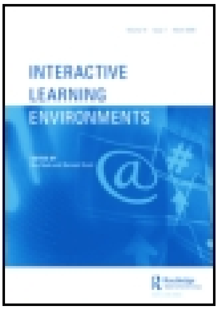

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Designing social presence in e-learning environments: Testing the effect of interactivity on children

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Designing Social Presence in e-Learning Environments: Testing the effect of interactivity on children

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The "computers are social actors" paradigm asserts that human-to-computer interactions are fundamentally social responses. Earlier research has shown that effective management of the social presence in user interface design can improve user engagement and motivation. Much of this research has focused on adult subjects. This study discusses the effects of social presence management in child e-learning environment development by specifically examining the role of interactivity in a computer-mediated learning environment in relation to the development of children's attitudes toward computers as well as their intrinsic motivation. A quasi-experimental methodology was adopted for this study. It was found that interactivity had a significant effect on the computer's social presence, its social attraction to children and children's involvement, and intrinsic motivation. The findings suggest that enhancing the interactivity of an e-learning environment can stimulate the presence of social actors, which in turn can enrich a children's learning experience and increase their motivation.

Introduction

Computers are now widely used to assist schoolchildren in learning or in developing particular skills (Druin & Inkpen, 2001). Computer-mediated learning attempts to provide children with a rich learning experience by using varied instructional content. The interactive component of the computer-mediated learning environment has a significant impact on children's motivation and the effectiveness of the learning experience. Many people initially found computer-mediated learning appealing because of the novelty of the experience, the availability of a variety of features, and the cumulative effects that graphics or animations have on the learning experience (Brown, 1986). That trend, which can

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be attributed to the popularity of the component of motivation, however, as Keller (1997) pointed out, has been on the decline as computers have become more widely used in educational environments. Once the excitement brought about by the novelty features fades, it becomes more challenging to stimulate and sustain learners' motivation as they engage in e-learning activities. It is, therefore, important to explore other possibilities and methods by which to increase and sustain learners' motivation and involvement in the e-learning environment. Another approach that may be effective would be the "computers are social actors (CASA)" paradigm (Nass, Steuer, & Tauber, 1994). With this as background, this study attempts to extend the concepts of CASA to the e-learning environment for children.

The findings of CASA studies indicate that the way people interact with computers is inherently natural and social, and sheds new light on finding potential strategies for interface design which provide learners with social presence to improve their engagement and motivation in an e-learning environment. Earlier CASA studies suggest that even minimal social cues rendered by a computer can make people see the computer as a social actor rather than as just an inanimate tool. This kind of social response by a user can create a more intimate human–computer interaction, which in turn improves user perceptions about the computer and fosters a more beneficial relationship between the user and the computer. CASA is identified by Lombard and Ditton (1997) as a conceptualization of social presence. Social presence is defined as the degree of awareness of another person in an interaction and the consequent appreciation of an interpersonal relationship (Walther, 1992). Social presence in a computer-mediated communication environment refers to the user's feelings, perceptions, or reactions being connected to another intellectual entity (Tu & McIsaac, 2002). It involves a subjective quality of the communication medium related to the psychological concepts of social intimacy and immediacy (Short, Williams, & Christie, 1976). In other words, a medium that provides people with intimate or immediate cues may evoke a social and emotional reaction. Such an experience enables the user to perceive the presence of another social being and an interacting between them.

Studies have suggested that enhancing social presence in an e-learning environment can create the impression of a quality learning experience on the learner. Another benefit is to induce and sustain learners' motivation (Aragon, 2003; Newberry, 2001; Tu, 2001). These examples mainly focus on the enhancement of computer social presence necessary to create a successful learning experience involving learners and instructors in an online environment. By comparison, the possibility that a learner perceives the social presence of the computer itself via the interaction and the interface design is seldom explored. A perception as such may satisfy the learner's social desire and achieve the instructional goal despite the absence of a human instructor. As stated, the CASA paradigm, a concept of social presence, involves social responses by people not to other entities through a medium, but to cues provided by the medium itself (Lombard & Ditton, 1997). The paradigm suggests that if a computer can be perceived as a social entity that this may improve user involvement and motivation as a child participates in a computerized learning activity with no instructor involved.

Going beyond this theory, several experimental studies have demonstrated that people do not respond to a computer merely as a tool. Rather, individuals adopt a wide range of social rules and learned behaviours to guide their interactions with and attitudes toward computers (Picard, 1997; Picard, Wexelblat, & Nass, 2002; Reeves & Nass, 1996, Turkle, 2003). One conclusion drawn by these studies is that people tend to feel that a computer is friendlier, more attractive, and more helpful if it is able to exhibit social cues. These studies on the user social interaction with computers have called attention to the field of human – computer interaction. The CASA paradigm is an important concept and should attract more interface designers to consider its application for improving human – computer relationships. Numerous experiments have been conducted on adult subjects and considerable evidence has been presented. Few experiments, however, have paid the same level of attention to children or tested whether children react to computers' social cues in a similar way. Turkle (1984) conducted a long-term observation on juvenile user-and-computer interrelationships based on the discipline of psychoanalysis. She found out that the boundary between computer and human interactions is blurry for children, as children tend to anthropomorphize computers and perceive them as having human intelligence. This noteworthy finding may be powerful evidence supporting the idea that children respond socially to computers in ways similar to, or even stronger than, their adult counterparts. At the same time, Turkle's finding raises the question of whether children see computers as a social entity regardless of the presence or absence of social cues. This question warrants further exploration in more detail as the authors seek to extend the employment of CASA to children.

This paper seeks to provide an insight into children's attitudes toward computers. If children can perceive a sense of social presence via the social cues of a computer itself and come to see the computer as a social attraction, it may follow that interaction can be specifically designed to engage children in the e-learning environment. This study aims to extend the employment of the CASA concept to children and to learn more about their attitudes toward the social attributes of a computer. More specifically, it attempts to examine the effect of interactivity in an e-learning environment on social presence perceived by child subjects. Interactivity is the most distinctive quality of computer technology. Likewise, in terms of human interaction, interactivity is an inherent property of the communication process (Rafaeli, 1988). This paper attempts to test whether modelling the computer-to-user interaction after interpersonal communication can indeed endow a computer with the attribute of social presence and thereby become socially attractive to children. It goes further to test how this treatment would affect children's intrinsic motivation and involvement.

The following sections outline the literature relevant to CASA and interactivity. The method and results of the study are then detailed. Finally, a discussion concerning the results as well as a conclusion is presented.

Literature Review

Computers are Social Actors

Technologists aspire to humanize the computer interface since it is suggested that a more humanized interface conveys a sense of comfort and ease to the user (Laurel, 1990; Sproull, Subramani, Kiesler, Walker, & Waters, 1996). In fact, computers may be perceived on a social dimension. Reeves and Nass (1996) compiled their empirical evidence into the book, *The Media Equation: How People Treat Computers, Television, and New Media Like Real People and Places*, which argues that people tend to equate media with real life. The book claims that people treat media socially just as they would real-world experiences. Nass et al. (1994) also proposed the "Computers are Social Actors" paradigm to highlight the way people attribute social or human characteristics to computers when these machines demonstrate sufficient social cues. The phenomenon of the human-to-computer social interaction does not derive from the mistaken belief that computers are human-like, but from a natural human psychological tendency. The use of social cues in interaction design may be an effective way to attain the goal of humanizing computers.

The CASA paradigm seeks to incorporate a set of context cues into user-interface design by replicating human-to-human interaction in the context of human-to-computer interaction. Several studies have provided evidence that people respond to computers by following interpersonal rules. Experiments conducted by Nass and his associates have demonstrated that people connect with computers in a team-like relationship via minimal cues of social identity in a controlled interaction (Nass, Fogg, & Moon, 1996), sense interactive characters' personalities via verbal and non-verbal cues and prefer a character that is complementary to them (Isbister & Nass, 2000). People also react to helpful, flattering, or humorous messages from a computer in the same way that they react to such messages from humans (Fogg & Nass, 1997a, 1997b; Morkes, Kernal, & Nass, 1999). These studies reveal that people are under the influence of the social attributes of computers and consequently treat computers the same way they treat humans.

To better understand this phenomenon, Nass and Moon (2000) reviewed a series of empirical studies they had conducted and came to the conclusion that individuals would unconsciously apply social rules and expectations to computers. How those individuals respond to the computer is mainly an indicator of their previous social experiences and accumulated learned social behaviours toward computers. These findings provide an insight into the social interactions between a user and a computer, which implies that designers may be able to create a more sociable and intimate user interface by properly utilizing social cues.

Interactivity

When people say that humans are social beings, they are speaking of the human tendency to conduct social activities and associate with others. Human communication is a universal and essential feature of an individual's social life. The processes and outcomes of human communication vary systematically with the degrees of interactivity afforded or experienced. Interactivity is not about non-verbal and verbal codes per se; rather, it offers potentially valuable insights into the interrelationship of humans and computers (Burgoon et al., 2002). Rafaeli (1988) argued that interactivity is one of the properties of the communication process, and he maintained that interactivity is variable given the way preceding messages are related to even earlier ones. That argument means that interactivity is a condition of communication in which participants are mutually engaging and taking turns as sender and receiver (Hanssen, Jankowski, & Etienne, 1996; Rogers, 1986). Interactivity can be viewed as a mutual process where message-exchange and role-exchange are two essential elements for maintaining the process and taking it forward. These two features derived from interpersonal communication can be developed into a set of social cues to evoke a sense of social presence.

Marakas, Johnson, and Palmer (2000) suggested that the social character of the computer technology serves as an important element enabling people to view the computer as a social actor. In regard to the social character of technology, Marakas et al. noted that promoting the sense of interactivity is one way to encourage the desire to incorporate social characteristics into the computer, and that perceptions of control have been proposed as a main category of social characteristics, which occur when the user's interaction with the computer is such that the individual is being directed in a proactive manner by the technology. Interactivity here is referred to as a means of developing sociable technology, and it involves a perception of control. Relevant educational literature shows that perceptions of control are critical to a computer-mediated learning environment. Popular arguments state that placing the learner in control can increase motivation (Schnackenberg & Sullivan, 2000; Yeh & Lehman, 2001), while some researches indicate that user control offers no benefits over program control (McNeil & Nelson, 1991). According to the aforementioned reviews, learner-control interactivity indicates that instructional media interact with an individual in a passive manner in which the individual primarily plays the role of sender with the computer as receiver. Passive interactivity may lower the quality of the communication experience, leading the computer to act more like a tool and fail to satisfy the learner's desire for a social relationship during the interaction. These studies suggest that instructional media that interact with the learner in an active manner enable learners to feel a stronger sense of social presence from a computer. Such awareness allows children to treat the computer as a companion, and such a learning experience can enhance children's involvement and intrinsic motivation. Therefore, it is argued that both learner-control and learner-controlled communication in an e-learning environment can persuade children to treat a computer as a social actor.

Hypotheses

This study, in sum, aims to extend the employment of the CASA concepts to the design of social interfaces for e-learning for children and to examine the effects interactivity in the learning environment has on a child's attitude toward computers and learning. A quasi-experimental methodology was adopted to test the effects of this factor on children. Specifically, the experiment attempted to investigate children's opinions on the two issues discussed as follows.

The first issue is how the interactivity of an e-learning environment influences the degree of social presence perceived by children. It is presumed that children perceive a higher degree of social presence in the active-interactivity environment than they would in the passive-interactivity environment. According to the CASA paradigm, if children can feel a sense of social presence from a computer, the computer may be more like a partner than a tool to them. Accordingly, children would be more socially attracted to a computer with active-interactivity than to one with passive-interactivity. The hypotheses for the first issue therefore are as follows:

- H1. Children perceive a higher degree of social presence in an active-interactivity environment than in a passive-interactivity environment.
- H2. Children are more socially attracted to an active-interactivity computer than to a passive-interactivity computer.

The second issue in discussion is whether a computer with active interactivity can foster children's involvement and intrinsic motivation for learning. Learning is a social activity. A learning environment provides a child with a sense of social presence that may satisfy his or her social desire and enhance intrinsic motivation in the absence of an instructor or a partner. Social presence is also defined as a sense of engagement or connection with a social entity and as a linked presence with involvement (Lombard & Ditton, 1997; Witmer & Singer, 1998). The following hypotheses are derived from this definition:

- H3. Children participating in a learning activity in an active-interactivity environment are more intrinsically motivated than those in a passive-interactivity environment.
- H4. Children in an active-interactivity environment involve themselves more actively in learning than do those in a passive-interactivity environment.

Method

Participants

Forty children (21 boys and 19 girls) from 2 fifth-grade classes of an elementary school in Taiwan were the participants in the experiment. The average age of the participants was 10.8 years. All participants had hands-on experience with computers and had received computer lessons at least once a week since the third grade. A total of 78 per cent of the participants reported that they used computers frequently at home for gaming and Internet browsing. This indicates that the participants are familiar with computers and are able to discern the different levels of interactivity provided by the study. Each participant was given a toy as a present upon completion of the experiment.

Experiment Design

A one-factor-at-two-levels (active interactivity – passive interactivity) counterbalanced within-subjects design was used in this research. The dependent variables were the degree of social presence perceived by children, the social attraction of computers to children, and children's intrinsic motivation and involvement.

Materials

The instructional materials were designed as a mathematical problem-solving practice program, which, designed in Macromedia Flash, was developed in two versions to represent active interactivity and passive interactivity environments, respectively. Each version had 10 math questions at a moderate fifth-grade level. Two sets of different questions with the same level of difficulty were assigned to the two versions. These were tested on and confirmed by students from another class. The sequence of the questions for each version was randomized to reduce the effect of practice. The programs were controlled by a keyboard on which the number keys and predetermined function keys were labelled with numbers or functions such as "start", "erase", "next", "again", "confirm", "answer", and "exit". In the active-interactivity environment the instructional program actively communicated with participants in a manner that exhibited message-exchange and role-exchange features. This means that the computer would follow a preprogrammed interaction mode to provide messages based on earlier inputs and to play the roles of both sender and receiver with the participant. In the passive-interactivity environment, the instructional program interacted with the participant in a learner-control manner in which the participant was the sender and the computer the receiver. The two levels of interactive manner are summarized as follows.

1. When a participant pressed the "start" key, the active-interactivity program would present a written greeting "Hi, Welcome!" and then automatically guide the participant to the first question. The passive-interactivity program, on the other hand, would immediately show the first math problem without any greeting.
2. When a participant gave a correct answer, the active-interactivity program would show the "right" symbol as feedback and automatically guide the participant to the next question. In the same situation, the passive-interactivity program would show an "answer right" symbol. The participant would then have to press the "next" key to go to the next question.
3. When a participant answered a question incorrectly, the active-interactivity program would display a "wrong" symbol on the screen and politely suggest that the participant press either the "again" or "next" key to proceed. If the participant decided to go to the next question, the program would show the

correct answer and move on to the next question. In the wrong-answer situation, the passive-interactivity program would display a "wrong" symbol without any further reference for what step was to be taken next. The participant could try again, check the answer, or move on to the next question by pressing the "again", "next", or "answer" key.

4. After an attempt had been made to answer all of the questions, the active-interactivity program would inform the participant of the final score and the count of correct and incorrect answers, along with positive comments. The passive-interactive program would present the participant's score without giving further information.

Measurement Tools

The dependent variables—social presence, social attraction, involvement, and intrinsic motivation—were measured with a set of paper-and-pencil questionnaires. The wording used in the questionnaires came about as the result of discussions with teachers and the children to prevent any misunderstanding.

1. The first set of questions adopted the four items proposed by Short et al. (1976) to measure social presence: sociable – unsociable, personal – impersonal, sensitive – insensitive, and warm – cold. It employed a semantic differential technique with a bipolar 5-point scale. The index was reliable (Cronbach's $\alpha = 0.83$).
2. The second set of questions was a modification based on Moon (1996) and was used to measure participants' perceptions of the computer with respect to its social attraction. The scale consisted of three items: Is this computer friendly? Do you like this computer? Do you enjoy doing this math exercise with this computer? The scale used was a 9-point Likert scale ranging from 1 (*very strongly disagree*) to 9 (*very strongly agree*). The index was reliable (Cronbach's $\alpha = 0.83$).
3. The third set of questions used an adapted version of the Activity-Feeling Scales (AFS) developed by Reeve and Sickeniuns (1994) to measure the participants' intrinsic motivation. The index developed was a 12-item measurement to evaluate a child's self-determination, competence, relatedness, and tension. The scale contained the following items:

   Choices were offered for the four categories as follows: self-determination—"what to do", "I want to do this", and "my participation is voluntary"; competence—"capable", "competent", and "achieving"; relatedness—"involved with friends", "part of a team", and "brotherly or sisterly"; tension—"pressured", "stressed", and "uptight". The scale used was a 9-point Likert scale ranging from 1 (*very strongly disagree*) to 9 (*very strongly agree*). The index was reliable (Cronbach's $\alpha = 0.75$).
4. The final set of questions was used to measure participants' involvement in the interaction. The scale comprised 5 items adapted from Heeter (1995): fun, involving, interesting, boring (reverse scale), and willing to play again. The scale was a 9-point Likert scale ranging from 1 (*very strongly disagree*) to 9 (*very strongly agree*). The index was reliable (Cronbach's $\alpha = 0.84$).

Procedure

This experiment consisted of two stages. The purpose of the first stage was to allow the participants to become familiar with the instructional program used in the study. A demonstration was given beforehand to show the participants how to manage the two versions of the program. This effort helped the participants understand the program mechanism of the two interfaces. The goal of the demonstration was to make sure that the results would not be compromised by the participants' unfamiliarity with the interfaces.

The experiment itself came in the second stage. Four identical computers were set up in a discussion room at the library of an elementary school. For each session, four participants took part in the experiment. Each participant was required to complete the two instructional programs. The conditions were counterbalanced. After a participant finished one program, an experimenter would ask him or her to fill out a questionnaire. Then the participant took a 5-min break before taking the second program. Each session took around 30 – 40 min to complete. Upon completing the experiment, the participants were debriefed, given a toy, and asked not to discuss the experiment with other participants.

Results

Hypothesis 1

Hypothesis 1 predicted that children would perceive a higher degree of social presence from an active-interactivity environment than from a passive-interactivity environment. The results showed that participants rated the social presence of active-interactivity computers ($M = 7.21$, $SD = 2.03$) higher than passive-interactivity ones ($M = 6.26$, $SD = 1.94$). A paired t test revealed that there was a significant difference between the means per participant for the two-level interactivity ($t = 2.80$, $df = 39$, $p = 0.008$). Thus, hypothesis 1 is supported and the results are summarized in Table 1.

Table 1. Summary of results for the dependent variables

Independent variable	Effects	*N*	*M*	*SD*	*t* value	*p* (two tails)
Social presence	Active interactivity	40	7.21	2.03	2.80	0.008
	Passive interactivity		6.26	1.94		
Social attraction	Active interactivity	40	6.43	1.72	3.00	0.005
	Passive interactivity		5.09	1.96		
Intrinsic motivation	Active interactivity	40	6.35	1.29	2.83	0.007
	Passive interactivity		5.70	1.33		
Involvement	Active interactivity	40	7.07	1.69	4.92	0.000
	Passive interactivity		5.52	1.98		

Hypothesis 2

Hypothesis 2 predicted that children would be more socially attracted to a computer which provides active interactivity. The results showed that participants rated social attraction to active-interactivity computers ($M = 6.43$, $SD = 1.72$) greater than that to passive-interactivity ones ($M = 5.09$, $SD = 1.96$). A paired t test revealed that there was a significant difference between the means per participant for the two-level interactivity ($t = 3.0$, $df = 39$, $p = 0.005$). Hypothesis 2 is supported and the results are summarized in Table 1.

Hypothesis 3

Hypothesis 3 predicted that children who participated in learning with a computer in an active manner would report greater intrinsic motivation than those who participated with a computer in a passive manner. The means of participants' intrinsic motivation in the active and passive interactivity conditions were 6.38 ($SD = 1.26$) and 5.76 ($SD = 1.33$). A paired t test proved that there was a significant difference between the means per participant for the two treatments ($t = 2.83$, $df = 39$, $p = 0.007$). Hypothesis 3 is supported and the results are summarized in Table 1.

Hypothesis 4

Hypothesis 4 predicted that children would be more involved in an active-interactivity environment than in a passive-interactivity environment. As predicted, participants in the active-interactivity condition had a higher degree of involvement with the learning activity ($M = 6.82$, $SD = 1.60$) than they did under the conditions of passive-interactivity ($M = 5.45$, $SD = 1.90$). A paired t test proved that there was a significant difference between the means per participant for the two levels of interactivity ($t = 4.924$, $df = 39$, $p = 0.000$). The results are summarized in Table 1.

Discussion

The results of the experiment indicate that the participants perceived a higher degree of social presence and social attraction in the active-interactivity environment than they did in the passive-interactivity environment. According to previous studies, an active-interactivity program interface bearing features of message-exchange and role-exchange is closer to the nature of interpersonal communication. This study tried to utilize those features as cues being incorporated into the interface design to enhance the social attributes of computers. The results of the study indicate that children prefer the active-interactivity interface and treat a computer possessing such an interface more like a friend than they do with one having a passive-interactivity interface. As for whether children tend to anthropomorphize computers regardless of the availability of any social cues, the results reveal that children can interact socially with computers. These findings further indicate that the social cues afforded the computer interface have a significant and positive impact on the social interaction between the user and the computer, and that active interactivity in an e-learning environment provides children with a strong sense of social presence and also increases their involvement in learning and motivation to learn.

There has been the assumption that the concept of interactivity is a natural attribute of interpersonal communication (Morris & Christine, 1996; Rafaeli, 1988). According to Goffman (1967), people would spontaneously become involved with and respond to participants during interpersonal communication. Goffman proposed that reciprocal responses are important for maintaining smooth communication. This study aimed to develop active interactivity by enhancing a computer's social attributes. This objective was achieved by more closely emulating an effective human-to-human communication where timely feedback was given based on earlier inputs. The responses from the computer were preprogrammed to simulate different situations. During the debriefing after the completion of the experiment, many children reported that they liked the way the computers automatically guided them to the next question when they gave a correct answer. They thought the computer was "kinder" and more "helpful" when it offered suggestions for the next step when they gave incorrect answers, and that they were more willing to try the question again under those conditions. They also reported that the computer "thought" they performed well because of the complimentary or encouraging comments that appeared on the screen at the end of each session.

It seems clear that the participants enjoyed the interactive manner in which encouraging messages and guidance were offered. Automatic guidance offered by a program does not deprive the learners of control over the process. On the contrary, an individual who plays the roles of both sender and receiver experiences a greater sense of social presence during the interaction. Accordingly, this paper suggests that computer programs providing appropriate, timely automatic guidance and anticipated responses allow learners to perceive a sense of social presence from the computer, which in turn enhances learners' involvement and motivation. Finally, regarding the divided views on the learner-control and program-control modes in e-learning environments, this study intends to provide an additional perspective on the social dimensions of e-learning program design. This study may serve as a foundation on which future studies may look into the impact of various design elements more closely. One likely area of interest for future studies would be determining the limits beyond which program cues become a burden or annoyance rather than a form of positive feedback and guidance. Another area of interest would be the study of which design elements would constitute the most effective social cues (e.g. graphics, text, speech, or other elements) for children of different ages.

Conclusion

Computer-mediated learning has not only expanded learning channels currently available, but also provides an enriched learning experience via a one-on-one social interaction not commonly available in the classroom teaching environment where students always outnumber teachers. Learning is a social activity that requires a close connection between the participating parties to improve qualitatively. The social dimension of the activity is a critical aspect for the learners. We call for attention to the aspect of learners' social desires in e-learning design. Establishing an e-learning environment conducive to social interaction also helps to counter-balance the negative effects that a dehumanized computer environment may have on children. This study provides empirical support for the claim that children's social responses to a computer can be elicited and affected by the social cues offered by the computer. Instead of using an anthropomorphic interface or artificial intelligence to attain this goal, this paper seeks to apply some features of human-to-human interaction to human-to-computer interaction. These simple and subtle social cues embedded in a computer interface endow social attributes and intimacy to the human – computer interaction. Hence, children would be able to perceive a computer not merely as a tool but as a friend or a companion. This can facilitate the formation of a social bond between children and computers. This social and emotional connection between children and computers can serve to increase and sustain children's motivation and involvement in computerized learning activities. This paper explored the potential of interaction design in a computer-mediated learning environment from the perspective of social interaction. Future studies may focus on the impact of various cues so as to explore more ways of humanizing the computer interface by linking the features of interpersonal communication with the characteristics of computer technology.

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