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Enhancing Instructor Credibility and Immediacy in the Design of Distance Learning Systems and Virtual Classroom Environments

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Social Presence   Instructor Credibility   Instructor Immediacy   Virtual Classrooms   Distance Learning

What are the optimal techniques for applying the latest generation of telepresence, video conferencing, and communication technologies in distance education and virtual classroom designs? If human beings use more than voice to communicate, what implications does the ability to more effectively replicate eye-to-eye contact have in collaborative distance education? This research study explored the effects of perceived faculty credibility and immediacy during virtual classroom presentations. This quantitative experiment created four independent treatments that varied the video resolution and varied the ability of the instructor to maintain virtual eye-contact with students during each presentation. Participants were assigned into one of the four treatment groups, each listening to the same instructor narration and viewing the same instructor present the same subject matter, only the resolution and camera angle differed. A series of 2x2 Analysis of Variances were conducted on independent groups where an instructor was simultaneously recorded from two high-definition (1920x1080) cameras, one at eye-level and one located 15-degrees above eye-level, during the delivery of a 20-minute instructional module. These two camera angles were also replicated in a lower resolution (320x240). A total of 108 undergraduate and graduate participants completed the video and audio multimedia presentations and completed credibility and immediacy survey instruments. The results suggest that the position of the instructor's camera is more important than the resolution of the recorded video.

Virtual classroom and video conferencing technologies can be very effective approaches to bridge the psychological and geographic gaps between instructors and students. The use of high-definition telepresence video conferencing can now offer effective, virtual recreations of face-to-face and eye-to-eye learning environments. Practical application of these real-time, two-way audio and video conferences include business meetings, depositions, telemedicine, distance learning, and many more. The implications in distance learning programs are especially interesting. Institutions can create joint programs, share subject matter expertise, and connect geographically disperse instructors and students. Students can now have real-time access to instructors and engage in collaborative discussions from any location with access to reliable Internet connections. The addition of high-definition, 4K, and 8K resolution cameras and monitors add yet another dimension that brings the experience closer to life-like class meetings. However, are the investments in

telepresence, high-definition, network architecture, bandwidth, and support worth the costs? In practice, do students notice the subtle nonverbal communication that is enabled by the added technology investments, and does this enhance the learning environment?

Eye contact is an important aspect of communication, and one can apply the latest high-definition telepresence technologies to make virtual eye contact much more realistic. A review of equivalency theory in distance education suggests that by increasing the resolution of the communication medium, the learning environment will become more effective in recreating a traditional face-to-face and eye-to-eye classroom (Simonson, 1995, 1999; Simonson et al., 2009). Equivalency theory advises instructional designers to recreate for distance learning students a learning experience equivalent to those obtained by traditional or local students. Fostering virtual eye contact in a high-definition learning environment should reinforce the students' perceptions of the instructor's social presence, immediacy, and ability to communicate with students. Therefore, given the higher resolution, would these communicative effects of immediacy and eye contact, or the lack of eye contact, be even more pronounced? Additionally, what real-world instructional design considerations would this suggest for the design of future virtual classrooms and distance learning systems?

A virtual classroom, in the context of this study, is a classroom that extends a live, interactive learning environment to and from distant students using video conferencing, telepresence, or web conferencing technologies. Video cameras, microphones, and displays are used to send two-way audio and video between students and instructors, recreating as best as possible a face-to-face classroom. The attention to detail, planning, and design of virtual classrooms are an important aspect of the overall learning experience. Optimal camera placement, supported end-point and conference resolution, and the bandwidth and network implications of high resolution needs, are a few critical design considerations. The purpose of this research experiment was to investigate the impact of camera angle and video resolution on student perceptions of instructor credibility and immediacy during online courses in virtual classroom learning environments. The best practices created or confirmed by this experiment would then help educators and instructional system designers better implement virtual classroom environments and systems.

Theoretical Foundations

Credibility, Immediacy, and Multimedia

Previous research into virtual classroom and learning environment design, as well as instructor social presence, credibility, and immediacy provide the foundation and stepping off point for this present study. Credibility is a combination of a learner's perception of an instructor's intelligence, character, and goodwill (Miller et al., 2014; Myers & Martin, 2006). Immediacy is the learner's perception of an instructor's nonverbal and verbal communication skills (Dixon et al., 2017; McCroskey et al., 2006). Earlier research using camera angle and display sizes and locations found that participants rated their instructor higher in terms of credibility and immediacy when they viewed the eye-level versions of four video treatments (Jayasinghe et al., 1997). Similar to Jayasinghe et al. (1997), Teven and Hanson (2004), measured for instructor credibility in video trials, and used four different videos. These 7-minute scripted videos were kept as consistent as possible and only varied the presenter's camera eye-contact, movement around the classroom, gestures, and natural levels of enthusiasm. Care appeared to be taken to include immediacy traits and the researchers looked to keep the presentation natural without the immediacy scripted. This experiment found that the treatments that gauged the highest levels of instructor immediacy also considered the presenter the most credible. While camera angle and eye-level positioning do appear to impact credibility and immediacy, would today's high-definition technologies enhance the influence?

Other learning factors and affective characteristics research also indicate the connection between mediated communication and effective learning. Another example of college classroom research used a 15-minute video module in an experiment comparing verbal and nonverbal immediacy to recall and comprehension (Witt & Wheeless, 2001). These researchers found participants recalled more presentation facts during nonverbal immediacy treatments as compared to specific 'verbal immediacy only' and 'low overall immediacy' treatments. Another study with studio

produced video created specifically for an experiment found similar results. These researchers asked their presenter being recorded to look into a camera for 30% of their presentation and to give the lecture again while never looking into the camera (Fullwood & Doherty-Sneddon, 2006). The content of the two presentation videos was kept as identical as possible while a third treatment group listened to only the audio. This research found that the recall was greatest when the presenter looked into the camera, followed by the gaze aversion and the audio-only versions. These research studies suggest that learning can be enhanced when the students can see and hear their instructors and teachers.

Eye Contact, Presence, and Immediacy in Distance Education

The history of film, motion pictures, and television illustrates a trend from low to increasingly higher resolution, with the goal of increasing the realism experienced by the audience (Seels et al., 2001). The ability to replicate reality for viewers, or learners who are not able to readily experience the event being replicated and transmitted, has long been harnessed by educators and instructional system designers ([Reiser, 2001](#)). The latest array of communication technology reproduces content more authentically than ever before. The newest telepresence video conferencing systems combine high-definition cameras, large high-definition displays, increased video processing, and increased bandwidth availability (Weinstein & Lichtman, 2005; Szigeti et al., 2009). The result is a system with life-sized displayed images and, perhaps more importantly, the ability to facilitate eye contact in high-definition. Telepresence differentiates itself from typical video conferencing applications with this new functionality, striving to make all distance participants feel as though they are in the same room (Davis & Weinstein, 2006; MacDonald, 2007; Ramlatchan, 2017). Taken together with equivalency theory and the design intent to replicate the live classroom experience, high-definition and telepresence technology should be able to replicate as closely as possible the live classroom. However, is the return on investment worth the cost? Research has shown that the difference between very high-end, immersive telepresence systems and video conferencing are minimal, both were effective means to achieve meeting goals and objectives (Standaert et al., 2015). However, the immersive telepresence system did appear to enhance the building of trust and relationships. Other research has shown that the casual immediacy of informal video may be more effective in certain scenarios as compared to high quality, studio produced video (Ortells-Badeness, 2015). Though what positive or negative impact does high-definition cameras, displays, and the additional bandwidth and costs, have on the learning experience in higher education?

Foundational Eye Contact and Communication Studies

Research suggests that eye contact, timing, movement, posture, gesture, facial expressions, touch, dress, classroom environment, and vocal expressions all play a role in classroom and student dynamics (Knapp, 1971; Thomas-Maddox, 2003). Other research has found that facial expressions, even in the form of black and white photographs, rather than vocalization, better communicate emotion (Mehrabian & Ferris, 1967). Encoding and decoding of nonverbal cues happen largely unconsciously, and many teachers may not recognize the positive or negative feedback they show students (Koch, 1971). The eyes may be the most crucial aspect of nonverbal communication, especially given their ability to both encode and decode information (Hess & Polt, 1960). Recent research has also shown the impact of visual communication in text and video feedback. Students appreciated the relationship building aspects of asynchronous video feedback from their instructor, as compared to text only feedback (Borup et al., 2012). Instructors and learners in classroom settings communicate via nonverbal actions, understanding these actions and learning how to foster this immediacy should improve learning environment designs.

Similar findings have been documented in traditional classrooms. For example, communication motivated by goals and objectives, such as the teaching-learning process, benefit from eye contact (Kleinke, 1986). In a study of preschool children, girls responded more favorably during 5-minute word games to increased eye contact with experimenters (Kleinke et al., 1977). The preschool boys in this study responded less favorably to the increased eye contact; however, this result could potentially be explained by undeveloped social skills. In an analysis of a seminar class of both female and male college students, presumably with more developed social skills, eye contact increased the discussion participation of all students (Caproni et al., 1977). Interpersonal connections and individualized instruction in a group can be established by connecting with each and every student during a lesson (Hodge, 1971). While social presence

and immediacy research has been conducted in live classrooms, more is needed to determine how technology can be used to best apply these findings in live distance learning and virtual classroom environments.

These studies highlight research, applications, and practices used to foster eye-to-eye communication and, thus, social presence in virtual classroom environments. These research studies all positively contributed to the creation of equivalence and immediacy using contemporary audio, video, and communication technologies. However, the evolution from low-resolution video streaming and standard-definition video conferencing may provide a new set of tools to enhance social presence in instructional systems.

Research Questions

Equivalency theory suggests that distance learning environments should replicate the live classroom as best as possible (Simonson, 1999). High-definition video should provide more realistic learning experiences than previous low-resolution and standard definition technologies. This study examined the effects of eye-level and above eye-level camera angle as well as high resolution and low-resolution video on the social presence aspects of instructor credibility and immediacy. Varying the camera angle and the video resolution in a series of treatments may affect the student's sense of the instructor's social presence. Of specific interest was to what extent can technology decrease psychological distance and increase the credibility and immediacy of teachers and presenters.

Research Question 1: How will differences in camera angle and video resolution compare in terms of participants' perception of instructor credibility?

Research Question 2: How will differences in camera angle and video resolution compare in terms of participants' perception of instructor immediacy?

Methods

Participants

The sample in this experiment was drawn from graduate and undergraduate students at a mid-sized, metropolitan university on the east coast of the United States. One hundred and eight participants responded to an announcement listed in the university's daily electronic newsletter emailed to all students. The sample was 69% female, 31% male with an average age of 25.9. Additionally, 13% of the sample were freshmen, 13% sophomores, 22% juniors, 29% seniors, 16% graduate students, and another 7% were taking continuing education classes. Participants were assigned to one of four treatments after completing an online registration form. The random distribution resulted in 25 students in the eye-level camera in high-definition, 25 students in the eye-level camera in low-resolution, 27 students in the high-angle camera in high-definition, and 31 students in the high-angle camera in low-resolution treatment groups.
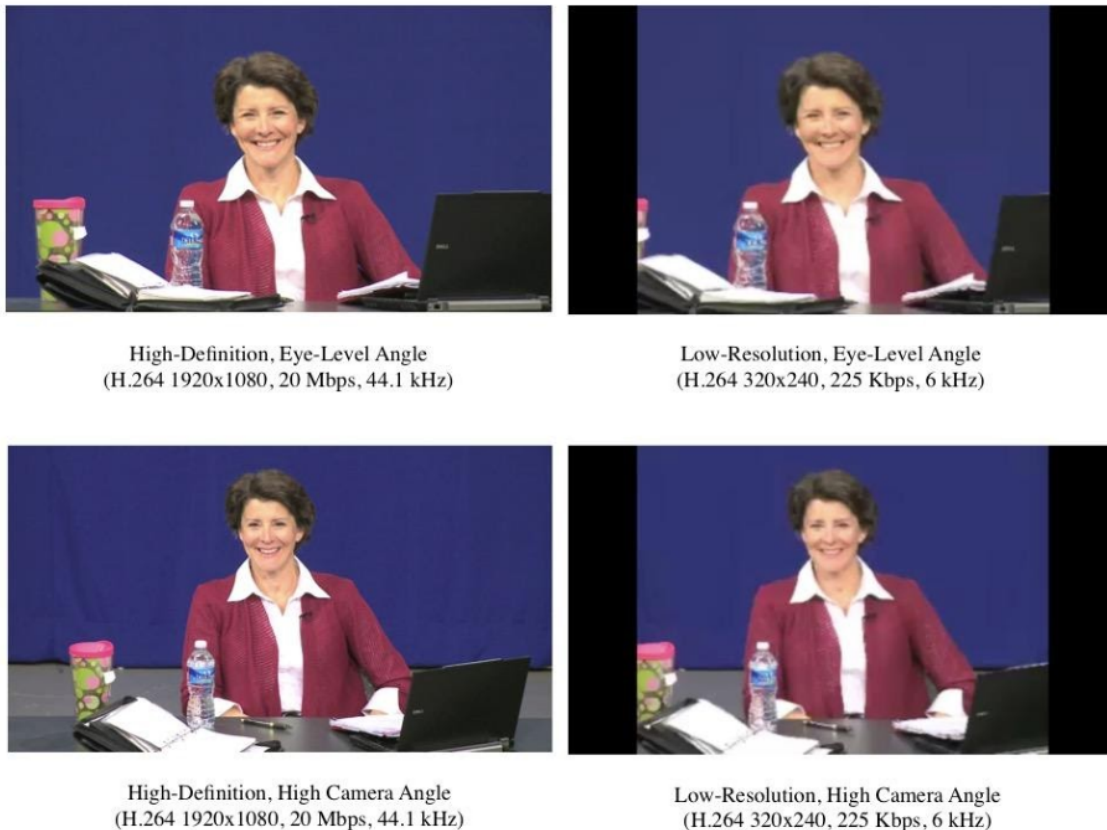
Materials and Environment

An experienced, female classroom instructor was used to help create and test the realistic teaching materials. The instructional material consisted of a single video session, recorded from two high-definition studio cameras. The instructor presented an authentic instructional 20-minute module on social media, specifically the history of social media and networking. This pre-recorded mini-lecture was used to emulate a live virtual class and to present identical audio and video presentations to all treatment groups.

One of the university's video production studios was used to record the instructional mini-lecture. Professional level audio was captured using a Sony ECM-77 lavaliere microphone, while the instructor was recorded simultaneously by two independent Sony PMW-EX3 high-definition cameras, in 1920x1080 resolution, at 20 Mbps. The first of the pair of cameras was located 3-feet, 6-inches (106.7 cm) vertically and 23 feet (701 cm) horizontally across the classroom from the instructor. Thus, the camera was located at eye level with the seated, presenting instructor. The second of the pair of cameras was also positioned 23 feet away from the presenter though was elevated to a height 9-foot, 6-inches (289.6

cm) from the floor. This height positioned the second camera at an angle 15-degrees above eye-level, thus well outside angles that would mimic eye-contact (Chen, 2002; Gale & Monk, 2000; Grayson & Monk, 2003; McNelley, 2005). The recorded files were used during the eye-level camera angle in high-definition and the high camera angle in high-definition treatment groups. These two video files were also each transcoded into much lower 320x240 resolution, at 225 Kbps, versions. These lower resolution video files were used in the eye-level camera angle in low-resolution and the high camera angle in low-resolution treatment groups. Figure 1 illustrates the camera configuration and video resolution of the four instructional videos used in each treatment.

Figure 1

Instructor Videos for the Four Treatment Groups

High-Definition, Eye-Level Angle
(H.264 1920x1080, 20 Mbps, 44.1 kHz)

Low-Resolution, Eye-Level Angle
(H.264 320x240, 225 Kbps, 6 kHz)

High-Definition, High Camera Angle
(H.264 1920x1080, 20 Mbps, 44.1 kHz)

Low-Resolution, High Camera Angle
(H.264 320x240, 225 Kbps, 6 kHz)

Note. The instructor video used in each of the four treatment groups varied the video resolution and the instructor's ability to maintain virtual eye-contact with the camera and with online students.

The virtual classroom used for these experiments was a video conferencing room designed, maintained, and actively used by the university's distance learning program. The classroom has four rows of tables arranged in a rectangle, for a total of 16 seats. Participants were able to self-select their seat during the procedure, and the distribution of students within the classroom was documented by the researchers during each meeting. Two 52-inch (132 cm) LCD displays were located at the front of the room and were used to show the instructional videos during each of the four viewing sessions. These displays were mounted 56 inches (142.2 cm) above the floor for optimum viewing. Seating was arranged such that all participants were within 45-degrees of one of the displays (Niemeyer, 2003). Participants also sat within 10 to 30 feet (304.8 cm to 914.4 cm) away from the front of one of the displays. These dimensions are within the minimal and maximum seating distances from a 52-inch display as described by previous research studies and best practices (Allen et al., 1996; Niemeyer, 2003). Figure 2 illustrates the layout of the virtual classroom used in this experiment.

Figure 2

Note. The design and layout of the virtual classroom helped ensure that all research participants had a clear view of the instructor's video.

Instruments

McCroskey's Source Credibility Measure was used to evaluate the first research question (McCroskey & Teven, 1999). This tool measures how study participants perceived the credibility of a communication source, or the instructor in the video, and was implemented on a 7-point Likert Scale. This instrument is based on earlier instruments such as the Semantic Differential Scale for Dimensions of Source Credibility for Spouses and Peers used in previous research studies that focused on the use of mass media to communicate the credibility of presenters (McCain et al., 1977; McCroskey et al., 1974; Jayasinghe et al., 1997; McCroskey & Jenson, 1975). The revised version recommends how to score and present 18 indicators such as the learner's description of the instructor's Competence (e.g., intelligent/unintelligent, inexpert/expert), Goodwill (e.g., self-centered/not self-centered, concerned/unconcerned) and Trustworthiness (e.g., untrustworthy/trustworthy, and unethical/ethical). The internal reliability alpha's of three dimensions of the Source Credibility Measure resulted in 0.78 for Competence, 0.89 for Goodwill, and 0.92 for Trustworthiness (McCroskey & Teven, 1999). McCroskey and Teven (1999) also found the combined alpha when measuring all three of these dimensions as an overall source credibility measured a reliable 0.94.

The second research question was evaluated with Anderson's perceived General Immediacy Scale which measures the learner's assessment of the immediacy of their teacher based on their perceived reduction of psychological distance (Anderson, 1979). The specific items used to assess the teacher included the participants' agreement or disagreement of the immediacy of the instructor's teaching style, such as their rating of the teacher as cold or warm, friendly or unfriendly, and close or distant. The items in this instrument account for verbal and nonverbal communication cues, such as mannerism and eye-contact, and was also implemented on a 7-point Likert Scale. The internal reliability of this scale using Nunnally's internal reliability formula was measured at 0.96 (Anderson, 1979).

Procedures

If students agreed to participate after reading the description of the study they clicked on a "yes I agree" icon, selected one of the treatment meeting times, and gave basic demographic information. Collected data included age, gender, academic status (e.g. freshman, senior, graduate student, etc.), degree or major, and experience taking a distance learning course. Students visited the conference room on their scheduled day and times and viewed one of the videos

on the classroom displays. Students then completed the Source Credibility Measure and the General Immediacy instruments. Participants were given a $5 Starbucks gift card after they completed their questionnaire booklets.

Results

Instructor Credibility

A 2x2 analysis of variance was conducted to determine the influence of the two independent variables (camera resolution and camera angle) on student perceptions of instructor credibility using McCroskey's Source Credibility Measure. The main effect of camera angle, with an F ratio of $F(1,104) = 6.53$, $p < .05$, resulted in a significant difference between treatment groups. The students who viewed the eye-level versions rated the credibility of the instructor higher (M = 5.45, SD = .86) than the students who viewed the high-angle version (M= 5.05, SD = .74). The main effect of camera resolution, with an F ratio of $F(1,104) = .65$, $p > .05$, did not result in a significant difference between treatment groups. The students who viewed the high-definition version rated the credibility of the instructor only slightly higher (M = 5.31, SD = .87) than the groups who viewed the lower resolution version (M = 5.17, SD = .77). The interaction effect between camera angle and camera resolution was not significant, $F(1,104) = .09$, $p > .05$. The internal reliability analysis of the credibility instrument resulted in a Cronbach's Alpha of .90 in this study.

The Source Credibility tool measured perceptions of the credibility of the instructor in the video based on the three combined constructs of competence, goodwill, and trustworthiness (McCroskey & Teven, 1999). A deeper analysis of each construct indicates specific areas where perception varied due to camera angle.

The main effect of camera angle, with an F ratio of $F(1,104) = 3.95$, $p = .05$, resulted in a significant difference between treatment groups in terms of perceived competence. The students who viewed the eye-level versions rated the competence, or subject matter expertise, of the instructor higher (M = 5.99, SD = .87) than the students who viewed the high-angle version (M= 5.66, SD = .81). The main effect of camera resolution, with an F ratio of $F(1,104) = .34$, $p > .05$, did not result in a significant difference between treatment groups in terms of competence. The students who viewed the high-definition version rated the competence of the instructor only slightly higher (M = 5.86, SD = .92) than the groups who viewed the lower resolution version (M = 5.76, SD = .79). The interaction effect between camera angle and camera resolution was not significant, $F(1,104) = .0001$, $p > .05$ in terms of the student perception of instructor competence. The internal reliability analysis of the competence submeasure resulted in a Cronbach's Alpha of .75.

The main effect of camera angle, with an F ratio of $F(1,104) = 8.77$, $p < .05$, resulted in a significant difference between treatment groups in terms of goodwill, or the perception of the instructor's concern for the students learning. The students who viewed the eye-level versions rated the goodwill of the instructor higher (M = 4.89, SD = 1.01) than the students who viewed the high-angle version (M= 4.32, SD = .94). The main effect of camera resolution, with an F ratio of $F(1,104) = .77$, $p > .05$, did not result in a significant difference between treatment groups in terms of goodwill. The students who viewed the high-definition version rated the goodwill of the instructor only slightly higher (M = 4.68, SD = 1.08) than the groups who viewed the lower resolution version (M = 4.48, SD = .95). The interaction effect between camera angle and camera resolution was not significant, $F(1,104) = .149$, $p > .05$ in terms of the student perception of instructor goodwill. The internal reliability analysis of the goodwill submeasure resulted in a Cronbach's Alpha of .81.

The 2x2 analysis of variance for the trustworthiness construct did not yield any significant main effect or interaction differences between camera angle and camera resolution treatments. The internal reliability analysis of this submeasure resulted in a Cronbach's Alpha of .83.

Instructor Immediacy

A 2x2 analysis of variance was conducted on the influence of the two independent variables (camera resolution and camera angle) on student perceptions of instructor immediacy using Anderson's perceived General Immediacy Scale. The main effect of camera angle, with an F ratio of $F(1,104) = 8.95$, $p < .05$, resulted in a significant difference between treatment groups. The students who viewed the eye-level versions rated the general immediacy of the instructor higher

(M = 5.25, SD = 1.29) than the students who viewed the high-angle version (M= 4.65, SD = 1.43). The main effect of camera resolution, with an F ratio of $F(1,104) = 2.43$, $p > .05$, did not result in a significant difference between treatment groups. The students who viewed the high-definition versions rated the credibility of the instructor only slightly higher (M = 5.16, SD = 1.26) than the groups who viewed the lower resolution versions (M = 4.27, SD = 1.53). The interaction effect between camera angle and camera resolution was not significant, $F(1,104) = 2.33$, $p > .05$. The internal reliability analysis of the immediacy instrument resulted in a Cronbach's Alpha of .95 in this study.

Implications for Research and Application

There are several interesting and applicable findings from these results. Students who viewed video created from the eye-level camera rated the instructor's credibility and immediacy higher than students who viewed video from the camera positioned above eye-level. The instructor was able to replicate eye-contact virtually by looking directly into the camera while being recorded. Thus, this camera was able to record any subtle eye movements that would nonverbally communicate credibility and immediacy cues to students. The camera positioned 15-degrees above line-of-sight would not have been able to record these cues. This 15-degree angle is not as pronounced as the 40-degree angle used in Jayasinghe et al. (1997), though the decreased credibility and immediacy response is similar. A deeper analysis did appear to show an impact of low-resolution (340x240) and high-definition (1920x1080) when combined with camera angle. The scenario where eye-level cameras record in high-definition does appear to communicate more information to students than cameras recording outside line-of-sight angles in lower resolutions. A similar study found that enhancing and creating 'warm' learning environments using audio and video required additional resources, though the return in terms of increased immediacy and credibility was worth the investment (Dixon et al., 2017). Bandwidth restrictions and availability may prevent virtual classroom implementations from using high-definition capabilities in practical application. However, the findings of this study do show that there should be benefit from making network and bandwidth investments to support high quality video conferencing.

McCroskey's Source Credibility Measure averages the three related constructs of competence, goodwill, and trustworthiness (McCroskey & Teven, 1999). Resolution alone did not appear to have an impact on any of the three constructs, however, the camera angle did appear to influence two of the three submeasures. Participants who viewed the eye-level recorded videos perceived the presenter as more knowledgeable and considerate than students who viewed the high-angle camera recordings. This finding suggests that students were able to gather information via eye-contact that indicated the instructor's knowledge of the subject matter and confidence speaking on the subject. This finding also suggests that the information conveyed by the instructor's eye contact was also enough to cause the participants to think about how the instructor enjoyed teaching and level of caring about the learning of her students. Several student remarks in the optional comments section of the survey responded that the video may have been too short to accurately gauge the trustworthiness of the instructor. Video modules in future studies longer than 20 minutes may give students more information to make this determination. Also, a larger treatment sample in the four individual groups may have revealed possible significant differences on these three individual credibility constructs based on video resolution.

Further insights into instructor immediacy were available when the data were analyzed based on the combined factors of camera placement and video resolution. Similar to the overall credibility findings, the combination of high-definition and eye-level camera placement resulted in the highest levels of perceived immediacy. Other recent research has also indicated that immediacy can be improved in distance learning and virtual environments by using technology to decrease perceptions of transactional distance and increase engagement and student satisfaction (Ghamdi et al., 2017). Adult distance learners do not want to be isolated; they appear to prefer contact with the instructor. The technology's ability to encode, transmit, and decode verbal and nonverbal communication from the instructor defines that instructor's social presence in a real-time web or video conferencing context. Social presence is the extent to which a person, in this case a distance learning student, perceives another person, the instructor, as real (Baker & Woods, 2004; Gunawardena & Zittle, 1997). Thus, the immediacy or social presence of the instructor is the student's perception of communicating with a live person. This awareness of an instructor's immediacy decreases the learner's sense of

distance from the instructor and increases feelings of being a member of the class, despite actual geographic separation (Baker, 2010; Baker & Woods, 2004; Hackman & Walker, 1990). These studies found a positive correlation between student perceived satisfaction and virtual classroom design. Specifically, classroom design aspects such as high quality audio and video, increased the social presence of the instructor. The more genuine the reproduction and inclusion of the instructor's nonverbal communication, the more positive should be the effect on the distance learning program's equivalency to traditional live classroom courses.

These immediacy findings could also relate to research into online communities of inquiry. A Community of Inquiry is a framework that can be used to describe the effectiveness of computer conferencing, and describes an optimal educational experience as a function of social presence, teacher presence, and cognitive presence (Garrison et al., 2000; 2010). Credibility and immediacy of an instructor may relate to and map to the social presence, teacher presence, and cognitive presence interaction points in the community of inquiry model. Similarly, fostering instructor immediacy with video can enhance information recall, perceived learning, and decrease cognitive effort (Wang & Antonenko, 2017). Multimedia, especially video, can also foster affective learning and motivation (Mayer & Estrella, 2014). Increasing teaching and social presence through credibility and immediacy may help instructors and instructional designers create and improve the educational experience in online environments.

Conclusion

There are several design best practices and areas for future research that can be derived from this experiment. A key best practice for instructors and instructional designers is to try to design virtual classroom layouts that allow instructors to maintain natural eye-contact with live or recording cameras to foster immediacy and enhance credibility. While it does appear that the instructor's perceived credibility and immediacy are enhanced by the eye-level positioning of virtual classroom cameras, the resolution of the virtual environment appears to have much less of an impact. Although the lower resolution versions appeared 'more blurry' than the high-definition video versions in the present study, the students were still able to perceive the virtual presence of the instructor.

There are practical limitations when designing a virtual classroom environment. However, designers should try to integrate eye-level cameras into the designs as best they can to enhance students' perceptions of the instructor's credibility and immediacy. While this study focused on emulating a live virtual classroom, these findings should also be applicable to asynchronous video environments. Instructors can enhance their credibility and immediacy when recording modules for online classes when they pay particular attention to the placement of their camera when recording. These results could also extend into informal and formal live environments with web cameras; credibility and immediacy can be improved by not avoiding the camera, and by instead using the camera as a communication tool. Students participating in a virtual class beyond 20 minutes may result in more conclusive results, especially video based classes where community of inquiry measures can be used to also gauge social, instructor, and content presence. Along with increasing the length of the video, and the number of videos, another future research project could look to replicate this study using 4K or 8K resolution cameras, files, and displays. Would the added information of 'ultra-high-definition' technology, beyond 1080 high-definition, even further influence credibility and immediacy?

The results of this virtual classroom study could also extend to online video and multimedia presentations for mobile devices. Online environments can be extremely isolating for distance and e-learning students. One potential way to reduce this sense of isolation is to decrease the psychological distance between students and instructors. The inclusion of instructor video could potentially reduce this sense of isolation and enhance instructor and social presence. Other future studies could include integration of presentation slides, live interactive video, different subject matter, and measures of learning effectiveness such as problem solving and application post-tests.

While there are numerous directions that can be explored in future experiments, the present study confirms previous research and helps define contemporary best practices. This study found support for enhancing virtual classroom systems using higher video resolutions and for the optimal placement of cameras to record the nonverbal subtleties communicated via eye-to-eye discussions. Designing systems that allow instructors to maintain eye-contact with

students is an effective communication approach that can enhance the social presence aspects of credibility and immediacy.

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