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Supporting Teachers' Technology Integration: A Descriptive Analysis of Social and Teaching Presence in Technical Support Sessions

JENNIFER L. ALBERT AND MARGARET R. BLANCHARD
North Carolina State University, USA
jennifer_albert@ncsu.edu
meg_blanchard@ncsu.edu

MEREDITH W. KIER
Howard University, USA
meredith.kier@howard.edu

SARAH J. CARRIER
North Carolina State University, USA
sarah_carrier@ncsu.edu

GRANT E. GARDNER
Middle Tennessee State University, USA
grant.gardner@mtsu.edu

Given the importance of technology in today's society, many teacher professional development (TPD) efforts incorporate instructional technologies. However, little is known about how to adequately support teachers in the use of these instructional technologies following TPD. Supporting teachers in geographically distant schools is particularly challenging. In this exploratory study, teacher participants were part of a professional development grant that provided them with new instructional technologies that were modeled to be implemented in their classrooms in reform-based ways. This study analyzed the nature of technical support sessions with teachers in both videoconferencing sessions and face-to-face sessions based on aspects of the community of inquiry (CoI) framework. Using the CoI framework, transcripts were coded according to three aspects of social presence (affective, interactive & cohesive) and two aspects of teaching presence (pedagogical & technical). While approximately one third of the exchanges in technical support sessions were technical in nature, social talk took place during one third of the technical support sessions. The overall teaching and social presences were comparable in both the videoconferencing and face-to-face sessions, and all teachers were highly satisfied and felt able to implement the instructional technologies. Implications for TPD using both formats are discussed.

The prevalence of technology in our society and its importance to the future of the global economy have increased national focus on, and concern about, students' readiness regarding 21st Century Skills (Partnership for 21st Century Skills, 2011). Several of these skills align closely with national reform goals in science, technology, engineering and mathematics education (e.g. NRC, 2011) such as using technology for research and communication. In many cases, teachers are presented with technological innovations that would help to align their instruction with national and educational goals, but are hesitant to meet the challenges of learning a new technology (Ertmer & Ottenbreit-Leftwich, 2010). Technology-infused professional development is a way to assist teachers in acquiring the necessary technological skills to be able to use technology effectively in their instruction. Indeed, a large body of research documents that teacher professional development incorporating technology use can be the central component of improving schools for the 21st Century (e.g. Partnership for 21st Century Skills, 2011).

Adopting reform-based practices requires teachers to assume new roles in their classrooms. As teachers are learning new technologies and modifying their beliefs about their role in student learning, they can be supported through professional development (e.g. Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012). As such, professional development for teachers is central to systemic reform initiatives (Woodbury & Gess-Newsome, 2002), but there is a need for more research to identify the exact characteristics of effective professional development, especially as related to technology use (e.g. Ertmer & Ottenbreit-Leftwich, 2010). After a review of nearly 400 articles on teacher professional development programs, Dede, Ketelhut, Whitehouse, Breit, and McCloskey (2006) asserted that research is needed that addresses such questions as "the impact of professional development on teacher change, particularly improvements that transform practice…factors influencing the sustainability of teacher improvement; and scalability of (teacher professional development) TPD programs into a variety of contexts" (p. 3). These "improvements that transform practice" include technological innovations.

In contrast to the focus of Dede et al. (2006), Schlager and Fusco (2003) described professional development scenarios that failed to support teachers or identify impacts on student learning. They recommended building a community of practice to support teachers involved in professional development experiences to address these gaps. The Community of Inquiry (CoI) model (Garrison, Anderson, & Archer, 2000) was developed to describe the interactions during computer-mediated communication among students and instructors. The CoI model offers a promising framework for analyzing two modes of technical support within the context of professional development; face-to-face and videoconferencing. To date, there are no studies in the literature linking the CoI model to technical support, and a paucity of literature compares face-to-face and virtual delivery formats in sustained professional development. Dede et al. (2006) asserted that continued support is a key to helping teachers implement new pedagogies. As reported in Ertmer et al. (2012), the National Education Association reports "that 57% of teachers felt adequately trained to integrate technology into instruction" (p. 425). Despite this training, many teachers are not incorporating technology in their classrooms in meaningful, reform-based ways (e.g. Ertmer & Ottenbreit-Leftwich, 2010), making models for sustained professional development particularly salient.

Sustained professional development becomes problematic when schools are at a distance from the providers of professional development. According to Mahaffey (2012), approximately 20% of US schools are in rural areas and almost half of those are considered high poverty. These schools lack exposure to technology and access to quality training (Avery, 2013). The schools in this study ranged from one to three hours away from the university that provided professional development. The professional development team provided follow-up technical support to assist teachers during the school year as they taught technology-enhanced lessons. The researchers wanted to investigate whether there were differences in the effectiveness of face-to-face and videoconferencing technical support as a form of sustained professional development. Given the highly interactive nature of the technical support sessions, the CoI model seemed appropriate to capture the nature of these interactions.

THEORETICAL FRAMEWORK

The CoI framework has been used in many distance education settings and focuses specifically on the interactions of the participants. The CoI model developed by Garrison et al. (2000) comprises three main "presence" components; social, cognitive, and teaching (see Figure 1). Swan et al. (2008) defined these components as:

> *Social presence* refers to the degree to which learners feel socially and emotionally connected with others in an online environment; *teaching presence* is defined as the design, facilitation, and direction of cognitive and social processes for the realization of personally meaningful and educationally worthwhile learning outcomes; and *cognitive presence* describes the extent to which learners are able to construct and confirm meaning through sustained reflection and discourse (p. 88).

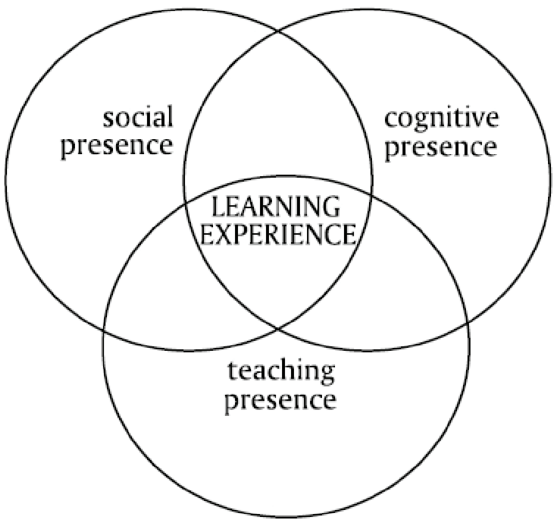

Figure 1. Community of Inquiry model (Garrison et al., 2000).

The CoI further develops the ideas of interaction of these three components by discussing the *whole* learning experience. Many of the precursors to CoI were considered "deficit models" because they were concerned with the absence of verbal and nonverbal cues during interactions instead of focusing on the cues that are present (Lowenthal, 2009). These cues are linked to the interpersonal relationships that develop in a classroom setting

(Bozkaya, 2008). CoI converted the idea of social presence as a deficit model to a model that fully encompasses the learning experience for both the student(s) and the teacher. The cues that are present give insight into the nature of the interactions taking place.

The CoI model was developed to inform computer-mediated communication with the end goal of creating an online community with interactions similar to those typical of face-to-face classrooms, in which the members in the class can express similar cues and create similar relationships. In addition, the CoI framework is a potentially useful way to consider the nature of technical support sessions via videoconferencing, and whether they differ from sessions that are conducted face-to-face. Rourke, Anderson, Garrison, and Archer (1999) created a model and rubric to assess social presence in online discussions using the categories affective, interactive, and cohesive (see Data Sources and Analyses for rubric). This study addresses the social presence and teaching presence assessed from transcripts of technical support sessions between the teacher and technical support provider, who also is a researcher (first author) and former science teacher. It was not possible to analyze cognitive presence for these sessions, given the nature of the data collected during the sessions.

REVIEW OF THE LITERATURE

In this section we will review the literature on the needs of teachers who are involved in technology-based professional development, needed technical support, and aspects of the community of inquiry framework relevant to examining interactions with teachers.

Technology-Based Professional Development

Watson (2006) emphasizes the unique demands of workshops for teachers that involve learning about new pedagogical technologies. She suggests the need for extensive training time and the availability of equipment to help teachers gain comfort with new technology. Hawkins (1997) lists factors that are necessary for helping teachers adapt new technology as: a) sufficient time to explore and practice, b) support with mentors over an extended period, and c) opportunities to communicate with other teachers who are at the same stage of learning. Ertmer et al. (2012) extend this idea by describing barriers to technology integration as "those that were external to the teacher and included resources (both hardware and software), training, and support" (p. 423). Trying to access external support resources is particularly difficult for teachers from remote areas who may have limited access to technology and a lack of technology infrastructure. This can contribute to feelings of frustration and emphasize the distance between users (Avery, 2013). Even experienced computer users can encounter technological problems whether it is an issue with access or the incompatibility of hardware (Thurmond & Wambach, 2004). Therefore, follow-up support is needed to help teachers whenever they experience problems.

Follow-up Support

As many other teacher reforms benefit from continued support, teachers who have recently been introduced to new technologies will likely need continued technical support. Luft (2001) explains the importance of combining teacher professional development (TPD) programs with follow-up experiences that include many opportunities for interaction. Classroom visits, meetings, and electronic discussions can give participants the opportunity to process their understandings following the TPD. Luft (2001) explains, "providing various opportunities for teacher development during an in-service programme acknowledges the complexity of teacher change and allows teachers to construct their own understandings of science instruction in a manner that is personally and professionally appropriate" (p. 532). Guskey (2002) describes the importance of including follow-up support and encouraging administrative support of professional development experiences to promote teachers' adapting new materials, especially if innovations are to become a regular part of a teacher's program. He explains that teachers need support as they grapple with the inevitable challenges of implementing change, and the support encourages them to persist through the change process (Dede et al., 2006). According to Ertmer et al. (2012), teachers receive most of their technical support from technology coordinators and social networking sites. This can be problematic if there is no school technology coordinator, which is a persistent issue in under-funded, high needs schools. Despite follow-up support being identified as a critical component for the sustained impact of professional development experiences, there is a paucity of data describing follow-up with teachers, including the use of online technologies for pedagogical or technical support of classroom teachers following TPD. Given the need to serve communities at a distance from major universities or other sources of TPD and the potential of virtual interactions, addressing this gap in the literature can inform teacher educators as to the efficacy of support for teachers via virtual means (e.g. email, video conferencing, social media).

Social Presence

Due to this gap in the literature, we look at the basic characteristics of the distance education environment (social presence and teaching presence) and look at ways to apply them more specifically to a technical support session. Bozkaya (2008) was among the first to compare the social presence in a face-to-face classroom to that in a distance learning environment. She found that rather than the learning environment, it was the teacher's verbal and nonverbal immediacy behaviors that had a greater impact on social presence perceptions. Given the potential importance of learner-interface interactions on learning, researchers have explored what it is about these interactions that drive effective communication. Social presence theory began with Mehrabian (1969) who explored the concept of *immediacy*, the role of nonverbal interactions such as facial features and gestures in facilitating communication. Since then, researchers have investigated how the lack of nonverbal cues impacts communication with computer-mediated communication (CMC) in business and education settings (Rourke et al., 1999). Gunawardena (1995) determined that even though CMC lacks social context clues, it can be perceived as active, interactive and stimulating if a sense of community is created. The feeling of community encourages users to view CMC as a social medium. However, lack of visual cues and one-to-one interactions with the instructor can lead to feelings of isolation (Atack & Rankin, 2002). Without face-to-face contact it can be difficult for students to sense the instructor's presence in the course, thus hampering student initiated student-faculty interactions. Richardson and Swan (2001) found a correlation between students' perceptions of social presence with other students and the instructor and their perceptions of learning. Students who reported higher social presence intensity perceived higher levels of learning. Richardson and Swan identified a need for more research on the aspect of social presence to determine the extent to which both the communication medium and the learner's perception have an effect on learning.

The CoI framework has served as an anchor for a variety of researchers' goals. Social presence is a particularly challenging component in computer mediated environments and features significantly in CoI research (e.g. Richardson & Swan, 2001). However, Swan et al. (2008) developed and validated the Community of Inquiry Instrument, a 34-item survey to measure students' perceptions of all three "presences" in an online learning environment. Many studies have made use of this instrument as a whole but others have used individual components (e.g. Shea, Li, & Pickett, 2006) finding high correlations among items and with other instruments, such as those that measure classroom community (e.g. Rovai's Classroom Community Index). In recognition of the importance of this framework to understanding digital interactions, the *Internet and Higher Education* journal published a special issue in January 2010 with 20 articles relating to various aspects of the framework to celebrate its tenth anniversary.

Teaching Presence

Teaching presence is another of the three components of the CoI model (see Figure 1). Teaching presence was first identified with Andersen's (1979) concept of teacher immediacy and her analysis of the instructor's eye contact, body posture, and gestures. Sanders and Wiseman (1990) connected teaching presence in the form of immediacy behaviors to behavioral and cognitive learning, finding some behaviors connected to behavioral learning but still more connected to cognitive learning (especially among diverse students). Anderson, Rourke, Garrison, and Archer (2001) identified three components of teaching presence; instructional design and organization, facilitating discourse, and direct discourse. The majority of studies relating to teacher presence make use of surveys such as Shea et al.'s (2006) Teaching Presence Scale, which includes items such as "drew in participants" and "focused the discussion". Finally, Akyol and Garrison (2011) developed an online graduate course around the principles of the CoI framework in which they encouraged the teaching presence of students by having them lead discussions. The researchers analyzed transcripts of online discussions and found indicators of metacognition in student-led discussions even though metacognition was not the intended goal.

While there is much research related to social presence and teaching presence in an online course, these constructs have not been applied to technical support sessions, a form of one-on-one instruction. Additionally, there is little research related to supporting teachers with technology integration following teacher professional development, nor providing technical support for teachers located at a distance. However, research shows that follow-up support plays a vital role in helping teachers to integrate new technologies. With teachers located in rural communities, follow-up support from a distance using virtual technologies may be the only viable option.

RESEARCH QUESTIONS

For this study, follow-up technical support was provided to teachers located at schools distant from the professional development providers (60-115 miles from campus). In the face-to-face TPD, teachers were introduced to integrating instructional technologies into their science and mathematics teaching. The selection of videoconferencing for follow-up support was intended to develop a similar feeling of community as the face-to-face sessions to encourage a sense of social presence without the need for travel by the PD provider. The CoI framework allows for the analysis of interactions between the teacher and the researcher during the follow-up support sessions and a careful comparison of the two methods of delivery. Given the paucity of literature related to the nature of technical support sessions, particularly those focused on supporting teacher technology integration, this study asks:

1. How are the conversations in technical support sessions characterized, based on aspects of social presence and teaching presence in the CoI model?
2. Are there differences between face-to-face sessions and videoconferencing sessions based on social and teaching presence, teacher satisfaction, rates of participation, and logistics?

METHODS

Teacher Professional Development Context

The 21st Century Learning TPD project provided hands-on technology training to 15 teachers in summer 1 and 14 additional teachers (29 total) in summer 2, employing inquiry-based, laboratory-centered curricula tied to integrated themes (e.g. crime scene forensics) and the state's course objectives for grades 6-8, science and mathematics (Blanchard, 2007). This study investigated the follow-up to TPD following summer 2. The project was staffed by three university professors with expertise in technology, mathematics, and science education, as well as several doctoral students in those majors. The professional development consisted of a 3-day summer face-to-face workshop offered at a rural public school site located centrally to the 8 schools in the project. Following that, there were one-day face-to-face fall and spring workshops requiring teacher participants to travel to the university, with additional support of two or more pre-announced school visits. The TPD program introduced technologies such as graphing calculators and probeware, interactive whiteboards, document cameras, laptop computers, and software, all presented in the context of integrated science and mathematics units. All of the technologies were purchased for the schools with grant funds and remained at the school sites. Teachers served by the project were located at 8 schools, in 6 districts in the southeastern U.S. that have little access to technology resources, high percentages of low socioeconomic-status (SES) students (~80% Free-and-Reduced Lunch) and high percentages of students from minority populations (approximately 80% African American students). Teachers' participation in the TPD was based on recommendation by their school principal or the district central office and the teacher's willingness to participate in the project.

Research Design

This study was designed to investigate the effectiveness of follow-up technical support for the project's teachers using both face-to-face and videoconferencing formats. Teachers in this study had already participated in a traditionally formatted (face-to-face) professional development (see Table 1 for timeline). Schools were randomly assigned to groups that would receive follow-up technical support either in face-to-face sessions or through videoconferencing. Assignment to a group was by school rather than individual teachers to avoid issues between teachers at the same school who may prefer one method over the other. Traditional follow-up technical support was done face-to-face, with the researcher traveling to the schools by car. Distance technical support was done via Polycom™ videoconferencing (researcher and teacher logged on and sat facing each other on large screens). The first author was an experienced chemistry teacher, with 5 years in TPD and strong technology skills. She conducted all of the technical support sessions and had a personal relationship with each participant that had developed during the professional development experiences. All TPD mathematics and science teachers were offered technical support prior to teaching the follow-up lessons from the workshop, all of which incorporated instructional technologies (e.g. document cameras, interactive white boards). The intention was to provide whatever support the teacher needed in preparation for the project lesson that he or she would teach with the relevant instructional technology, ranging from basic planning, technical support, or pedagogical support, as needed, to facilitate implementation of the lesson.

Table 1
Description and timeline of activities during the TPD program and technical support study

	TPD Program (all face-to-face)				
TIMELINE ACTIVITY	**Summer 1 TPD**	**Summer 2 TPD**	**Fall TPD**	**Spring TPD**	**Each Semester School Visits**
DESCRIPTION	Teachers attended at local middle school	Teachers attended at local middle school	Teachers attended at university	Teachers attended at university	Researchers visited each school at least twice to check on teachers
			Technical Support Follow-up		
			Teachers were visited by (face-to-face), or connected via videoconferencing with, researchers at least once during the school year to receive additional support in planning an upcoming lesson using instructional technology		

Technical Support Sessions

Polycom™ was selected as the mode for videoconferencing because it was the videoconferencing technology available in the participating school systems. Polycom™ is a videoconferencing company that features free standing, large video screens with high quality picture and sound on a mobile cart. There was one at each of the schools assigned to that method of technical support, and teachers either had the school's media person wheel the cart into their classroom or they went to the media center to participate in the technical support videoconference. This videoconferencing method was selected because it was the most similar to being at the school in person; a large, clear image with the ability to make eye contact, and the ability to see both participants simultaneously on the screen. Teachers in the face-to-face group could collect these materials from around the classroom as the technical support session unfolded. Unlike teachers in the face-to-face group, the videoconferencing group had to gather their instructional technology and materials prior to the session to have them on hand for ease of communication with the technical support provider. After each of the technical support sessions, teachers were asked to go online and complete a short satisfaction survey (Blanchard, 2007) and Technology Familiarity survey (Blanchard, 2007), which included a short, open-ended questionnaire about why they participated in the session, whether their questions were answered, and how satisfied they were with the technical support (See Data Sources and Analyses section for items).

Face-to-face sessions. For the face-to-face sessions, the researcher arrived at the school site and met with the teacher, often with the instructional technologies (e.g. force probe, graphing calculator, and motion probe) in hand or nearby. Sometimes the session occurred during the teacher's planning period immediately prior to the class in which they were going to teach the lesson. More commonly, the session took place approximately a week prior to teaching the lesson.

Videoconferencing technical support sessions. Because the videoconferencing was done via Polycom™, a technology specialist from the school or county needed to be on hand to help the teacher operate the Polycom™ device (but usually left once the session was started). In order to avoid moving the Polycom™ many sessions took place away from the classroom. In this case, teachers needed to pack up and move the equipment that they wanted to discuss in their support sessions (e.g. calculators, probeware). Therefore, if a piece of equipment was missing or the batteries ran out in the calculator, it was difficult to walk the teacher through the issue during the planning time, thus hindering the available support.

Participants

Fifteen teachers participated in technical support sessions that were transcribed and coded (three of these teachers received technical support together in the same face-to-face session, although they were planning different lessons). This sample included teachers with a range of experience (0 to >15 years) and a mix of advanced degrees (see Table 2).

DATA SOURCES AND ANALYSES

Technical support sessions were documented by type of session (face-to-face or videoconferencing), teacher, date, and the type of instructional technology to be used in the upcoming lesson. Teachers were able to see and hear the technical support person (researcher), with whom they were familiar, regardless of the type of session. All sessions were recorded via audio and/or video recorder and transcribed verbatim (a total of 249 pages, with an average of 14 transcribed pages per session). Sessions lasted from about 20-50 minutes, usually the length of time the teacher had available for planning.

Table 2

Demographics of teachers involved in technical support

Teacher	Gender	Years of Exp.	Degree[#]	Grade Level	Content Area	Technology Used During Technical Support	Taught Lesson
Teacher 1	M	0-3	PhD	7th	Science	Heart rate monitor	Yes
Teacher 2	F	8-11	B (NBCT)	7th	Science	Motion and dual-range force probes	Yes
Teacher 3	F	8-11	M	8th	Math	TI-84 calculator, mimio	No
Teacher 4	F	4-7	B	8th	Science	Gas pressure sensor	Yes*
Teacher 5	F	0-3	B	6th	Science	mimio, TI-84 calculator	Yes
Teacher 6	F	8-11	B	6th	Math	mimio, TI-84 calculator	Yes
Teacher 7	M	>15	M	8th	Science	mimio, pH probe, TI-84 calculator	No
Teacher 8	F	>15	M	6th - 8th	Math	Temperature probe and TI-84 calculator	Yes
Teacher 9	M	4-7	B	8th	Science	pH, temperature, conductivity,	Yes
Teacher 10	M	>15	B	7th	Math	Gas pressure sensor and TI-84 calculator	No
Teacher 11	F	4-7	B	7th	Math	Gas pressure sensor	Yes
Teacher 12	M	>15	M	6th	Math	mimio, TI-84 calculator	Yes
Teacher 13	F	4-7	B	7th	Science	Temperature probe and TI-84 calculator	Yes
Teacher 14	F	0-3	B	6th	Science	Temperature probe	Yes
Teacher 15	M	0-3	B	6th	Math	Temperature probe and TI-84 calculator	Yes*

#B=Bachelor's degree, M=Master's degree, NBCT=National Board Certified Teacher; *Teachers taught lesson but used different technology than discussed during technical support

Assessment of Social and Teaching Presence

Transcripts from the technical support sessions were each independently coded by two coders (there were 3 coders in total) using the Assessment of Social Presence (Rourke et al., 1999) and codes developed for Teaching Presence based on the CoI (Garrison et al., 2000). Social presence was coded using the three main categories; affective, interactive, and cohesive (see Table 3 for the social presence rubric and examples of quotes). Teaching presence was coded as either pedagogical talk (i.e. talk related to how the lesson should be carried out) or technical talk (i.e. talk related to the function of the probes or other technology). A small portion of the transcripts included exchanges about logistics related to such things as arranging when the researcher would return to the school. These exchanges were not coded as they were not related to the technical support itself. The CoI model suggests that Teaching Presence has three components: instructional design, facilitating discourse, and direct instruction (Swan et al., 2008). However, technical support sessions do not follow the natural progression of a traditional teaching situation. Sessions were structured to be very open-ended, driven by what the teacher needed, so the instructional design was the same across all sessions. Given the nature of the exchanges, the sessions were more similar to a tutoring session with two professionals, in which the discourse was very evenly distributed and the instruction dealt with either technical issues or pedagogical issues. Therefore, our two aspects of teaching presence were technical and pedagogical (see Table 4 for the teaching presence rubric and examples of quotes). In some cases, the teacher was trying to figure out how the technology worked, coded as technical teaching presence, and in other cases, considering decisions about how to enhance instruction using the technologies, coded as pedagogical teaching presence.

Analysis of social presence conducted by Rourke et al. (1999) coded text from transcripts, then divided each coded segment by the total number of words, to compare the quantity of utterances between different participants. In our study, however, the conversations in the transcripts between the teacher and researcher were back and forth and when coded, were equivalent in length, as well as in distribution between the categories of social and teaching presence. Therefore, utterances were coded holistically, using phrases, sentences, or a paragraph as appropriate (see Results and Discussion for examples of conversational exchanges and coding). Each technical support session was transcribed and coded individually by two coders, and each code was compared and negotiated to consensus. The inter-rater reliability of the first pass at coding each transcript was computed as 97%.

Table 3

Exemplar quotes and definitions for social presence codes*

Category	Indicator	Definition	Example
Affective	Expression of emotions	Conventional expressions of emotion, or unconventional expressions of emotion, include repetitious punctuation, conspicuous capitalization, emoticons.	*I told you, it's been one of them days.*
	Use of humor	Teasing, cajoling, irony, understatements, sarcasm.	*My whole life is a catch twenty-two.*
	Self-disclosure	Presents details of life outside of class, or expresses vulnerability.	*I got an "A" in Statistics.*
Interactive	Asking questions	Students ask questions of other students or the moderator.	*Is that what you're saying?*
	Complimenting, expressing appreciation	Complimenting others or contents of others' messages.	*You were doing good.*
	Expressing agreement	Expressing agreement with others or content of others' messages.	*Yeah.*
Cohesive	Vocatives	Addressing or referring to participants by name.	*I sent Ms. H the temperature probes…*
	Phatics, salutations	Communication that serves a purely social function; greetings, closures.	*Thank you very much. You guys have a good day.*
*adapted from Rourke et al., 1999			

Table 4

Exemplar quotes and definitions for teaching presence codes

Category	Definition	Example (T=Teacher, R=Researcher)
Pedagogical	Exchanges relating to how an idea or action will be carried out in the classroom. Exchanges in which questions were asked regarding an exchange previously coded as pedagogical were also coded as pedagogical.	**R**: *Right. You don't have to. It's entirely up to you. Um, it…it really depends on how much time you have. You could actually just have the students record measurements every two minutes, three minutes. Might keep them busier while they're outside. It's entirely up to you.* **T**: *Okay. Um, something that will help you in getting everything outside. I don't know if you remember, but we used backpacks to put everything in. Giving the students like Wal-Mart shopping bags to put everything in to take it outside would be a really good idea.*

Table 4 continued

Category	Definition	Example (T=Teacher, R=Researcher)
Technical	Exchanges relating to how a technology functions. Exchanges in which questions were asked regarding an exchange previously coded as technical were also coded as technical.	**T**: *Okay. When Easy Data comes up, there's a tab at the bottom that says, um, 'Graph'. I think…and then one of your selections is 'Time Graph'. I think it's number one or number two.* **R**: *…there's a little switch…And it needs to be in the 150,000[lux] place.* **T**: *So, one is 0 to 6,000 [lux]; the middle is 0 to 600 [lux]; and then down is 0 to 150,000 [lux].*

Technology Familiarity Measures

A teacher's technology familiarity score is based on the teacher's responses to questions regarding his or her perception of the ability to use a particular instructional technology in the classroom. This measure was a gauge of whether the technical support session met the goal of supporting the teacher's use of the technology; that is, to help the teacher feel comfortable using the instructional technology in the classroom. The list of technologies was developed from the instructional technologies that teachers learned to use during the face-to-face, on-site summer TPDs. Teachers were asked, "What level of familiarity do you have with each of the technologies listed below?" in which coding 5 meant the teacher "could implement in classroom," to 3 "somewhat experienced" to 1 "no experience." Twenty technologies were included on the survey, such as probeware (e.g. light, force, heart rate monitor, motion, pH), graphing calculator, software (e.g. TinkerPlots® and LoggerPro), document camera, interactive whiteboard (mimio®), and online videoconferencing software. Surveys from pre- and post-workshop were collected as well as after the technical support sessions. After their technical support sessions, 12 of the 15 teachers took the technology familiarity survey. Ten teachers (83%) reported a 5 for those technologies used during the sessions while the two other teachers (17%) reported a 3. This suggests that the technical support sessions were perceived as effective in supporting teachers' ability to implement selected technologies in their classrooms.

Satisfaction Survey

Teachers were asked to respond to a Likert-type scale satisfaction survey online, immediately following the technical support session (either via videoconferencing or face-to-face). Responses ranged from 5 "strongly agree" to 3 "neutral" to 1 "strongly disagree", with 0 indicating "Not applicable" on 4 questions regarding their satisfaction with the support session, including:

1. Was relevant to my needs.
2. Enhanced my understanding of ways to use technology with my students
3. Helped me gain new information
4. Will assist me in integrating technology into the curriculum.

Teacher satisfaction items had high inter-correlations as confirmed by an item reliability analysis. The coefficient alpha was .879 for the four items across the teacher sample.

RESULTS AND DISCUSSION

Based on the data collected and analyzed, the following results and discussion are drawn in response to the research questions relating to social and teaching presence in face-to-face and videoconferencing technical support sessions.

Characterization of conversations

Analyses of the technical support session transcripts indicate that the teachers carried on conversations with the researcher that involved not only technical support, but also pedagogical issues and personal exchanges. In fact, the technical support interactions were often shorter in duration than discussions about pedagogical issues, such as how many lab stations were needed, etc. Below is an excerpt of a typical technical support session transcription with a female mathematics teacher assigned to receive technical support via videoconferencing. In the following exchange, the math teacher wanted to do a lesson from an environmental unit in which students took measurements outside using temperature probes to determine differences in microclimates around the school campus, and then develop reasoning for these differences. In the math class, the teacher planned to have the students analyze data collected from students in all of the classes. The exchange focused on how to attach the probe to a pencil to get the measurements, which also involved connecting the probe to a TI-84 graphing calculator (social and teaching presence codes in brackets, T=teacher, R=researcher):

R: *You can take a ruler and stick it in the ground, or like a pencil and stick it in the ground to anchor it, uh, right above the…ground. So it…it needs to be like a couple centimeters above the surface of the ground so it's picking up the reflection. And see different surfaces, that way, will obviously show you differences as well. So grass, dirt, different colored dirt…* **[Teaching-technical]**

T: *…'cause you can't…you can't have it but so far out of the ground because it's gonna be connected to the calculator, right?* **[Teaching-technical]**

R: *Right. No, I'm…talking like literally a few centimeters.* **[Teaching-technical]**

T: *So if you put the stick in the ground…* **[Teaching-technical]**

R: *Uh huh.*

T: *…calculator on the ground, and then the temperature probe taped to the yardstick.* **[continued from previous thought (Teaching-technical)]**

R: *Right.*

T: *Is that what you're saying?* **[Teaching-technical]**

R: *Yep. You can take…or you can use rubber bands. You may not want to use tape. That could be interesting…* **[Teaching-pedagogical]**

T: *…use rubber bands with sixth graders?* **[Social-interactive]**

R: *Do you want to get sixth graders to take the tape off the probes and the ruler?* **[Social-interactive]**

T: *You want the sixth graders to shoot the rubber bands at each other?* **[Social-affective]**

R: *[laughing] It's a catch twenty-two. [laughing]* **[Social-affective]**

T: *My whole life is a catch twenty-two.* **[Social-affective]**

The transcript excerpt above demonstrates the back and forth exchanges, mostly brief, between the teacher and the researcher as they talked through planning for the upcoming lesson. Table 5 summarizes how coded exchanges were quantified from each teacher's technical support session. As illustrated, the teacher and the researcher had a similar number of exchanges, with one notable exception. Teachers 5, 6, and 12 teach 6th grade students math (Teachers 6 & 12) and science (Teacher 5) and were team planning when the researcher arrived. The teachers decided to do the technical support session together, resulting in each of the teachers talking to the researcher, decreasing the researcher's percentage of talk (see Table 5).

Table 5

Number of exchanges coded between teacher and researcher

Teacher	Group	Teacher Exchanges	Researcher Exchanges
Teacher 1	f2f	150	138
Teacher 2	f2f	152	137
Teacher 3	f2f	135	153
Teacher 4	VC	74	63
Teachers 5,6,12	f2f	173	71
Teacher 7	f2f	152	171
Teacher 8	VC	244	257
Teacher 9	f2f	151	170
Teacher 10	f2f	69	62
Teacher 11	f2f	66	60
Teacher 13	f2f	75	73
Teacher 14	f2f	126	148
Teacher 15	VC	109	123
VC=videoconferencing, f2f=face-to-face			

Although the number of overall exchanges was relatively consistent between teacher and researcher among the sessions, the nature of the exchanges varied greatly. Teacher and researcher codes were combined to determine an overall percentage for each category for each teacher's technical support session. Figure 2 displays the social and teaching presence by category, using percentages from each of the technical support session codes. The black bar separates codes related to social presence (bottom section) and teaching presence (upper section) with the percentage of technical exchanges displayed in that relevant section at the top of the graph.

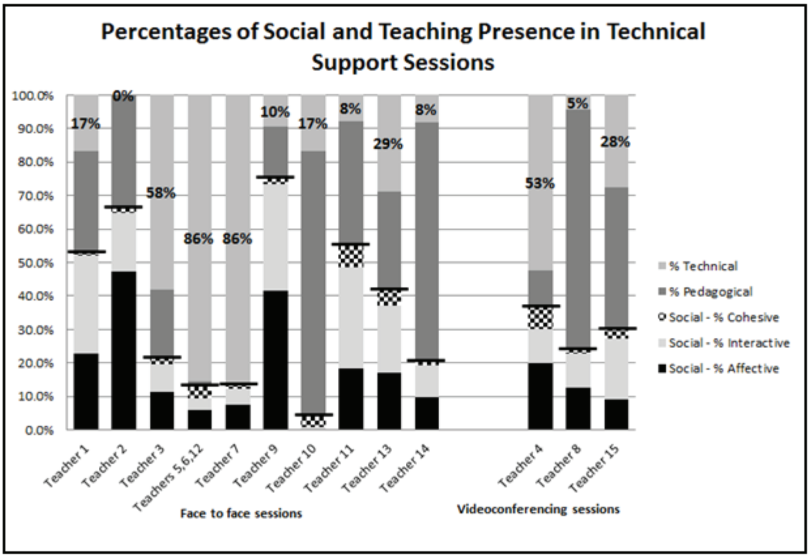

Figure 2. Breakdown of social and teaching presence in both face-to-face and videoconferencing sessions.

There is not an overall trend in the data; rather, technical support sessions grouped into three types of sessions, based on the main focus of the session (see Figure 3). Interactions during technical support sessions were grouped according to their primary focus (50% or more of the session) e.g. technology, pedagogy or social talk.

The pie charts displayed at the top of each box in Figure 3 display the percentage of sessions (out of 13 total for 15 teachers) that may be categorized by that type. Teachers whose technical support session focused on technical aspects tended to be familiar with technology, and were categorized in the technology-centered support session. Two teachers (3 & 7) had not previously attended a summer TPD and therefore were not familiar with the technology beyond knowing what was available. Teacher 4 had attended the TPD but planned to use a probe that she did not remember from the summer. The group support session for Teachers 5, 6, and 12 also fell into this category and matches the trend of little or no familiarity with the supported technology before the session.

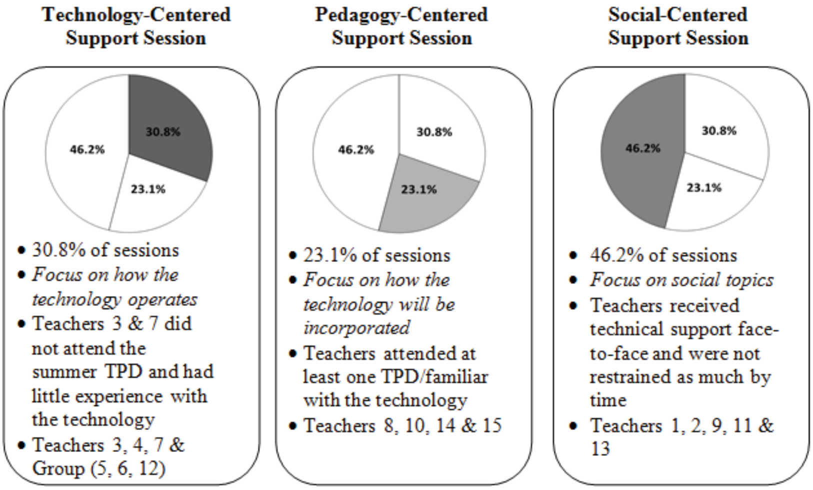

Figure 3. Summary of types of technical support sessions.

Teachers 8 and 10 focused on the pedagogical aspects of incorporating technology during technical support sessions, and therefore were categorized in the pedagogy-focused support session. Although they each had more than 15 years of teaching experience, they were unfamiliar incorporating instructional technologies into their teaching, particularly following the reform-based method of putting the technologies into the hands of their students. Teacher 14 was a new teacher who was entering teaching as a second career and had attended the summer TPD. Although confident with the technology, she was unsure how the lesson would work in her classroom.

Teachers 2, 9, and 11 exemplify social-centered support sessions. Each teacher had between four and 10 years of teaching experience and was fairly familiar with the technology, having attended at least one summer TPD. Therefore, once the lesson was discussed, the conversation turned social as they all had a friendly relationship with the researcher, built during the summer TPD. Teachers 1 & 13 may also be included in this support type as their percentages for social talk were 53% and 43% respectively but were not necessarily representative of all the criteria; Teacher 1 had less than four years of experience and Teacher 13 fell slightly below the 50% mark. However, in general, Teachers 1, 2, 9, 11, 13, and 15 were fairly comfortable with their technical and pedagogical knowledge and seemed more interested in the social aspects of the interaction.

The variation in the topics and types of interactions among the teachers in the technical support sessions suggests that an individual providing technical support ought to be well-versed in the technology in which they are supporting the teachers as well as subject matter pedagogy. The large portion of social talk between the teacher and researcher suggests that the teachers welcomed a colleague with whom to share their experiences. It also indicates that the support provider ought to be able to converse with teachers in a social manner (e.g. shared teaching experiences) and that it may be helpful to have an established relationship between teacher and support provider. The teachers' technology familiarity scores indicate that regardless of whether the focus of the session was teaching or social, all teachers felt more familiar with the technology they used in their lesson.

It is clear from qualitative data that the teachers enjoyed and learned from their interactions with the researcher, and all seemed to trust her and/or perceive her to be a colleague or even a friend. The extended pedagogical sessions that were a portion of the technical support ("How many stations do you think I should set up?" "How long do you think this will take?") seemed to convey the trust and competence of the researcher with the teachers, resonating with Richardson and Swan's (2001) findings that perceptions of social presence predicted students' perceptions of learning.

Comparing Face-to-Face and Videoconferencing Sessions

The face-to-face and videoconferencing formats of the technical support sessions seem to be comparable, with some notable differences. Social and teaching presence and teacher satisfaction with the technical support were comparable regardless of the format of the technical support session. However, the rates of teacher participation and the requirements to conduct each type of session are quite different.

Social and Teaching Presence

The overarching trend for technical support sessions is that the social and teaching presence was constituted as approximately one-third pedagogical, technical, and social. As displayed in Figure 4, face-to-face technical support sessions (on average) closely resemble this overall trend. In contrast, videoconferencing sessions were more focused on pedagogy. This may be due to the more public context of the videoconferencing sessions, typically the school's media center, and reliance on external personnel for their time and expertise. Indeed, none of the teachers who received technical support via videoconferencing have more than 37% of the discussion as social talk. Given that this percentage is comparable to six (50%) of the teachers in the face-to-face support sessions, this does not seem related to the differences between CMC and face-to-face as suggested by Atack and Rankin (2002) and others. Figure 4 illustrates the average percentages of social and teaching presence in face-to-face and videoconferencing session.

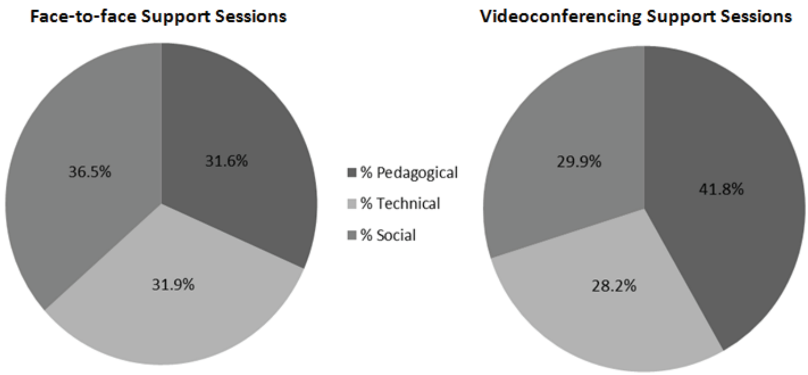

Figure 4. Average percentages of social and teaching presence in face-to-face and videoconferencing sessions.

The literature indicates that teachers need follow-up to professional development to implement new practices in their teaching (e.g. Guskey, 2002) and indeed, little is known about supporting classroom teachers via web-based technologies (Dede et al., 2006). The technical support was designed mindful of interactions between individuals relevant to web-based considerations (e.g. Hillman, Willis, & Gunawardena, 1994). Specifically, the distance support through synchronous videoconferencing was selected purposefully to enhance the feeling of the technical support person being socially present (Bozkaya, 2008) with the teacher. The aspects that we highlighted in our design included Mehrabian's (1969) immediacy. The researcher, an experienced former high school chemistry teacher, talked with teachers in a typically collegial way, using a normal volume, using eye contact and gestures, normal conversational pauses, small talk, and other immediacy strategies (Bozkaya, 2008) typical of teachers talking to one another in a face-to-face setting.

We believe it is a combination of the personal relationship that the researcher was able to establish with the teachers during teacher professional development, paired with the personal feel of the synchronous technical support, whether that was via videoconferencing or in face-to-face sessions, that led to the teachers' satisfaction. We suspect that, done well, this trusting relationship could be established without initial face-to-face contact with the teachers, if it was designed to allow for the development of personal relationships (Bozkaya, 2008).

Teacher Satisfaction

On average, teachers in the face-to-face group reported similarly high satisfaction (Likert score = 4.5) with the technical support as teachers in the videoconferencing group (Likert score = 4.1). The following analyses for teacher satisfaction were conducted using a general linear regression model with three categorical predictor variables (gender, technology treatment, and whether the instructor was a mathematics or science instructor) and one continuous outcome variable (normalized satisfaction index scores with *Mean* = .841, *SD* = .196). Of the 15 teachers who participated in the technical support sessions, 13 responded to the survey (response rate = 87%). Overall the regression model (Pearson Chi-square goodness of fit = .037) showed that none of the hypothesized predictors had any significant effect on the outcome variable. To summarize, teacher satisfaction with their follow-up professional development experiences was not dependent on mode of delivery or whether the instructor taught mathematics or science. However, all of the teachers "agreed" that the sessions helped, were relevant, and enhanced their understanding of the technology in ways that they could implement the technology into their science or mathematics teaching.

Rates of Participation

Fourteen teachers were assigned to face-to-face technical support. Of these, 12 (64%) voluntarily participated in the technical support sessions throughout the course of the extended sessions provided. Three of the teachers who received face-to-face technical support never informed us that they taught the technology lesson that the sessions were intended to support and thus we assume they did not use them. Also, three of the teachers assigned to this group participated in not just one, but two technical support sessions (14%). There were 15 teachers assigned to the videoconferencing technical support group. Of these, six participated in the technical support sessions (40%). One teacher did not receive VC technical support, but taught a lesson using the technology that we videotaped (she said she did not need the help, and instead asked a colleague for help). Two of the VC teachers (13%) received technical support twice. We know anecdotally that several of the teachers used new instructional technologies, and did not require technical support.

Logistics for Technical Support Sessions

As previously described, teachers who received technical support through videoconferencing were required to set a time with the researcher and the technology (or media center) coordinator at the school or county who was responsible for the Polycom™ system. Although these sessions seemed to be as effective as those carried out face-to-face, setting them up involved more steps and required the teacher to set up a time with the technology support provider. In contrast, many of the face-to-face technical support sessions took place because the researcher was already in the building and visited teachers during their scheduled planning time asking if they needed assistance, which was not possible with the videoconferencing sessions. However, with the advent of easier technologies such as Skype™, teachers in a follow-up program have contacted the researcher with questions when seeing she was online.

We began the project with a concern about using videoconferencing for technical support. This was replaced by a concern about being able to stimulate teachers at a distance to participate in technical support at all, or to implement the use of the new instructional technologies with their students. It is possible that those teachers who selected not to participate (38% of the teachers invited) did not feel as connected to the project team as those who did participate, or perhaps they did not feel prepared enough, and were reluctant to participate due to feelings of inadequacy. Richardson and Swan's (2001) work suggests that if teachers felt less connected, it is possible they did not learn as much during the summer professional development.

CONCLUSIONS

Technical support sessions are not restricted to discussions about how to use the technology. The technical support sessions in this study all included some interactions that were pedagogical and social in nature, as well. Overall, sessions were approximately one-third each of technical, pedagogical, and social discussions for both the face-to-face and videoconferencing support formats suggesting that the videoconferencing technical support using Polycom™ closely resembled that of the face-to-face with regards to the CoI model (Garrison et al., 2000). With the positioning of the camera and the ability for the teacher to see the technical support person as well as him/herself, all of the verbal and nonverbal cues described by Bozkaya (2008) were relayed through the technology, enabling a similar social presence found in the face-to-face sessions. According to Bozkaya (2008), it is these cues, a teacher's (researcher's) immediacy, that can be a predictor of social presence and positively impact student (teacher) learning. Teachers in this study were also positively impacted by their technical support sessions.

Many researchers (e.g. Dede et al., 2006) agree that providing follow-up support for teachers is critical, yet it is a difficult charge for professional development providers, especially with teachers at a distance. The large body of research reviewed by Dede et al. documented the need for follow-up support, which is often lacking, but not how best to provide that follow-up support. In this study, it was difficult to encourage busy teachers to take an hour or less to discuss a lesson because they either did not want to participate, were pressed for time due to other commitments, or they already felt confident in their ability to carry out the lesson. Only 18 of the total 29 teachers (62%) in the project elected to receive the follow-up support despite multiple correspondences through a variety of methods (i.e. phone, email, school visits). More work is needed to better understand teachers that choose not to participate. Of the 18 teachers who did participate in the technical support, three of them received support as a group in a single session and three others did not follow through with teaching the lesson following the technical support session. The teachers who participated in the technical support sessions were highly satisfied with the support they received and felt able to use the technology in their upcoming lesson. Further supporting the perceived usefulness of the technical support sessions, five teachers also completed a second technical support session later in the year, two of which were conducted via videoconferencing.

IMPLICATIONS

This study suggests a number of implications that may be useful for those who provide technical support to teachers. First, videoconferencing-based technical support seems to be a viable option for teachers who are at a distance from the technical support provider. In this study, face-to-face and videoconferencing technical support sessions had similar levels of social presence, satisfaction, and teachers' belief that they could use the instructional technology in their teaching. Second, for the person providing technical support, having the technical knowledge is not enough. Due to the high percentage of time spent on pedagogical issues related to the use of instructional technologies in lessons, the technical support provider also needs to have pedagogical content knowledge. Third, a large percentage of social talk between the teacher and technical support provider seems to indicate that the teachers were pleased to be able to communicate with a person they perceived to be a peer. This suggests that the support provider ought to have sufficient social skills, and ideally some shared experiences (e.g. shared teaching experiences). In addition, this suggests it may help boost the success of technical support if there is an established relationship between teacher and support provider.

Fourth, regardless of the nature of the technical support session, on teaching or social, the sessions were successful in helping the teachers to feel more confident in their ability to use the technologies. Therefore, it does not matter where the emphasis lies in terms of the CoI model. Fifth, this study suggests that it is possible to support teachers in their use of instructional technologies through videoconferencing or in face-to-face sessions who have had no previous experiences with the instructional technologies. The one-on-one mentoring is a viable alternative to getting teachers 'up to speed' who were not a part of the original TPD. This is particularly salient in high needs districts in which 20-40% annual teacher turnover is not unusual. Because this study took place with a small number of teachers in a rural, high need district, caution should be used in generalizing these findings to other teachers. However, we are encouraged by the results, given that many of the teachers had little previous knowledge of integrating instructional technologies into their teaching, or using videoconferencing.

Videoconferencing may save schools time and resources for these instructional technology coaches, who ideally have pedagogical content expertise. We anticipate that providing instructional technology support via videoconferencing will work, also, with teachers who are far away from the initial source of professional development, such as located in large cities, in different states or different countries. We recommend that additional studies be conducted to assess the efficacy of online follow-up support with a larger group of teachers, in other situations. We hope that this study will lay the groundwork for additional work to be done on follow-up technical support for teachers adding instructional technologies to enhance their teaching.

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