The Effect of Video Camera, Microphone and Chat Box Use on Social Presence and Engagement in an Online Group Activity

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Abstract

With the rapidly expanding availability of online courses, concerns have been raised about student engagement and connection within the online environment. Using an experimental design, we examined the effects of video camera, microphone (audio), and chat box communication on students' experiences of social presence, peer rapport, motivation, satisfaction, and anxiety. A total of 133 undergraduate students were randomly assigned to a video, audio, or chat box condition and completed an online interactive group task followed by a post-task survey. Multiple one-way ANOVAs indicated that participants in the chat box condition reported lower levels of social presence, peer rapport, motivation and satisfaction compared to both the video and audio conditions. However, there were no differences between the video and audio conditions. Those in the video condition also reported higher anxiety levels than those in the chat box condition, but all groups reported low levels of anxiety. We recommend that students participate in their online classes using video cameras and/or microphones to increase engagement and interpersonal connections with peers.

Keywords: Online learning, engagement, interpersonal connections, video cameras, communication

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Online education has been growing steadily in popularity and availability over the last several decades (McPartlan, 2020; Britt, 2015). Since 2011, online learning has seen a growth rate of over 9% a year (McPartlan, 2020). In 2016, 35% of students had taken at least one online course (Lederman, 2018) and by the fall of 2020, 75% of students were enrolled in at least one online course (Al-Fanar Media, 2022). As such, online education is not a new concept; however, the impact of COVID-19 and mandated online learning in 2020 left universities scrambling to transition every class into an online format, resulting in a struggle to adapt among students and teachers alike (Vakil, 2020; Shin, 2021).

Challenges in facilitating interpersonal connections among peers and between students and instructors have been noted as a consistent negative outcome of online learning (Driver, 2018; Muilenburg & Berge, 2007; Parkes & Barrs, 2021). Key differences between online learning and the more traditional in-person learning revolve around communication methods and group dynamics. While in-person environments allow for more immediate, in-depth, and organic conversations among students and between students and faculty, online environments—particularly asynchronous environments—have more rigid and structured communications (Hailey Jr. et al., 2001; Tallent-Runnels et al., 2006). Moreover, online communications are more likely to be in a written format and to involve time delays as a result of waiting for responses to messages. In relation to group dynamics, virtual environments have been described as more mechanical and consisting of intentionally structured tasks rather than naturally organic conversations that occur in physical classrooms (Tallent-Runnels et al., 2006). Students are also much more limited in their ability to interact with one another in the online environment. As such, students in online courses have reported lower levels of connection, motivation, trust and accountability with their peers compared to in-person courses (Alsharo et al., 2017; Muilenburg & Berge, 2007; Rovai et al., 2005; Saghafian & O'Neill, 2018; Tseng & Yeh, 2013). This also could explain why student motivation during the COVID-19 pandemic was found to be lower (Suarsi et al., 2021; Hanesty et al., 2020; Chiu et al., 2021), especially since teachers and students had to abruptly switch to an online format with little time for preparation.

Active engagement with others in the learning environment has been identified as an important component of successful learning for students (Martin & Bolliger, 2018; Pascarella & Terenzini, 2005) and helps to promote a sense of community within the classroom (Kim & Bonk, 2006). Axelson and Flick (2010) define engagement as "how *involved* or *interested* students appear to be in their learning and how *connected* they are to their classes, their institutions, each other" (p. 38). High levels of engagement have been viewed as an indicator of successful classroom instruction (Fletcher, 2015), institutional excellence (Axelson & Flick, 2010), and as a key predictor of learning and personal development (Kuh, 2003). Engagement is closely linked with motivation as students who are engaged in their studies are more likely to be self-directed in their learning and to express positive emotions, such as enthusiasm during learning (Skinner & Belmont, 1993). Additionally, social presence (Garrison et al., 2010) and rapport (Faranda & Clarke, 2004) have also been linked with student motivation and engagement (Benson et al., 2005; Frisby & Martin, 2010) and can be vital to a student's success in an online course (Kaufmann & Vallade, 2020). Active learning activities such as collaborative group tasks, which are based on peer participation and interaction (Conrad & Donaldson, 2012), have been found to increase student motivation and learning (Hake, 1998; Nilson, 2016; Redmond et al., 2023). However, Peper and colleagues (2021) have reported that students find virtual classes less

engaging than in-person classes. When students interact with their peers in a collaborative group task within a virtual environment, they are able to communicate with one another via three primary methods: a video camera, a microphone and/or the chat box. The purpose of this study was to examine whether these three communication mediums lead to differences in a student's sense of engagement during an online task, as measured through motivation, peer rapport, social presence, and satisfaction. If one, or more, of these methods leads to improved engagement and connection, then this could have important implications for student success in online environments.

Media Naturalness Theory

Drawing on Darwin's theory of evolution by natural selection, media naturalness theory (MNT) argues that we are biologically attuned to prefer face-to-face communication and the natural cues inherent in this form of communication (Kock, 2005). This theory argues that the different mediums that we use to communicate possess varying levels of a trait called naturalness. Face-to-face communication is considered to have the highest level of naturalness (Sacco & Ismail, 2014), as based on five criteria: (1) sharing a common physical space, (2) synchronous and immediate exchange of information, (3) availability of facial expressions, (4) the availability of body language, and (5) communication via natural speech (Blau et al., 2017; Kock, 2005). A decline in media naturalness is seen the further a medium is from its resemblance to face-to-face communication (Blau et al., 2017). These declines in media naturalness led to increases in cognitive effort, communication ambiguity and a decline in physiological arousal (Kock, 2005). Cognitive effort, which is the amount of mental activity required to process a communication interaction is increased when it becomes more difficult to interpret a message because of time delays or a lack of contextual cues. Similarly, a lack of contextual cues can limit one's ability to interpret a message increasing the risk of misinterpretation. Finally, when elements of natural face-to-face communication are suppressed (e.g., lack of facial cues), there is a decrease in physiological arousal which tends to make interactions less engaging (Kock, 2005). Recently, Reidl (2022) used MNT to develop a model of Zoom fatigue that describes inconsistencies in the synchronicity of communication, atypical experiences of body language cues, eye contact, and interactions with multiple faces, and greater perceptions of self-awareness that is evident in video conferencing. Other researchers in online education have drawn from MNT to study the impact of COVID on motivation, satisfaction and learning outcomes (Fabriz et al., 2021) and to explore limitations of video conferencing as a method of communication (Shingjergji et al., 2021).

According to MNT, there would be key differences in the level of naturalness between the use of a video camera, microphone, and chat box during online synchronous communications. Of the three, video cameras would provide the most natural communication as this method of communication meets aspects of all of the above noted criteria except for the element of communicating in the same physical space. Being able to communicate using non-verbal cues, including smiles, frowns, head nods, looks of uncertainty, or other reactionary cues in response to verbal communications (Ishii et al., 2019; Olson et al., 1995), has been linked to perceptions of relationships that are closer and more trusting warmer, closer, and more comfortable (Falloon, 2011). Kushlev and Epstein-Shuman (2022) suggested that students who have their video cameras on may be more engaged and have a richer online class experience compared to those that can't be seen by others. However, as noted by Reidl (2022), these cues

still have some limiting differences compared to in-person communications. Additionally, concerns have been raised that requiring students to turn on their video camera during a class session may negatively impact student anxiety and depression (Costa, 2020). A survey study by Castelli and Sarvary (2020) found that the top three reasons that students did not turn their video camera on was because keeping their video camera off was considered the norm, followed by concerns about how they looked and what would be viewed in their background. Microphones would be next in their level of naturalness after video cameras. Microphones, on their own, meet only the elements of a synchronous exchange of information and communication via natural speech; they lack the use of facial cues and body language that are afforded by video cameras. Communicating through the chat box would be the least natural of the three communication methods as it only meets the criteria of a synchronous exchange of information, which is also at a notably slower pace than the other two mediums. Additionally, the lack of contextual cues increases the risk of misinterpretation as it can limit the student's ability to interpret the message. The use of chat space only could potentially disadvantage some students as it could cause a delay in responses by individuals within group discussions because rates of typing and reading differ from person to person (Hambley et al., 2007).

Purpose of the Present Study

With the expansion and necessity of online courses, there is limited research comparing the effects of using a video camera, microphone, or chat box to communicate within the online learning environment. Therefore, the purpose of this paper was to provide experimental evidence on the effect of these three different communication mediums on students' experiences of social presence, peer rapport, motivation, satisfaction, and anxiety. The following hypotheses were proposed:

1. Participants in the video camera condition will report higher levels of social presence, rapport, and motivation and satisfaction than participants in the microphone condition, who will report higher levels than participants in the chat box condition.

2. Participants in the video camera condition will report higher levels of anxiety than participants in the other two conditions.

These results will have the potential to positively impact teaching and the online learning environment by potentially identifying whether the use of video cameras during synchronous online sessions can improve the development of interpersonal connections among peers which can lead to a stronger sense of community within online classrooms.

Methods

Design

We conducted this study using an experimental between-groups research design with three conditions: video camera, microphone and chat box. Prior to the start of the study, we created a session schedule that contained a randomized list of the session order for a total of 45 sessions (15 each for the video camera, microphone, and chat box conditions.) We then followed the order in this list for running the study sessions. Each session was run with a facilitator and a

confederate, who posed as one of the study participants, and consisted of three phases: (1) group task, (2) survey, (3) debriefing. Each session took approximately 40 minutes. Data was collected between June 2022 and April 2023.

Participants

A total of 133 participants were recruited through our university's subject pool. All sessions were run in small groups with at least two participants and a confederate (who monitored participation during the task) being needed in order to conduct a session. The number of participants per session ranged from 2 to 7 (M = 3.33 SD = 1.27). We ran a total of 40 sessions: video camera (13 sessions and 43 participants), microphone (13 sessions and 51 participants), and chat box (14 sessions and 39 participants).

The participants in the video condition had a mean age of 20.69 (SD = 2.97) and were predominantly female (n = 34; 79%). The majority of participants identified as South Asian (n = 31; 72%), followed by Southeast Asian (n = 6; 14%), White (n = 3; 7%), and other (n = 2; 5%). The sample was varied in years of study: 24 year one students (56%), 7 year two students (16%), 7 year three students (16%), 2 year four students (5%) and 2 year five or higher students (5%).

The participants in the audio condition had a mean age of 23.80 (SD = 7.79) and were predominantly female (n = 43; 84%). The majority of participants identified as South Asian (n = 23; 45%), followed by Southeast Asian (n = 11; 22%), White (n = 9; 18%), and Black (n = 3; 6%); five participants (10%) identified as other. The sample was varied in years of study: 20 year one students (39%), 16 year two students (31%), 6 year three students (12%), 6 year four students (12%) and 3 year five or higher students (6%).

The participants in the chat condition had a mean age of 21.77 (SD = 3.26) and were predominantly female (n = 32; 82%). The majority of participants identified as South Asian (n = 24; 62%), followed by Southeast Asian (n = 6; 15%), White (n = 5; 13%), and other (n = 4; 10%). The sample was varied in years of study: 18 year one students (46%), 13 year two students (33%), 2 year three students (5%), and 6 year four students (15%).

Materials

Social Presence

The Community of Inquiry Survey (Arbaugh et al., 2008) is a 35-item scale consisting of three subscales: social presence, teaching presence and cognitive presence. Only the 9-item social presence subscale was used in this study, with a higher score indicating a greater sense of self within the environment. Participants responded to the items on a five-point scale from "strongly disagree" to "strongly agree." Coefficient alpha for this scale was .89.

Student Rapport

The measure of Perceptions of Rapport (Frisby & Martin, 2010) is an 11-item measure of student rapport initially developed by Gremler and Gwinner (2000). While Frisby and Martin (2010) modified the scale to focus on instructors/classmates rather than employees, we made another modification and used peers instead of instructors/classmates. Additionally, although the scale is intended to be responded to on a 7-point scale, we modified this to a 5-point scale ("strongly disagree" to "strongly agree") to be consistent with the other measures used in this

study. Higher scores on this scale indicate a higher degree of connection with one's peers. Coefficient alpha for this scale was .92.

Motivation

Motivation was measured using the four-item motivation scale from a larger scale developed by Curran and Rosen (2006). We modified the scale to refer to "other participants" instead of "other students." A higher score on this scale indicates a more positive influence of others on one's enjoyment of the task. These items are responded to on a 5-point scale from "strongly disagree" to "strongly agree"). Coefficient alpha for this scale was .88.

Satisfaction

Satisfaction was measured using the 4-item semantic differential scale by Krishen (2013) who adapted the scale from Spreng and colleagues (1996). These items were responded to on 5-point scales with the anchors ranging from dissatisfied/satisfied, displeased/pleased, unfavorable/favorable, and unhappy/happy. Coefficient alpha for this scale was .91.

Anxiety

Anxiety was measured through three self-developed items. These items included: "I felt anxious during this task," "I felt anxious communicating with my peers," and "This method of communication made me anxious." Each item was responded to on a five-point scale from "strongly disagree" to "strongly agree" A confirmatory factor analysis confirmed these three items formed a single scale, with higher scoring indicating greater anxiety. Coefficient alpha for this scale was .89.

Communication Method Preferences

Participants completed five closed and one open-ended question asking about their access to video cameras and microphones and which communication method(s) they use and prefer.

Confederate Sheet

The confederates involved in this study completed a confederate sheet for each session that documented the session condition (video, audio, or chat), the number of participants, participant participation rated on a 4-point scale (none to minimal participation, moderate participation, high participation, dominated the session). There was also an open-box question to note anything else of interest during the session (e.g., if introductions were made, how much time was used for the task, if anyone did not comply with the study requirements).

Procedures

All sessions were conducted online through Zoom. At the start of each session, the facilitator welcomed the participants to the session, obtained electronic consent by providing a link to the consent form in the chat box, and notified the participants which experimental condition they were in. The study was then run in three phases: (1) group task, (2) survey, (3) debriefing. In phase one, participants completed a task called "NASA Exercise: Survival on the Moon" (published in the July 1999 issue of the Night Times). This task described a scenario where they were stranded on the moon and they had to work together to rank order 15 items needed for survival. Participants were given 15 minutes to complete this task and could only communicate with one another using their assigned mode of communication. The confederate

joined in the task with the participants and completed the confederate sheet at the end of the task. Confederates were instructed to participate at a minimal level in the session (e.g., agreeing with other group members, keeping group on task). The facilitator left the room with the camera turned on (so participants could see they stepped away) and was not part of the group task. The facilitator returned to check on the participants at the ten-minute mark to ask if they wanted more time and stopped all sessions at the fifteen-minute mark. Once this phase was completed, the facilitator provided instructions and a link to an anonymous online survey. Participants completed this survey individually. When all participants had completed the survey, the facilitator provided a debriefing, including explaining the role of the confederate. At the end of each session, participants were granted bonus credit for their participation.

Results

First, we conducted a series of linear mixed models in which the effects of the video, audio, and chat box condition were modeled as a fixed factor (mode) and the session group was modeled as a random factor (group), separately for each of the five dependent variables: social presence, peer rapport, motivation, overall satisfaction, and anxiety. Prior to running these analyses, we examined the assumptions of normality and homoscedasticity by conducting histograms and scatterplots of the residuals, respectively, for each of the five variables. The assumption of homoscedasticity was met for each variable, and normality was met for peer rapport, satisfaction, and anxiety. While a negative skew was found for the social presence and motivation variables, Schielzeth and colleagues (2020) have found linear mixed effects models to be robust to violations of normality. For the social presence, peer rapport, and motivation analyses, a warning was given that the final Hessian matrix was not positive definite. This was due to the estimate of the covariance parameter for the group variable being equal to zero; a finding that could result from the grouping variable not having an impact on the dependent variable or the result of the small number of participants within each group. West and colleagues (2014) advise that a simpler model, without the random effect, can be run as an alternative.

Therefore, we next ran each set of analyses as one-way ANOVAs to compare the effects of communication mode on each dependent variable. As the results of these analyses demonstrated the same conclusions regarding the pairwise differences between the video, audio, and chat conditions for each dependent variable, as did the linear mixed models, we are reporting the results of these analyses only. Table 1 presents the means, standard deviations, and ANOVA results for each of the five dependent variables. Because the homogeneity of variance assumption was violated for the peer rapport and satisfaction variables, we have reported a Welch corrected result for these variables. All five variables showed statistically significant effects of communication mode with medium to large effect sizes. Tukey post-hoc tests were conducted for the three variables meeting the homogeneity of variance assumption and Games-Howell post-hoc tests were conducted for the two variables violating this assumption. The results of the post-hoc tests found that those in the chat box condition reported lower scores for social presence, peer rapport, motivation, and satisfaction compared to those in both the video and audio conditions. There were no differences between the video and audio conditions. For anxiety, those in the video condition reported higher anxiety scores than those in the chat box condition. There were no other differences. Overall, these results partially support our hypotheses which predicted that the video condition would report higher scores than the chat box condition on each variable.

However, we did not see the differences between the video and audio condition that were anticipated.

Table 1

Descriptive Statistics and Analysis of Variance Results for the Effects of Communication Mode on Five Dependent Variables

	Video Camera		Microphone		Chat Box				
Variable	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F*	*p*	η^2
Social Presence	3.97	0.94	3.93	0.68	3.27	0.83	9.47	<.001	.13
Peer Rapport	3.62	0.93	3.26	0.77	2.75	0.60	14.22	<.001	.16
Motivation	4.15	0.98	4.12	0.84	3.54	0.99	5.64	.004	.08
Satisfaction	4.03	1.01	3.96	0.70	3.44	0.87	5.62	.005	.08
Anxiety	2.85	1.21	2.29	1.18	2.12	1.13	4.48	.013	.06

We then ran frequency analyses investigating the five questions querying student accessibility to, and preferences for, using video cameras, microphones, and the chat box. While the majority of students had access to video cameras (*n* = 106; 80%) and microphones (*n* = 122; 92%), very few students reported actually using their video cameras in either a full class setting, or when speaking with peers in a small group setting, and preferred communicating via microphones or the chat box (See Table 2). When asked about their preferred method of communication, most students preferred using their microphones (*n* = 61; 46%), followed by the chat box (*n* = 42; 32%), then video camera (*n* = 24; 18%). A small proportion of students indicated they preferred "other" means of communication (*n* = 4; 3%).

Table 2

Counts and Percentages of Students Using Video, Audio, or Chat for Full Class and Small Group Discussions

	Full class		Small group	
	n	%	*n*	%
Video	37	28	50	38
Audio	103	77	114	86
Chat	103	77	67	50

Participants were also asked an open-ended question to explain why they selected their preferred method of communication. After aggregating the responses of the 117 students who answered this question, common themes within each communication mode were identified. For students who identified video as their preferred method of communication (*n* = 24; 21%), they chose this option because the visual presentation of peers increased communication and possibly engagement depending on the class sizes. For those participants who preferred microphones (n = 55; 47%), they reported that they felt more comfortable with speaking when in a big class and less worried about their physical appearance. They also noted that communication is faster and

more coherent compared to using the chat function. For those participants who preferred the chat function (n = 39; 33%), this option was selected because it helped with nervousness and decreased the possibility of judgement from the class. Furthermore, it allowed people to input their thoughts without interrupting the lecture. Table 3 presents exemplar quotes from each condition.

Table 3

Exemplar Quotes from Participants Explaining Their Preferred Communication Method

Preferred communication method	Exemplar Quotes
Video camera	I prefer to use the video camera because I feel more confident while doing so. I like to talk to others and I really feel very happy when others talk too in using the same mode. It is easier to understand other because of their facial expressions and body language, while also learning remotely.
Microphone	Chat box is easy to use and not disruptive in the class meeting but when in a breakout room it is easier to speak and get everyone opinions and hear everyone thoughts rather than using a chat box. I use microphone and not the camera usually because I am not in a very presentable attire when I am attending online classes.
Chat box	Writing makes me more comfortable in my English skills than speaking, as I am an immigrant. Microphone may be faster to communicate in break-out sessions, but during synchronous lectures it is so annoying to have people not be on mute. It is too loud when people use microphones. Whilst turning your camera and microphone on can be the most effective, and I have personally experienced that in one of my classes, it feels rather uncomfortable to do so if the prof doesn't highly encourage it and other students aren't doing it.

Lastly, we investigated the descriptive data from the confederate sheets. Out of the three conditions (video, audio, and chat), the audio condition had the highest levels of participation out of all the participants, while chat had the least. However, all conditions had mixed levels of participation, with one person often dominating the session. Chat also seemingly had the least amount of collaboration between participants. Many of the confederates reported that in each condition, but especially in the chat condition, users did not introduce themselves prior to starting the task.

Discussion

With the continuing rise in online education, it is important to acknowledge and seek solutions to challenges that accompany it. . Decreases in motivation and limited opportunities to develop peer connections are two of the most commonly cited drawbacks to online learning (Driver, 2018; Mann et al., 2023; Muilenburg & Berge, 2005; Parkes & Barrs, 2021). Therefore, finding strategies to motivate students and facilitate connections with their peers is needed. In this study, we experimentally examined whether the method of communication (i.e., video camera, microphone, or chat box) that students used to engage with their peers in an online synchronous activity could impact their ratings of social presence, peer rapport, motivation and satisfaction; our hypotheses were partially supported.

For the first hypothesis, we had predicted that those using a video camera would report the highest levels of social presence, rapport, motivation, and satisfaction, followed by those using a microphone, followed by those using the chat box only. We found that both the video and audio conditions reported higher scores than the chat box condition but there were no differences between the video and audio conditions.

With our second hypothesis, while we had predicted that those in the video camera condition would report higher levels of anxiety than the other two conditions, we only found this difference between the video and chat conditions and not the video and audio conditions. According to self-presentation theory (Baumeister, 1982; Goffman, 1959), people are concerned about how they appear to others and become self-conscious of how they are presenting themselves when they perceive they are being watched. Using one's video camera has a default setting of seeing oneself in real time during the session. The anxiety that people feel in seeing one's own face as they communicate with others via video conferencing, which in this context has been called mirror anxiety, has been linked with greater appearance anxiety, lower test performance (Tien et al., 2022), and greater fatigue (Shockley et al., 20210. Furthermore, Castelli and Sarvary (2021) found that over half of their sample reported anxiety about needing to have their camera on, with 41% citing appearance reasons for keeping their camera off. Thus, it is possible that being focused on one's appearance and perceived flaws may contribute to the slightly higher levels of anxiety felt by those in the video camera condition. However, it is also important to note that the mean rating for anxiety for the video group was still less than the midpoint of the scale (neutral), indicating that while the video condition was higher in anxiety than the chat box condition, participants did not feel overly anxious in the video condition.

MNT posits that those forms of communication that most closely resemble face-to-face communication result in greater engagement, clarity, and ease of interpretation of a message (Kock, 2005). There are five criteria that are considered in the evaluation of the naturalness of a medium: a common physical space, synchronous exchange of information, availability of facial expressions, body language, and the use of natural speech. Of the three forms of communication examined in this study—video camera, microphone, and chat box—video cameras most closely resemble face-to-face communication as this medium meets all the criteria mentioned above except for sharing the same physical space. The use of a microphone also lacks the same physical space as well as both facial expressions and body language. Using the chat box to

communicate is the least natural form of communication in that it only meets the criterion of a synchronous exchange of information, but with the further limitation of time delays in typing out one's message.

In evaluating the naturalness of these mediums, and the limited cues provided through chat box communication, it is not surprising that students who participated in the group task using the chat box as their communication medium found the experience to be less engaging, motivating, and satisfying, and they reported feeling less connected to their peers in the session. When communicating through the chat box only, students have very limited information with which to get a sense of who their peers are which can inhibit their levels of arousal, and thus engagement (Kock, 2005). What was surprising was the lack of difference between the video camera and microphone conditions. The use of video cameras allows students to see their peers and gather additional information through facial expressions and body language, which more closely mimics face-to-face communication and the in-person class experience and should have resulted in a richer and more connected experience (Falloon, 2011). In support of this, Kushlev and Epstein-Shuman (2022) found, in an experimental study that compared student engagement between students assigned to listen to a lecture with or without their cameras on, that students who used their video cameras felt more engaged than those who did not have them on. We speculate on two possibilities for this lack of a difference in our study. One, perhaps because of the structured and objective nature of the group task that had students rank order a set of items to take on a moon mission, the additional information provided by facial and body language cues did not provide any additional clarity or meaning to the communication needed during this task. The focus of the task was not to get to know their peers but was to work together to complete the assigned task. As found in the confederate data, students typically did not take time to introduce themselves and just started immediately on the task. Future research may want to replicate this study but have students participate in a group task that has more of a social goal in getting to know one another to see if that may increase the impact of using one's video camera on the development of rapport and motivation. Two, drawing again from self-presentation theory (Baumeister, 1982; Goffman, 1959), perhaps the slightly elevated levels of anxiety felt by students in the video camera condition had a moderating effect on the outcome variables. Students who had their video cameras on may have felt more self-conscious during the task which lowered their ratings of social presence, rapport, motivation, and satisfaction to a similar level to those in the microphone condition.

In looking at student use, and preference for, these different communication mediums, students were least likely to use their video cameras, despite most students having access to one. This is consistent with a study by Castelli and Sarvary (2020) who found that 90% of students reported leaving their video cameras off for all, or part, of a synchronous class session. The main reason students cited for why they did not turn on their camera was because it was the standard practice in their classrooms, followed by appearance concerns. The findings of the open-ended question querying why the participants preferred a particular method of communication indicated varied preferences among the sample, with the microphone being selected as the preferred method by nearly half of respondents. Perhaps this was the favoured method given that microphones can communicate immediately and in natural speech, without the pressure of having to be seen by others. Both the results of this study, and other studies (Kushlev & Epstein-Shuman, 2022; Mann et al., 2023) suggest that video camera use can increase students'

engagement and connections within the online class. Furthermore, Sederevičiūtė-Pačiauskienė and colleagues (2022), in a study with Lithuanian students, found that these students viewed using video cameras as a tool to promote communication and cooperation and that not using their cameras had a negative impact on peer and instructor relationships. When having small group discussions, students were more likely to use their video cameras and microphones to communicate rather than the chat box and it is perhaps in these smaller environments that students feel more comfortable turning their cameras on (Mann et al., 2023).

Limitations

These findings should be considered in the context of several limitations of this study. First, over half of the scheduled sessions needed to be cancelled during the course of this study, primarily due to participants not showing up for their session, but also because of technical issues faced by the research team (i.e., log-in issues and scheduling errors). This ended up extending the study for longer than anticipated and resulted in a smaller sample size than intended. Second, during the sessions, participants were assigned to a condition; however, sometimes the students did not uphold or follow the instructions fully for that session (e.g., video camera session but also communicated using chat). Third, multiple facilitators and confederates ran these sessions and, although the facilitators followed a script, and the confederates were trained on how to participate in the sessions, there is the possibility that these individuals had differing impacts on the sessions. Fourth, the majority of participants were female which could limit the generalizability of these findings. Fifth, the task that was used, which was quite structured, could also limit the generalizability of these findings. Finally, this study was conducted at a single Canadian university and future research will want to assess the generalizability of these findings.

Conclusion

Overall, the results of this study suggest that participation in online synchronous activities using a microphone and/or video camera is beneficial to student engagement and the development of interpersonal connections. Thus, we recommend that instructors should encourage, but not require, students to turn on their microphones and video cameras. Given that no difference was found in this study between the video and audio conditions, these results suggest that microphones may be sufficient to promote greater engagement if students are not comfortable with turning out their cameras. As noted by Castelli and Sarvary (2020), students have differing access to video cameras and private spaces and camera use should not be mandated, but only encouraged. Noting the benefits of using video cameras and microphones may entice students to use these communication mediums more often. It should also be noted that the context of the classroom may influence students' choice of communication methods. In sessions involving the full class, students are most likely to communicate through microphone and chat and have cited that communicating through chat is less intimidating and disruptive. However, in small group sessions, such as through breakout rooms, students appear to be more likely to use their video cameras and this may have the most beneficial effects for students to engage with their peers.

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