%), and non-degree graduate ( $n = 5$ ; 7%) students. The majority of participants self-identified as female ( $n = 53$ ; 76%), with 13 students (19%) identifying as male, 3 students (4%) identifying as trans male or female, and 1 student preferring not to identify their gender. In terms of race/ethnicity, 52 (74%) identified as White, 10 (14%) as Asian, 5 (7%) as Hispanic, Latino, or

Spanish, 2 (3%) as White and Asian, and 2 (3%) preferred not to identify their race/ethnicity. Most participants ( $n = 59$ ; 84%) reported taking at least 3 remote or online courses with a synchronous online component before this course, indicating they were familiar with video conferencing tools.

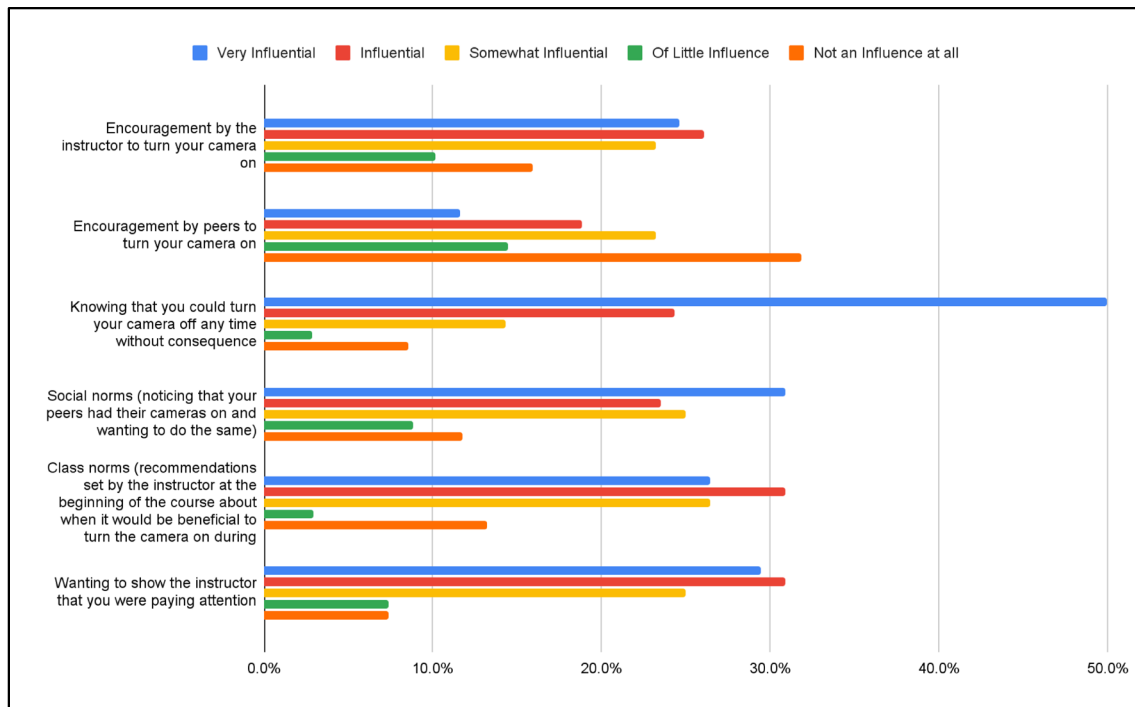
## Data Analysis

We adopted an interpretivist perspective (Erickson, 1986) to guide the data analysis process in order to examine students' experiences, views and perceptions as they were situated within the context of the courses. For the grid questions, we generated descriptive statistics and graphical displays to interpret the data. For the open-ended responses, we engaged in a thematic analysis (Braun & Clarke, 2006) in order to identify common themes across the dataset. To start the thematic analysis, we placed the open-ended responses in a spreadsheet and separately reviewed 50 responses, which yielded 31 unique codes representing common patterns in the dataset. Through discussions and further review of related literature, we determined that the APA (1997) 14 learner-centered psychological principles would allow us to consolidate the codes into broader themes. We used the APA's four overarching categories (i.e., Cognitive and Metacognitive Factors, Motivational and Affective Factors, Developmental and Social Factors and Individual Differences) to guide the design of our main themes as well as our sub-themes and then recode the data.

## Findings

**RQ1:** What factors influenced students' use of cameras in synchronous online Zoom classes?

Participants were asked to rate the level of influence a specific factor had on whether they turned their cameras on during class. They identified the following five factors as the most influential: 1) knowing that they could turn their camera off at any time without consequence ( $n = 52$ ; 74%), 2) wanting to show the instructor that they were paying attention ( $n = 41$ ; 59%), 3) class norms ( $n = 39$ ; 56%), 4) social norms ( $n = 37$ ; 53%) and 5) encouragement by the instructor to turn the camera on ( $n = 35$ ; 50%) (see Fig. 2 for more details). These results indicate that there are multiple factors that influence whether a student turns a camera on at any given moment during an online synchronous class. Students seemed most likely to turn their cameras on when they felt they could choose to turn their cameras off without punitive measures. Interpersonal relations, including norms, instructor encouragement and demonstrating presence, also played a substantial role in influencing camera use.



**Fig. 2** Factors that influenced whether students turned their cameras ON at any given moment during class

Participants were also asked to rate the level of influence a specific factor had on whether they turned their cameras off during class, with the most influential being: 1) not wanting to be seen eating on camera ( $n = 51$ ; 73%), 2) concern with what instructors or peers might see or hear in their surroundings ( $n = 47$ ; 67%), 3) not wanting to be seen walking away from the computer ( $n = 43$ ; 60%), 4) fatigue from being in Zoom for long hours ( $n = 40$ ; 57%) and 5) difficulty concentrating when seeing themselves on camera ( $n = 34$ ; 49%) (see Fig. 3). These results indicate that both physical needs and physical spaces shaped when and why students turned their cameras off during class. Interestingly, less students ( $n = 27$ ; 39%) reported a concern with their physical location being seen compared to a concern with what the instructor and classmates might hear or see in their surroundings ( $n = 47$ ; 67%), suggesting that students were more worried about the people in their surroundings than their physical surroundings.

The selection of “somewhat influential” is worthwhile to examine for this prompt since it might illuminate factors that are not influential enough for students to turn their camera off, but still play a role in shaping students’ attention, engagement and/or learning in synchronous online classes. The most commonly selected factors for the “somewhat influential” category were: 1) students’ concern with others making judgements about them based on their physical appearance ( $n = 18$ ; 26%), 2) feeling that everyone was looking at them when their camera was on ( $n = 15$ ; 21%) and 3)

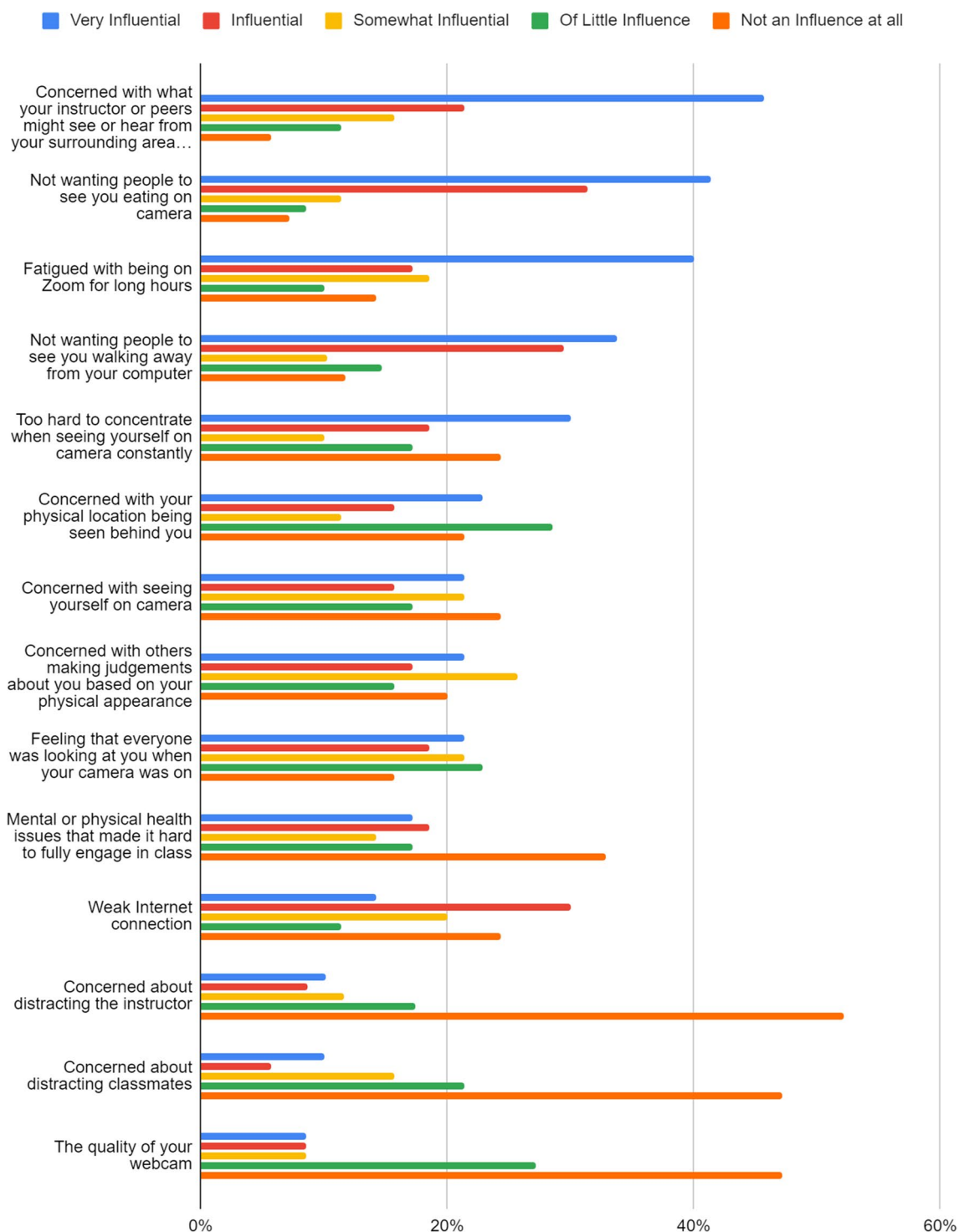
concern with seeing themselves on camera ( $n = 15$ ; 21%). These results indicate that both “mirror anxiety” and “Zoom gaze” played a role in shaping students’ experiences with using video conferencing technology during synchronous online learning.

Students were also asked to openly describe why they turned their cameras on or off during particular parts of class. While their responses varied – with no two exactly alike – there were common patterns across the responses. Using the APA (1997) learner-centered psychological principles as a lens, we categorized students’ responses into four themes and nine sub-themes (see Table 2).

A total of 68 students responded to the five open-ended prompts, yielding 340 comments. Each comment was coded based on the nine sub-themes resulting in 623 total codes. Every comment received between 1 and 6 codes, with an average of 1.83 codes, indicating that students often presented multiple reasons for turning their cameras on or off in a single comment. In the following section, we will briefly discuss the four main themes and nine sub-themes based on our dataset.

**Social Factors** The most commonly cited reason students turned their cameras on or off during class was social factors, with 214 of the 623 total codes (34%) falling in this theme. Within this theme, there were two sub-themes: interpersonal relations and social interactions. For interpersonal relations, students reported turning their cameras on or off





**Fig. 3** Factors that influenced whether students turned their cameras OFF at any given moment during class

based on how they felt others would perceive them, how they presented themselves to others and how their presence influenced others. For example, one student identified several interpersonal relations factors that shaped their camera use:

When I would decide to have my camera on, it was often because I wanted the professor to not experience the discomfort that I often hear around "staring at black boxes" and I wanted to be seen as participat-

**Table 2** Open-ended data themes and sub-themes based on APA learner-centered psychological principles

Theme	Sub-Theme	<i>n</i>	% of 623
Social	Interpersonal Relations	145	23%
	Social Interactions	69	11%
Cognitive & Metacognitive	Nature of Learning	102	16%
	Context of Learning	53	9%
	Thinking About Thinking	34	5%
Individual Differences	Physical Needs	100	16%
	Surroundings	30	5%
Affective & Motivational	Affective	73	12%
	Motivation	17	3%

ing as fully as possible. When I would decide to have my camera off, it was because I was just joining (not ready to be seen), eating or something else related to feeling anxious about how I would be seen.

This student reported that empathy for the professor, interest in being present for the professor, readiness with being seen by others and concern about how they would be seen by others all played a role in shaping their camera use. This quote exemplifies the complex dynamics of interpersonal relations that shape student camera use.

For responses coded as social interactions, students shared how using a camera made it easier to communicate and interact with others and helped build a sense of community. Several students mentioned that having cameras on allowed them to pick up on nonverbal cues. For instance, one student commented, “Most of the time I had my camera on in breakout rooms for design projects because it’s easier to collaborate and communicate with others when we can see nonverbal communication (nodding, etc...).” While another student noted that audio and text-based communication were not sufficient for social interactions: “I also think you can’t engage properly with the group if you don’t have the camera on.” Like many of the other participants, this student felt that turning cameras helped improve social interactions.

However, with twice as many responses coded as interpersonal relations compared to social interactions, students’ camera use seemed to be more influenced by perceptions of others than its benefits. That is, students seemed to be more concerned with what others were thinking than with how the technology might support their social engagement and learning.

**Cognitive & Metacognitive Factors** Cognitive and metacognitive factors were the second most popular reason students turned their cameras on or off during class, with 189 out

of the 623 total codes (30%) relating to this theme. Within this theme, there were three sub-themes: nature of learning, context of learning and thinking about thinking.

Nature of learning reflected the way learning happened during class, such as listening to the instructor, working on group projects, engaging in discussions, posting in the text chat box or participating in design activities. Several students mentioned that when they were listening to the instructor or taking notes, they did not feel that having the camera on enhanced their learning - as one student commented: “I am just listening [when the instructor is speaking], so having my camera on will have little to no impact on my learning.” On the other hand, a student wrote that when “the nature of activities is socioculturally and constructively constructed, it is beneficial [to have the camera on].” Students’ camera use seemed to shift fluidly based on the nature of learning, as one student wrote: “We would often fluctuate between cameras on and off in [breakout] rooms for design projects depending on what we were doing. When taking a moment to review or to work independently, we typically would mute audio and cameras, but when discussing or working together, would have cameras/audio on.” Students’ responses highlighted that they were mindful of how the camera shaped their ability to learn based on the nature of learning.

The context of learning, which refers to environmental factors, such as technology and instructional practices, also played a role in shaping students’ camera use. Some students mentioned technical issues, such as Internet and device reliability and instructional practices, such as instructor expectations regarding camera use, as contextual factors influencing their camera use. While others noted that the design of Zoom’s user interface was a significant contextual factor shaping their camera use. For instance, one student wrote:

I turn my camera off. It's difficult to work when you think people are always looking at you. In a classroom I've never been concerned that everyone can see me. With Zoom, it's exhausting to have to worry about facial expressions and what my hands are doing ALL of the time.

In this case, both the “mirror anxiety” and “Zoom gaze” aspects of the Zoom interface created a context of learning that negatively influenced camera use.

Some students also mentioned metacognitive factors, including thinking about thinking, that influenced their camera use. These responses mainly centered on students’ ability to focus when their cameras were on or off. In some cases, students felt that turning the camera off improved their focus, as one student noted: “I did not have my camera on because I feel as if I can focus better when my camera is off, because I feel distracted and I have ADHD and have a hard time sitting still.” While in other cases, students felt that turning the

camera on improved their focus: “I do think that turning my camera on helps me connect better with the material.”

**Individual Differences** Individual differences, including physical needs and surroundings, were the third most popular reason students turned their cameras on or off during class, with 130 out of the 623 total codes (30%) falling within this theme. In terms of physical needs, students commonly mentioned that when they were eating, drinking, moving about, stretching, multitasking, getting ready for class or going to the bathroom, they would turn off their cameras. For instance, one student wrote: “Oftentimes if I didn’t have my camera on I was maybe running to the bathroom, prepping my work space, getting a snack, filling my water, etc...” Many students also reported turning their cameras off due to physical or mental health issues, as one student shared: “I did not feel comfortable turning on my camera. My mental health is not good so I do not feel good enough to show myself,” while another reported turning their camera off “if I am eating or having a mad allergy fit or need to do something. Also, I need to move around sometimes (body and focus issues). Also, if I feel crappy I will turn it off.” These quotes indicate that camera use can be uniquely dependent on students’ individual physical and mental health needs.

Students’ physical surroundings influenced camera use, too. Many students reported keeping their cameras off for privacy purposes, as one student mentioned, “This is a big class, so I’m a little uncomfortable with many people seeing myself and the background that I am.” Students also reported turning their cameras off when people in their living space would be seen or heard by the instructor or classmates.

**Affective & Motivational Factors** Affective and motivational factors were the fourth most popular reason students turned their cameras on or off during class, with 90 of the 623 total codes (14%) falling within this theme. For this theme, students most commonly wrote about feeling self-conscious when their cameras were on. For instance, one student commented, “I don’t have my camera on during the main session because I do not want 70 people looking right at my face. I get paranoid that someone will pin my video or that I’ll make a weird face when I am concentrating. You can’t tell if someone is looking at you or recording you,” while another student wrote that it’s easier “to concentrate when no one is ‘looking’ at me – especially me looking at me! When I’m the one receiving the lesson, it’s more relaxing to just listen without being watched.” On the other hand, a few students reported that turning their cameras on increased their motivation and engagement in learning. For instance, a student wrote “I feel like I’m participating more when it’s on. It’s like active listening,” and another shared, “I usually try to start with my camera on and keep my camera on; it helps me stay disciplined and gives it more of a ‘class’ feel.”

In summary, students’ decisions regarding camera use were multifaceted and uniquely individualized. Some students turned their cameras on to improve their focus, while others turned theirs off to improve their focus. Some students turned their cameras on because they cared about their instructors’ feelings (e.g., not having to teach to black boxes) while others turned their cameras off because they also cared about their instructors’ feelings (e.g., not wanting to distract their instructor with their movement or physical surroundings). These results showcase the myriad of factors that can shape student camera use, but the extent that these factors influenced camera use seemed to vary from student to student.

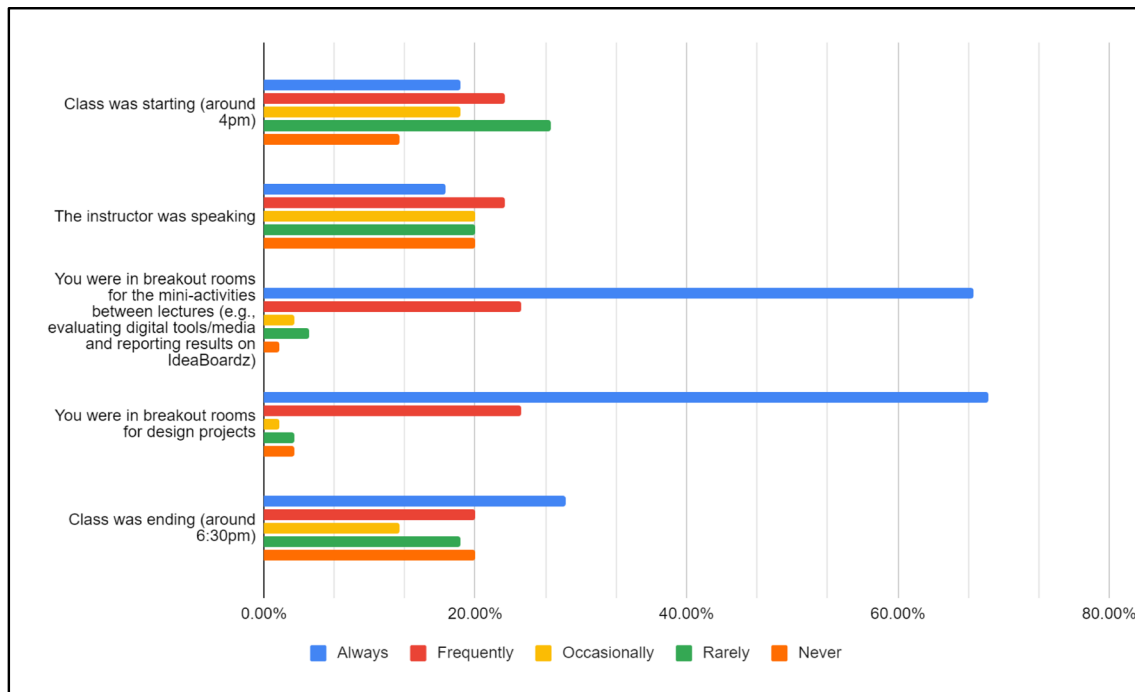
**RQ2:** How do these factors change within and across the spatial and temporal contexts of a class?

Students’ reported camera use seemed to fluctuate from space to space and time to time within a single class. In a multiple-choice question, students were asked to share how often they had their cameras on during particular times (i.e., start and end of class) and in particular spaces (i.e., main room, breakout rooms). When in breakout rooms, more than 90% of students reported having their cameras on frequently or always (see Fig. 4). While in the main room at the start of class, when the instructor was speaking and at the end of class, less than half of students (43%), on average, reported having their cameras on frequently or always. In the following section, we will discuss how the factors described in the previous section shifted within and across the spatial and temporal contexts of a class.

**Start of Class** At the beginning of class, students most commonly identified physical needs ( $n = 33$ ; 49%), interpersonal relations ( $n = 26$ ; 38%) and affective factors ( $n = 22$ ; 32%) as the reasons they turned their cameras on or off. In regard to physical needs, students often turned their cameras off because they were running late, getting ready for class or eating or drinking, as one student noted, “I did not have my camera on mostly because I am getting settled at my desk, moving around. Sometimes I was eating or running to the bathroom quickly before we got started.” For interpersonal relations, some students mentioned turning their cameras off to not distract classmates while they were getting ready or moving around on screen, while other students turned their cameras on to show the instructor that they were present and ready for class. In terms of affective factors, students’ comments centered on feelings of self-consciousness and not wanting to be watched by others, especially in a large class in Zoom.

**Instructor Speaking** When the instructor was speaking, interpersonal relations ( $n = 29$ ; 43%) and physical needs ( $n = 28$ ; 41%) were the most common reasons students





**Fig. 4** Participants' reported frequency of having camera on during different times and spaces in class

turned their cameras on or off; however, affective ( $n = 19$ ; 28%), nature of learning ( $n = 19$ ; 28%) and metacognitive ( $n = 18$ ; 26%) factors were also influential. For interpersonal relations, students either mentioned wanting to show the instructor they were listening (cameras on) or not wanting to distract others (cameras off). For physical needs, several students reported eating, drinking, moving around or doing off-task activities while the instructor was speaking (cameras off). In terms of affective factors, some students mentioned that they felt comfortable on camera, while others reported concerns with seeing themselves on camera ("mirror anxiety") or with others looking at them ("Zoom gaze") while the instructor was speaking. The responses coded as metacognitive related to students' noticing of whether being on or off camera influenced their focus. For instance, one student commented: "I honestly focus better when I don't have to keep looking and staring at myself seeing if I look okay for the entire class." In regard to the nature of learning, multiple students expressed that since the instructor was speaking they did not feel they had to be on camera.

**Mini-Activities and Design Projects in Breakout Rooms** For both the mini-activities in breakout rooms and design projects in breakout rooms, the three most commonly identified factors influencing camera use, when averaged between the two, were, interpersonal relations ( $n = 35$ ; 51%), nature of learning ( $n = 32$ ; 46%) and social interactions ( $n = 31$ ; 46%).

In breakout rooms, students' responses coded as interpersonal relations focused on group size and dynamics, social norms and respect. Several students mentioned that they felt more comfortable turning their cameras on because the breakout room group size was much smaller than the main Zoom room. Students also reported turning their cameras on or off based on social norms. For instance, one student wrote: "When in BO [breakout] rooms, we typically were 3-4 people, so we all just kept our camera on. It seemed very comfortable for me. Also, I missed the first class, so I kind of assumed it was a norm, as all folks had their cameras on." This student, like many others, noted that both the group size and social norms influenced their camera use in breakout rooms. However, while students seemed to be more likely to use their cameras during breakout rooms, their use was fluid depending on the nature of learning, as one student shared: "We were also flexible about when we had it on or off. When we are doing our work and not talking, cameras off. When we're talking and discussing, cameras on." The responses coded as social interactions aligned with this sentiment as well, as students reported turning their cameras on to support social interactions, including communication, collaboration, discussions and connecting with peers.

**End of Class** At the end of class - often when students would return to the main Zoom room after a breakout room activity or design project - students cited physical needs ( $n = 23$ ;

34%), interpersonal relations ( $n=21$ ; 31%) and context of learning ( $n=17$ ; 25%) as influential factors regarding their camera use. Several students reported they were exhausted, hungry or moving around by the end of class. For example, one student shared:

By the time our class is over, I feel completely mentally shot because it comes after a long day of work. I try to supplement engagement by writing things in the chat when I feel inclined to do so, but feel that the pressure of having my camera on only adds to anxiety and exhaustion of life+class.

Since there were other ways of showing engagement (i.e., writing in the chat), this student chose to turn their camera off to preserve their physical and mental health at the end of class. Several students noted that if the instructor was sharing their screen, they would not turn their camera on because the instructor wouldn't see them, but if gallery view was showing, they would turn their camera on to wave goodbye to the instructor. These responses exemplify how both the context of learning (e.g., Zoom features) and interpersonal relations influenced students' camera use at the end of class.

## Discussion

In this study, we sought to highlight and elevate students' authentic experiences with using cameras for video conferencing in synchronous online learning settings. Far too often decisions regarding technology use for teaching and learning are made without seeking student input, which can lead to "feeling[s] of powerlessness among students" especially during a "traumatic time" such as the global pandemic (Literat, 2021, p. 11). In the wake of the COVID-19 pandemic, Literat recommended that educators make sure students' struggles are seen and heard and their voices matter. Since previous studies on video conferencing technology have tended to center the instructor or the technology (Serhan, 2020; Vandenberg & Magnuson, 2021; Lowenthal et al., 2021), there is a clear need for examining student use of this technology from a learner-centered perspective. Based on our analysis of the data using the APA (1997) learner-centered psychological principles, we offer three key findings, which we will detail in the following section.

First, there are several different factors that influence student camera use in synchronous online learning settings. Our initial round of coding identified 31 unique factors influencing camera use. We organized these factors into four themes (i.e., Cognitive and Metacognitive Factors, Motivational and Affective Factors, Social Factors and Individual Differences) and nine sub-themes (i.e., interpersonal relations, social interactions, nature of learning, context of learning, thinking about thinking, physical needs, physical surroundings, affective and

motivation). These findings align with prior literature, which has showed that student camera use is influenced by multiple factors, including privacy, social norms, concerns about personal appearance, concerns about distracting peers, Internet connection, being distracted or disengaged, cooperation and accountability (Castelli & Sarvary, 2021; Maimaiti et al., 2021; Schwenck & Pryor, 2021). This study adds new factors influencing student camera use to the literature – including the nature of learning, context of learning and metacognitive factors – while also demonstrating that a learner-centered framework can serve as a lens for investigating the reasons students use their cameras in Zoom for synchronous online learning.

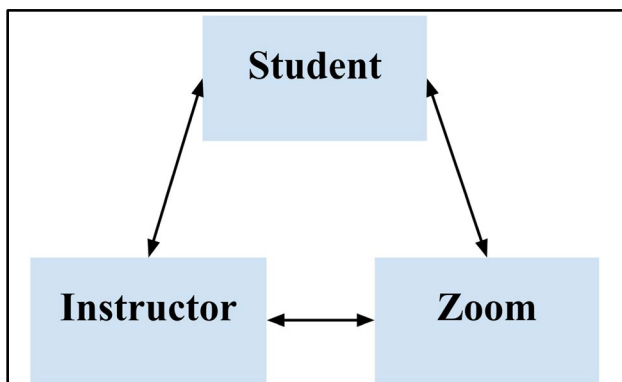
Second, the level of influence of each factor varied from student to student, space to space and time to time. While previous research has focused on what factors influence student camera use (Castelli & Sarvary, 2021; Schwenck & Pryor, 2021), researchers have not yet investigated whether these factors are different for each student and whether these factors shift within and across space and time in a single class. This study demonstrated that these factors do indeed vary by student, space and time. For example, some students turned their cameras on to feel less distracted, while others turned theirs off because they felt it was distracting. Some students turned their cameras on only in breakout rooms, while others turned theirs on when the instructor was speaking. Some students turned their cameras on at the start and end of class to connect with the instructor, while other students turned their cameras off at the start or end of class because of physical needs. Ultimately, students' camera use shifted fluidly based on the level of influence of each factor, the space they were in (e.g., main Zoom room, breakout room) and the time (e.g., start, middle, end of class). These findings indicate that students' decisions regarding camera use are more complicated, individualized and multifaceted than previously presented in the literature.

Third, there is an interconnected, dynamic relationship among the student, instructor and Zoom, with each of these influencing one another as well as the use of cameras in online synchronous learning. Students have physical, mental, affective and social needs and concerns that shape whether they use their camera to engage with the instructor, but at the same time, the instructors' pedagogy (e.g., lecturing vs. group activities), requirements regarding camera use and use of Zoom (e.g., main room vs. breakout room) influence whether students turn their cameras on or off. Meanwhile, the design of the Zoom interface influences what instructors and students can do in Zoom, but at the same time, instructors and students can proactively shape how Zoom is used. For example, Zoom presents a speaker view, gallery view, screensharing view and whiteboard view. The instructor can choose which view to feature. The student can decide whether to use the camera feature, whether to minimize self-view and whether to spotlight the speaker based on their needs and concerns, thus shaping Zoom. These findings build

on prior literature indicating that instructor pedagogical skill and use of the video conferencing platform tool impacts student learning and engagement in online settings (Maimaiti et al., 2021), while also presenting a new model that highlights the complex interconnected relationship between student, instructor and Zoom (see Fig. 5).

## Implications for Practitioners

Based on the findings presented in this study, instructors and course designers must think about the multifaceted, dynamic relationship between the student, instructor and video conferencing technology and consider the way that choices related to one element influence the other two and vice versa. For instance, if the instructor plans to lecture in Zoom, they might consider how their pedagogical decision (i.e., lecturing) shapes the way they use Zoom (i.e., screensharing, presenting as a talking head) and the way students use their cameras. Several students in our study mentioned turning their cameras off when the instructor was speaking due to the experience of seeing oneself (“mirror anxiety”) and awareness of being watched (“Zoom gaze”), as well as physical needs. While other students mentioned turning their cameras on for accountability and to show the instructor they were paying attention. Knowing this, an instructor might encourage students to turn their cameras off, teach them how to turn off self-view and spotlight the speaker and/or provide an opportunity for all students to be on camera momentarily in gallery view to show they are paying attention before they start their lecture. Or, they might survey students at the beginning of a course to elicit their thoughts about camera use and then collaborate with them to define class guidelines and norms for camera usage. Setting norms is especially helpful for reducing the cognitive load students might spend wondering when and why they need to be on camera during class.



**Fig. 5** Bidirectional relationship between factors influencing student camera use

If instructors are concerned that taking a learner-centered approach might mean teaching to “black boxes,” they should have conversations with students regarding when being on camera is helpful to their learning, such as to aid communication and collaboration, build relationships and to enrich the sense of class community. On the other hand, if they choose to require or force students (with punitive measures) to be on camera because they do not want to teach to “black boxes,” they might risk negatively impacting students’ physical and mental health, feelings of privacy, engagement and learning. Students in this study reported that having agency to turn their camera on or off at any time without consequences was the most influential factor shaping whether they turned their cameras on, which indicates that a “cameras optional” policy may be more beneficial to student learning than a “cameras required” policy.

If instructors are concerned that a “camera optional” policy might make it harder to observe and assess student engagement, they might explore ways of making student engagement, thinking and learning visible without requiring students to be on camera. For instance, educators might ask for students to reply to a question in the video conferencing platform’s text box, use an emoji to represent their level of understanding of a concept, participate in a poll or complete a digital activity, such as writing on a shared Jamboard. Interestingly, while students can show they are paying attention in multiple ways using video conferencing technologies, several students in this study indicated that they turned their cameras on specifically to show the instructor they were paying attention. This may indicate that students’ perceptions of what it means to be paying attention are tied to traditional in-person classroom practices where the instructor looks for students to be paying attention rather than providing students with multiple ways to show they are focused on learning.

The findings from this study indicate that practitioners should approach online synchronous course design and teaching in Zoom with intention and an awareness of the complex, individualized needs students have – many of which may be unique to this learning environment – and the way these needs influence students’ decisions about camera usage during class sessions. Flexibility, empathy and an awareness that an individual student’s needs will likely change across a class session should inform policy and practice regarding student camera use during online synchronous learning.

## Conclusion

Given the increase in use of video conferencing tools in educational settings, this study highlights the need for research and instructional design practices that center the learner. The findings from this study demonstrate that there are a myriad

of factors that can shape student camera use and the influence of these factors varies from student to student, space to space and time to time. Rather than presenting top-down mandates regarding camera use in online synchronous learning settings, educators should seek to learn with and from students regarding when being on camera is beneficial to learning and when it is harmful to their learning and then design course requirements and set expectations accordingly.

**Authors' Contributions** All authors contributed equally to this manuscript.

## Declarations

**Consent to Participate** Informed consent was obtained from all individuals included in this study.

**Competing Interests** We, the authors, declare that we have no known competing financial interests or personal relationships that influenced the work reported in this paper.

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