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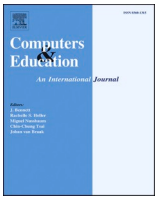

Teaching and social presences supporting basic needs satisfaction in online learning environments: How can presences and basic needs happily meet online?

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ABSTRACT

This study examined the hypothesized relationships between perceived teaching presence and social presence accounting for social-contextual factors in online learning environments and online students' basic psychological needs satisfaction. Participants enrolled in online courses at universities in the United States responded to an online survey and the survey data (N = 462) were analyzed using three hierarchical multiple regressions. Findings indicated that perceived teaching presence was a significant positive predictor of the basic psychological needs for autonomy, competence, and relatedness, with greater contribution than social presence to the perceived satisfaction of the need for competence. Social presence was also a significant positive predictor of the three basic psychological needs, with greater contributions than teaching presence to the perceived satisfaction of the needs for autonomy and relatedness. These results point to the significance of both teaching presence and social presence as two key online presences that can positively influence students' basic psychological needs satisfaction, which is known to be crucial to higher-quality self-determined motivation and engagement. Our findings have implications for CoI theory development and practical implications for online teaching and learning.

1. Introduction

Online education has been growing exponentially, especially in higher education settings (Hsu et al., 2019; Martin et al., 2019). With the continuing increase in the popularity of online education, serious concerns regarding the quality of online courses and programs have also emerged (Caskurlu et al., 2020; Kozan & Richardson, 2014a, 2014b). Online education is not without its challenges, the most obvious being lack of face-to-face and real-time interactions with peers and instructors (Broadbent, 2017; Caskurlu et al., 2020; Sherblom, 2010; Wang et al., 2019). Such unique characteristics of online education are likely to influence students' basic psychological needs (Chen & Jang, 2010; Hsu et al., 2019). The current study examined the hypothesized supportive effects of teaching and social presences on the satisfaction of online students' basic psychological needs for autonomy, competence, and relatedness. We postulate that these two Community of Inquiry (CoI) presences (i.e., teaching and social presences) integral in online learning environments are theoretically capable of providing need-supportive social-contextual conditions, as posited by Self-Determination Theory (SDT), and they can theoretically serve to satisfy students' basic psychological needs for autonomy, competence, and relatedness (Chen

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& Jang, 2010; Hsu et al., 2019). We argue that when online students are given clear goals and expectations, provided with clear instructions on how to participate in learning activities, presented a clear course structure with clear due dates, and provided with instructor facilitation and feedback (i.e., teaching presence) (Garrison, 2011), they can know exactly what they need to do, how to do it, and by when to do it. As a result, they can develop a sense of control over their online learning process since they have opportunities for self-direction, being able to make their own plans, self-endorse their own decisions along the way and take ownership of their own learning, which is directly linked with the basic psychological need for autonomy (Ryan & Deci, 2017; Vansteenkiste et al., 2020). Similarly, when the online course instructor helps the students understand course topics, keeps them engaged in learning tasks and activities, helps them clarify their thinking and learn the course content, and enables them to understand how much learning progress they have achieved in the course (i.e., teaching presence) (Garrison, 2011), online students can develop a sense of mastery, effectiveness, and achievement, which is directly linked with the basic psychological need for competence (Ryan & Deci, 2017; Vansteenkiste et al., 2020). We also argue that feeling belonging or connected to an online learning group, having a group identity, communicating and interacting openly and comfortably with other online participants, and collaborating with others for accomplishing common goals (i.e., social presence) (Garrison, 2011) are directly linked with the basic psychological need for relatedness since relatedness as an SDT construct refers to "feeling connected and involved with others and having a sense of belonging" (Ryan & Deci, 2017, p. 86). This study, to our best knowledge, is the first to examine online social-contextual conditions viewed through the lens of two specific CoI presences in relation to basic psychological needs satisfaction in online learning environments.

Teaching and social presences are two key support mechanisms that can account for social-contextual conditions in online learning environments in relation to students' basic psychological needs satisfaction. Teaching presence with its design and organization, facilitation, and direct instruction components was theoretically hypothesized in this study to contribute primarily to the perceived satisfaction of the basic needs for autonomy and competence (see Fig. 1). Although teaching presence is also assumed in the CoI to contribute to the development of a sense of community through instructor actions, there is only one teaching presence item in the CoI survey about instructor actions reinforcing a sense of community among online students, which could be theoretically associated with the basic need for relatedness. Therefore, we used teaching presence to primarily explain autonomy and competence rather than relatedness.

Social presence with its affective expression, open communication, and group cohesion components was hypothesized to contribute primarily to the perceived satisfaction of relatedness (see Fig. 2). There is only one social presence item that is about one's sense of being acknowledged by others, which could be theoretically associated with the basic need for autonomy and there is no social presence indicator that could be theoretically associated with the basic psychological need for competence. Therefore, we used social presence to primarily explain the basic need for relatedness. Social presence has been empirically studied in online learning environments and has been positively associated with important student outcomes including online student satisfaction and online perceived and actual learning (Richardson et al., 2017). Relatedness, although less explicitly studied when compared to autonomy and competence in the relevant literature, has also been empirically examined in relation to different antecedents and outcomes across learning environments (Filak & Sheldon, 2008; Trenshaw et al., 2016). However, no study has attempted to provide empirical evidence for the theoretical relationships between social presence and relatedness, which was one of the goals of this study. This study is the first to attempt to demonstrate such an empirical relationship between the CoI's social presence and the SDT's relatedness in online learning environments.

Based on all these theoretical relationships and prior research showing the positive impact of contextual support on basic needs satisfaction in online learning environments (Chen & Jang, 2010; Hsu et al., 2019; Wang et al., 2019), we aimed to investigate the extent to which teaching presence would positively predict perceived autonomy and competence and the extent to which social

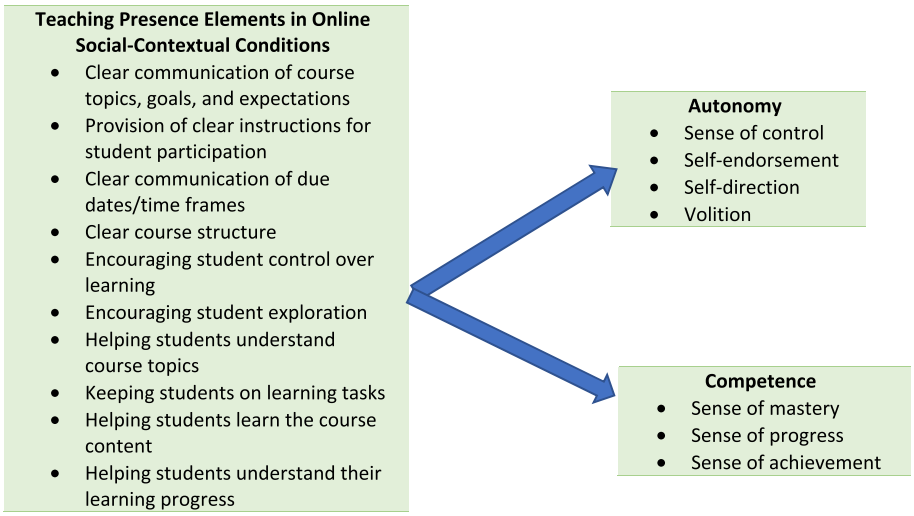

Fig. 1. Proposed linkages between teaching presence and the basic needs for autonomy and competence.

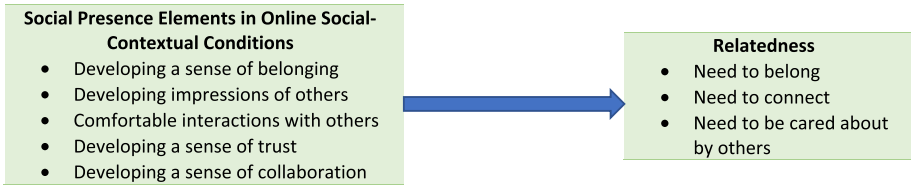

Fig. 2. Proposed linkage between social presence and the basic need for relatedness.

presence would positively predict perceived relatedness in online learning environments.

SDT research on basic psychological needs satisfaction in academic settings indicates that autonomy is optimally satisfied in learning environments with an autonomy-supportive structure or organization capable of promoting a sense of learner control and agency among students (Reeve et al., 2004; Ryan & Deci, 2017). We tested this with a hierarchical multiple regression (HMR) utilizing teaching presence as the CoI presence primarily responsible for communicating clear course goals and objectives, providing a clear course design and structure, and encouraging students' sense of control and exploration (Anderson et al., 2001; Caskurlu et al., 2020) in order to predict the perceived satisfaction of the basic need for autonomy.

SDT research in learning environments also shows that competence as another fundamental psychological need is optimally satisfied when students perceive that they are capable of learning and are making progress in their learning process (Ryan & Deci, 2017) and we tested this with a HMR utilizing teaching presence as the CoI presence primarily responsible for helping students understand course topics, learn the course content, and experience a sense of progress and achievement (Anderson et al., 2001; Caskurlu et al., 2020) in order to predict online students' perceived competence.

SDT research also indicates that relatedness is optimally satisfied in learning environments in which students feel connected with and cared by significant others including their teachers and peers (Ryan & Deci, 2017). We tested this with a HMR utilizing social presence as the CoI presence primarily responsible for enabling students to feel comfortable communicating and interacting with other course participants and to feel a sense of belonging and collaboration in the online learning environment (Caskurlu, 2018; Garrison, 2009) in order to predict online students' perceived satisfaction of the basic need for relatedness.

In what follows, we briefly present the previous research on Community of Inquiry (CoI) around teaching presence and social presence as it theoretically relates to Self-Determination Theory (SDT) and its basic psychological needs in online learning environments.

2. Theoretical frameworks

We used the Community of Inquiry (CoI) and its teaching and social presences and Self-Determination Theory (SDT) and its basic psychological needs satisfaction as the theoretical frameworks that informed this study.

2.1. Self-Determination Theory (SDT) and basic psychological needs satisfaction (BPNS)

Self-Determination Theory (SDT), proposed by Deci and Ryan (1985) and studied extensively across various life domains and contexts, is an empirically well-established motivation theory postulating that humans have potential energy, interest, and propensity to explore and learn through their interactions with their worlds (Ryan & Deci, 2000a, 2000b, 2017). According to the SDT, individuals engaged in a particular activity or action just for the enjoyment or pleasure that the activity itself brings are intrinsically motivated (Ryan & Deci, 2000b). Individuals who engage in a particular course of action not because of their personal interest, enjoyment or curiosity but because of external factors or reasons separate from the activity itself (e.g., grade, money, prestige) are extrinsically motivated (Ryan & Deci, 2000b). More importantly for the current study, SDT posits three universal basic psychological needs, namely *autonomy*, *competence*, and *relatedness*, all of which need to be optimally satisfied by need-supportive social-contextual conditions in order to promote and support not only intrinsic motivation but also autonomous or self-determined forms of extrinsic motivation for healthy development and psychological well-being (Deci & Ryan, 2008; Ryan & Deci, 2017). SDT was chosen as the theoretical framework in this study because it explicitly explains the role of social-contextual conditions in satisfying the basic psychological needs in learning environments including online contexts (Chen & Jang, 2010; Hsu et al., 2019; Wang et al., 2019).

2.1.1. Basic psychological needs

Autonomy is the basic psychological need for having choice, sense of volition, and endorsement of one's own actions (Baard et al., 2004). When individuals have a sense of volition and control over their lives, their autonomy need is satisfied (Ryan & Deci, 2017). Several factors including course structure, teacher's motivating style, and classroom dynamics influence the perceived satisfaction of the need for autonomy. *Competence* is associated with one's sense of successfully performing optimally challenging and personally meaningful tasks and feeling efficacious (Ryan & Deci, 2000a; 2000b). When individuals experience the sense of being capable of bringing about desired changes in their environments, their need for competence is satisfied (Ryan & Deci, 2000a; 2000b). A learning environment needs to enable students to experience mastery and success so that they can perceive themselves as being efficacious and capable (Deci & Ryan, 2000).

Finally, *relatedness* is the third basic psychological need associated with one's feeling connected to others in a group (Ryan & Deci,

2000a; 2000b). Human beings have a fundamental need to belong to a certain community such as a college classroom, a soccer club, a religious community, or a fraternity (Baumeister & Leary, 1995). Relatedness is optimally satisfied by need-supportive learning environments when students feel that they are connected to a larger group (i.e., peer learners, teachers) (Deci & Ryan, 2000). In this study, the two CoI presences primarily account for those social-contextual supports provided for online students by course instructors (i.e., teaching presence) and by peers (i.e., social presence) in the same online learning environment in which such social-contextual support is vitally important to online student motivation and success (Wang et al., 2019).

2.1.2. Empirical research on SDT and basic needs satisfaction

A substantial body of empirical research across multiple settings and domains indicates self-determined and autonomous motivation and basic needs satisfaction can yield a wide range of desirable outcomes ranging from better engagement to increased learning (Ryan & Deci, 2017). Given that basic needs satisfaction can help students to have high-quality motivation and become more actively engaged in learning activities (Reeve, 2012), satisfaction of the three basic needs within learning environments is of paramount importance. Research indicates that positive social-contextual conditions, such as teachers' autonomy-supportive teaching styles and classroom dynamics, support basic needs satisfaction, thus producing desirable learning outcomes, whereas those controlling or coercing conditions do not, thus yielding certain undesirable consequences including disengagement and poor learning outcomes (Reeve, 2012). Social-contextual factors in learning environments have been shown across studies to significantly promote or forestall students' basic needs satisfaction. For example, when rewards were conditioned on students' participation, engagement, and performance in learning tasks and activities, those rewards diminished students' autonomous motivation since rewards were perceived by students as controlling their task or activity behavior and not supporting their need for autonomy (Deci et al., 1999). On the other hand, verbal rewards or positive feedback, especially when they were unexpected, positively influenced students' autonomous task behavior, satisfying their basic psychological need for competence (Deci et al., 1999). Perceived autonomy support as another autonomy-supportive social-contextual factor in learning environments was also shown to significantly predict college students' academic performance and positively influenced students' perceived autonomy and perceived competence as well (Black & Deci, 2000). Each of the basic needs for autonomy, competence, and relatedness was also empirically shown to have a strong association with autonomy support from parents and autonomy orientation, and especially the need for competence was shown to have a strong association with prosocial engagement of college students (Gagné, 2003). Significant positive effects of autonomy-supportive learning environments on basic needs satisfaction, motivation, and other positive student outcomes have consistently been shown across SDT studies in traditional and online learning environments (e.g., Black & Deci, 2000; Chen & Jang, 2010; Deci et al., 1999; Hardre & Reeve, 2003; Hsu et al., 2019; Jang et al., 2010; Vallerand et al., 1997; Wang et al., 2019).

2.2. The community of inquiry (CoI) framework

The CoI as a theoretical framework and an online learning model was originally developed by Garrison et al. (2000) as a result of their empirical examinations of text-based and asynchronous computer conferencing environments in higher education settings (Garrison, Anderson, & Archer, 2010). According to the CoI framework, students learn with and from each other in an online learning community of inquiry through engaging in and actively contributing to negotiations of ideas, joint reflections, and meaning-making endeavors in online learning environments (Garrison, 2011; Garrison & Akyol, 2013). Using Dewey's (1959) ideas of practical inquiry and described as a social-constructivist model of online learning, the CoI postulates three core online presences as the most essential constituents of high-quality online learning experiences in higher education environments, which are *teaching presence*, *social presence*, and *cognitive presence* (Caskurlu et al., 2020; Garrison, 2013; Garrison et al., 2000, 2001; Kozan & Richardson, 2014a; Swan et al., 2009; Swan & Ice, 2010). Theoretically, these three closely related and interdependent presences must be established and maintained by online participants for high-quality educational experiences in online learning environments (Garrison, Anderson, & Archer, 2000; Kozan & Richardson, 2014a; Swan & Ice, 2010). The CoI framework has been one of the most heavily cited theoretical frameworks of learning and instruction in online education research (Befus, 2016; Caskurlu, 2018; Richardson et al., 2017; Stenbom, 2018). Of the three presences, teaching presence and social presence primarily constitute social-contextual support factors in online learning environments, whereas cognitive presence is more about online learners' individual-level achievements of critical thinking, higher-level learning, and problem solving in online learning environments. Therefore, for the specific lines of our inquiry in this study, teaching presence and social presence were further explored in the next sections.

2.2.1. Teaching presence

Teaching presence refers to "the design, facilitation, and direction of cognitive and social processes for the purpose of realizing personally meaningful and educationally worthwhile learning outcomes" (Anderson et al., 2001, p. 5). Teaching presence has been commonly conceptualized and operationalized by the CoI framework to have three major dimensions, which are *design and organization*, *facilitating discourse*, and *direct instruction*. This three-factor model of teaching presence has also been empirically supported (e.g., Arbaugh & Hwang, 2006; Caskurlu, 2018). Empirical evidence also indicates that each of these three dimensions of teaching presence can positively influence important student outcomes in online learning environments, such as perceived learning and learner satisfaction in online courses (Caskurlu et al., 2020).

2.2.1.1. Dimensions of teaching presence. As part of the *design and organization* dimension of teaching presence, an online course instructor is responsible for designing the entire learning process and accordingly creating the course structure and content (e.g., tasks

and activities, interactions, assessment) (Anderson et al., 2001). As part of *facilitation*, an online course instructor encourages their students to engage in meaningful, purposeful, critical, reflective, and productive dialogues with others so that they can come up with new understandings of the content (Anderson et al., 2001; Swan et al., 2009). Through facilitating discourse, teaching presence also helps to ensure that online students stay motivated, interested, and actively engaged in their online learning experiences throughout the entire learning process (Anderson et al., 2001). Finally, the *direct instruction* component of teaching presence requires online instructors to provide necessary direct instruction and feedback for their students when they identify areas to be clarified and misconceptions to be eliminated (Anderson et al., 2001). Online instructors' guiding behaviors addressing content-related issues as well as technological issues fall under this component of teaching presence (Anderson et al., 2001). Fulfilling the requirements of these different roles and establishing and maintaining teaching presence in online learning environments is considered crucial to the maintenance of an effective online community of inquiry (Garrison & Arbaugh, 2007; Ke, 2010; Swan et al., 2009).

2.2.1.2. Research on teaching presence and student outcomes. Researchers have consistently found strong positive relationships between teaching presence and different student outcomes considered important in online learning environments (Caskurlu et al., 2020). Perceived learning and student satisfaction are two such student outcomes commonly measured and reported in online learning research (Arbaugh, 2010; Caskurlu et al., 2020; Richardson et al., 2017). For example, Shea, Fredericksen, et al. (2003) reported moderate to strong correlations between the three dimensions of teaching presence and online students' perceived or reported learning. Likewise, Shea et al. (2005) found a strong positive correlation between teaching presence and perceived learning. Similar moderate to strong positive correlations between teaching presence and perceived learning were found and reported by other CoI studies in the literature (e.g., Akyol & Garrison, 2008; Arbaugh, 2008, 2010; Shea, Pickett, & Pelz, 2003). Arbaugh (2010) also found that teaching presence was a significant positive predictor of perceived learning in online learning environments. In addition to perceived or reported learning as an online student outcome, Garrison and Cleveland-Innes (2005) found that teaching presence including course design and structure contributed to students' deep approaches to learning online and Kupczynski et al. (2010) found that different dimensions of teaching presence could contribute to students' perceptions of success in online courses.

While this literature indicates that teaching presence influences students' perceptions of learning and success in online courses, it is also positively associated with students' satisfaction (e.g., satisfaction with delivery medium, course satisfaction, satisfaction with instructor) in these online learning environments (Akyol & Garrison, 2008; Arbaugh, 2008, 2010; Caskurlu et al., 2020; Joo et al., 2011) and their sense of community (Shea et al., 2005). This strong empirical foundation regarding the impact of teaching presence on positive student outcomes justifies the current study's attempt to incorporate teaching presence as a key variable into its empirical investigation of students' basic needs satisfaction in online learning environments where social-contextual support is of critical importance to students (Chen & Jang, 2010; Wang et al., 2019).

2.2.2. Social presence

We now turn to social presence within the CoI framework (Garrison, 2011), which includes the sense of belonging to an online learning community and interacting comfortably with other online participants. Despite several different definitions in the CoI literature, social presence usually refers to "the ability of participants to identify with the community (e.g., course of study), communicate purposefully in a trusting environment, and develop inter-personal relationships by way of projecting their individual personalities" (Garrison, 2009, p. 352). Through social presence, online participants can engage in intellectual and social interactions with others for the purpose of knowledge construction and meaning making (Kozan & Richardson, 2014a; Richardson et al., 2017).

2.2.2.1. Dimensions of social presence. Social presence is identified by three sub-dimensions: *emotional or affective expression*, *open communication*, and *group cohesion* (Caskurlu, 2018; Garrison et al., 2000). Affective expression refers to online participants' interpersonal relationships with others by disclosing personal information and expressing their emotional reactions (Garrison & Akyol, 2013). Open communication refers to online participants feeling comfortable responding to each other's comments and questions in a respectful and trusting environment (Garrison, 2011; Garrison & Akyol, 2013). The final dimension of social presence, group cohesion, is more likely to emerge when interpersonal relationships and respectful communications are consistently established in an online community of inquiry (Garrison & Akyol, 2013). Group cohesion is accomplished by a sense of belonging to the online community, which in turn positively influences critical inquiry, collaborative reflection and learning, and overall learning experiences within the online community (Garrison, 2011; Garrison & Akyol, 2013).

2.2.2.2. Research on social presence and student outcomes. Social presence, just like teaching presence, has also been empirically shown to be positively associated with important online student outcomes (Richardson et al., 2017). For example, a recent meta-analysis conducted by Richardson et al. (2017) has found social presence to have a moderate positive association with student satisfaction and perceived learning in online learning environments. Several studies have also examined social presence in relation to the other CoI presences and found social presence mediating the predictive relationship between teaching presence and cognitive presence (e.g., Garrison, Cleveland-Innes, & Fung, 2010; Shea & Bidjerano, 2009). Such empirical linkages have been consistently drawn in the relevant research literature between social presence and important online student outcomes, including student satisfaction, perceived learning, and actual learning outcomes (e.g., academic performance, course grades) in online learning environments (e.g., Akyol & Garrison, 2008; Arbaugh, 2008, 2014; Cobb, 2011; Gunawardena & Zittle, 1997; Hostetter, 2013; Joksimović et al., 2015; Richardson & Swan, 2003; Swan & Shih, 2005). In sum, all these empirical studies suggest that social presence and its strong relationships with important student outcomes in online learning environments are also worth seriously considering not only in the design and

implementation of online courses but also in empirical examinations of online learning environments (Richardson et al., 2017).

2.3. Tying it all: linkages between online presences and basic psychological needs

According to SDT, social-contextual conditions in learning environments (e.g., traditional classrooms, online courses) or learning climates can either support and satisfy students' basic psychological needs for autonomy, competence, and relatedness through being highly informative and autonomy supportive or they can neglect and thwart these needs through being highly controlling (Reeve, 2012; Ryan & Deci, 2017). From the SDT perspective, teachers or instructors can support their students' three basic psychological needs by adopting an autonomy-supportive teaching style in which they provide their students with opportunities to self-control, self-regulate, and self-endorse their decisions and actions during their own learning process (Ryan & Deci, 2017). On the other hand, teachers or instructors adopting a controlling teaching style coerce their students into thinking, feeling and behaving in certain ways, ignoring their students' perspectives (Ryan & Deci, 2017). Translated into the context of online learning environments, online course instructors can support their students' need for autonomy with their teaching presence actions through which they provide their students with a sense of control and self-direction of their own learning process. Online course instructors can also support their students' need for competence with their teaching presence actions through which they provide their students with opportunities to feel effective and successful in what they are supposed to master in their online courses. Finally, online students' perceptions of social presence through their comfortable and trusting interactions and collaborations with their peers can support their need for relatedness. In this study, we measured perceived teaching presence and used it as a proxy of perceived autonomy and competence support provided by the online course instructor. We also measured perceived social presence and used it as a proxy of perceived relatedness support provided by other students in the online learning environment.

Given the potential positive effects of social-contextual support on perceived basic needs satisfaction and the associated positive outcomes in both traditional face-to-face and online learning environments, further research is warranted for examining the potentially significant link between online social-contextual conditions as accounted for by teaching presence and social presence elements and basic needs satisfaction in online learning environments, which was the major goal of the current study. Based on our theoretical frameworks and extant research, the following research questions and hypotheses guided our study:

RQ1. To what extent does perceived teaching presence predict the perceived satisfaction of online students' basic psychological need for autonomy, when controlling for the impact of perceived social presence?

H1. When controlling for the impact of social presence, perceived teaching presence will positively predict the perceived satisfaction of online students' basic psychological need for autonomy.

RQ2. To what extent does perceived teaching presence predict the perceived satisfaction of online students' basic psychological need for competence, when controlling for the impact of perceived social presence?

H2. When controlling for the impact of social presence, perceived teaching presence will positively predict the perceived satisfaction of online students' basic psychological need for competence.

RQ3. To what extent does perceived social presence predict the perceived satisfaction of online students' basic psychological need for relatedness, when controlling for the impact of perceived teaching presence?

H3. When controlling for the impact of teaching presence, perceived social presence will positively predict the perceived satisfaction of online students' basic psychological need for relatedness.

3. Method

3.1. Research design

We utilized a cross-sectional survey research design (Creswell, 2014) to examine the proposed linkages between teaching presence and autonomy, teaching presence and competence, and social presence and relatedness. We conducted a total of three hierarchical multiple regression (HMR) analyses utilizing teaching presence as the focal predictor of autonomy and competence used as the dependent variables and social presence as the focal predictor of relatedness used as the dependent variable in their respective models to address our research questions and test our hypotheses.

3.2. Participants

Data were collected in Spring and Fall 2020 semesters via an online survey from undergraduate and graduate-level students taking at least one fully online course at the time of data collection. Snowball convenience sampling was used to recruit potential participants for the current study (Watson & Rockinson-Szapkiw, 2021). Snowball sampling is a sampling strategy used by researchers to reach out to potential participants through key individuals or organizations known to have access to large numbers of information-rich potential participants as part of their personal, social or professional networks (Creswell, 2014). Two rounds of emails were sent to online course instructors and program directors to recruit more participants. Our online survey was accessed via Qualtrics by a total of 886 people, but 157 cases did not complete any surveys at all and were removed from the data set, leading to 729 cases with missing data points across the indicator variables of our interest. When we listwise-deleted 254 cases with missing data points, we obtained a complete

data set of 475 participants. We did not replace any missing values or use any data imputation since the Little's MCAR test was significant (p = .032), indicating that data imputation (e.g., EM) was not appropriate (Tabachnick & Fidell, 2013). After the removal of thirteen outliers, we reached a final sample of 462 cases used for the major analyses of the five study variables (see 3.5. Data Screening and Preliminary Analyses section for the description of this process). Based on the available demographic data, the participants' ages ranged from 17 to 67 years, with a mean of 25.57 (*SD* = 9.66), 74.3% of the participants (n = 333) identified themselves as female and 23.4% as male (n = 105), with six choosing neither (e.g., queer, non-binary) and four preferred not to report their gender identification. A large majority of the participants (n = 305, 68.2%) were White/Caucasian, 3.4% African-American/Black (n = 15), 3.4% American Indian or Alaskan Native (n = 15), 9.2% Asian (n = 41), 6.3% Hispanic/Latino (n = 28), 5.8% Multiracial and/or multiethnic (n = 26), 1.6% other nationalities and ethnicities (e.g., Middle Eastern) (n = 7) while 10 participants preferred not to report their ethnicity. Most of the online learners were at undergraduate level (n = 309, 69%) and 30.8% (n = 138) were at graduate level. Academic disciplines ranged from math to sociology to education to business. A large majority of the participants (n = 381, 89.8%) had taken at least two online courses.

3.3. Measures

3.3.1. CoI survey instrument

The previously established 34-item CoI survey instrument developed and validated by Arbaugh et al. (2008) was used to measure online students' perceptions of teaching presence and social presence. The survey version (v14) used in the current study was retrieved from the CoI website https://coi.athabascau.ca/coi-model/coi-survey/(see Appendix A for the instrument). The reliability and validity of the CoI instrument has been well-established and reported by previous studies (e.g., Arbaugh et al., 2008; Caskurlu, 2018; Díaz, Swan, Ice, & Kupczynski, 2010). A 5-point Likert-type scale ranging from 1 = Strongly disagree to 5 = Strongly agree was used. High scores of each online presence indicated high levels of that particular presence. Composite scores for teaching presence and social presence perceptions were created. Social presence subscale with nine items (α = 0.883) and teaching presence subscale with thirteen items (α = 0.924) were found to have strong levels of internal consistency (see Appendix B for individual item reliabilities).

3.3.2. Basic psychological needs satisfaction (BPNS)

To measure online students' perceptions of autonomy, competence, and relatedness, we used a slightly modified version of the 21-item Basic Psychological Need Satisfaction (BPNS) in General scale (Deci & Ryan, 2000; Deci et al., 2001; Gagné, 2003; Ilardi et al., 1993; Kasser et al., 1992; Thøgersen-Ntoumani et al., 2011) made available by the Center for Self-Determination Theory (CSDT) website (See Appendix C for the instrument). The reliability and validity of the measure was reported by previous studies conducted in both traditional and online learning environments (e.g., Baard et al., 2004; Gagné, 2003; Wang et al., 2019). We slightly modified the scale for the purpose of the current study to fit the online learning context. For instance, an original autonomy item "I feel like I am free to decide for myself how to live my life" was modified as "I feel like I am free to decide for myself how to study in this online course." All negatively worded items were reverse coded in Qualtrics. A 5-point scale ranging from 1 = Not at all true to 3 = Somewhat true to 5 = Very true was used. Composite scores were computed for each basic psychological need. Higher scores on each need indicated higher levels of perceived satisfaction for each basic psychological need. Autonomy subscale with seven items (*α=.693)*, competence subscale with six items (*α=.834)*, and relatedness subscale with eight items (*α=.826)* were found to have acceptable internal consistency reliabilities (see Appendix D for individual item reliabilities). The internal consistency reliability of the overall 21-item scale was acceptable too (*α=.890)*. [1]

3.4. Procedure

After we obtained approval from the Institutional Review Board (IRB), we reached out to online program coordinators and course instructors teaching online undergraduate and graduate-level courses in the United States and requested them to share our survey with their students. When participants clicked on the survey link, they were taken to the Qualtrics survey page and asked to provide their online consent. After providing consent, they responded to the CoI and basic needs scales. They also responded to demographic questions.

3.5. Data Screening and Preliminary Analyses

We computed the composite score for each latent variable (i.e., teaching presence, social presence, autonomy, competence, relatedness) by taking the mean of the observed variables within the dataset of 475 cases. Next, we screened these composite variables for any univariate outliers using the conventional z-score > 3.29 as well as visually screening the data (Tabachnick & Fidell, 2013). We also screened the data for any multivariate outliers using Mahalanobis Distance (MD) (Tabachnick & Fidell, 2013) and as a result we decided to remove thirteen outlier cases, yielding a final dataset of 462 cases used for the analysis of the five composite variables.

For the assumptions of the hierarchical multiple regressions (HMRs) we used for data analysis in the current study, we checked the

[1] Please note that while the CFA loadings and individual item reliabilities for item#4 for Autonomy subscale and item#7 for Relatedness subscale were relatively weak, their removal did not change any outcomes. Therefore, we chose to include them to maintain the consistency of the original BPNS scale. However, we caution that future researchers should reexamine these scales on their own participants.

data for normality assumption by visually inspecting the histograms and Normal P–P plots of standardized residuals, and we found reasonable evidence of normality. Meeting the assumption of normality also helped to meet the assumption of independence of residuals because "if normality is present, the residuals are normally and independently distributed" (Tabachnick & Fidell, 2013, p. 81). The residuals in the scatterplots of standardized residuals versus standardized predicted values seemed to be reasonably random and independent (Lomax & Hahs-Vaughn, 2012). Homoscedasticity and linearity assumptions were also visually inspected and judged to be reasonably met without any strong evidence of a systematic pattern or a clear shape like curvilinear or quadratic relationships (Pallant, 2020; Pituch & Stevens, 2016; Tabachnick & Fidell, 2013). In addition, we visually inspected the partial regression plots and also found reasonable evidence of linearity between the dependent and independent variables (Tabachnick & Fidell, 2013). As for multicollinearity assumption, there was no bivariate correlation at and above 0.90 between the predictor variables (Tabachnick & Fidell, 2013) and also the tolerance values (0.55) were always above 0.10 and the VIF values (1.817) were well below 10, all indicating no multicollinearity issue either (Tabachnick & Fidell, 2013). We concluded that all the assumptions of the HMRs were reasonably met by our data (Lomax & Hahs-Vaughn, 2012; Pallant, 2020; Pituch & Stevens, 2016). The alpha level .05 was adopted for statistical significance with 95% confidence intervals.

4. Results

4.1. Relations between teaching presence, social presence, and three basic psychological needs

We conducted all statistical analyses of the data using IBM SPSS version 27. Table 1 provides descriptive statistics and bivariate correlations among the five study variables and all of the correlations were moderate to strong and significantly positive. The means of the study variables each indicate the extent to which the participants agreed with the survey item statements given for each single variable. Overall, the perceptions of the online students regarding teaching presence, social presence, autonomy, and competence were moderately high, while their perceived relatedness was relatively lower (see Table 1).

4.2. Relationship between teaching presence and autonomy

To address our first research question, we conducted a two-stage hierarchical multiple regression (HMR) using autonomy as the dependent variable in the model in order to assess the ability of teaching presence to predict perceived autonomy after controlling for perceived social presence. In line with the nature of our research question, social presence was entered into the first block to statistically control for its effect and teaching presence was entered into the second block as the theoretically more relevant predictor of autonomy. The first model (Model 1) in which social presence was the only predictor variable was statistically significant, $F(1,460) = 309.965$, $p < .001$, and this model explained 40.3 percent of the variance in autonomy. In this first model, social presence was found to be a statistically significant positive predictor of the perceived satisfaction of online students' basic psychological need for autonomy.

The entry of teaching presence into the second model (Model 2) to predict the perceived satisfaction of the need for autonomy explained an additional approximately 7% of the variance in autonomy after controlling for social presence as the other presence accounting for social-contextual conditions and factors in online learning environments. This final model as a whole explained 47 percent of the variance in autonomy, $F(2,459) = 203.720$, $p < .001$. When controlling for the effect of social presence, teaching presence was found to be a significant positive predictor of the perceived satisfaction of online students' basic psychological need for autonomy. Social presence was still a significant positive predictor of the perceived satisfaction of autonomy. Based on the semi-partial correlation coefficients of social presence and teaching presence ($sr = .296$, $sr = .260$, $p < .001$) respectively, social presence uniquely explained approximately 8.8% of the variance in autonomy, while teaching presence uniquely explained approximately 6.8% of the variance in autonomy. These relatively low unique contributions were expected due to the high shared variance resulting from reasonably strong correlations between social presence and teaching presence ($r = .67$) as two core online presences accounting for social-contextual factors in online learning environments (i.e., online course-related factors including instructor actions and online interactions with peers). However, the greater unique contribution of social presence than teaching presence to the prediction of the

Table 1
Descriptive statistics and correlations for five study variables (N = 462).

Variable	1	2	3	4	5
1. Autonomy	–				
2. Competence	.679**	–			
3. Relatedness	.529**	.486**	–		
4. Teaching Presence	.618**	.704**	.542**	–	
5. Social Presence	.634**	.625**	.669**	.670**	–
Mean	3.37	3.47	3.02	3.76	3.33
SD	.724	.940	.751	.753	.851
Skewness	-.288	-.447	.234	-.505	-.274
Kurtosis	-.394	-.428	-.342	-.086	-.456

**Correlation is significant at the 0.01 level (2-tailed).

basic need for autonomy in online learning environments was surprising since the basic need for autonomy was theoretically expected to be more relevant to online teaching presence, especially with its design and organization and direct instruction and feedback components giving students a sense of control over their online learning process from the beginning to the end of an online course. Table 2 presents the HMR analysis results regarding the relationship between teaching presence, social presence, and autonomy.

4.3. Relationship between teaching presence and competence

To address our second research question, we conducted a two-stage hierarchical multiple regression using competence as the dependent variable in the model in order to assess the ability of teaching presence to predict perceived competence when controlling for social presence. In line with our second research question, social presence was again entered into the first block to statistically control for its effect and teaching presence was entered into the second block as the theoretically more relevant predictor of online students' basic psychological need for competence, especially with its components of facilitation of online student discourse and direct instruction including feedback. The first model (Model 1) in which social presence was the only predictor variable was statistically significant, $F(1, 460) = 295.312$, $p < .001$, and this model explained 39.1 percent of the variance in competence. In this first model, social presence was a statistically significant positive predictor of the perceived satisfaction of online competence.

The entry of teaching presence into the second model (Model 2) to predict the perceived satisfaction of the need for competence explained an additional approximately 15% of the variance in competence over and above social presence as the other presence accounting for social-contextual conditions and factors in online learning environments. This final model as a whole explained 53.9 percent of the variance in the basic need for competence, $F(2, 459) = 267.993$, $p < .001$. When controlling for the effect of the social presence dimension of social-contextual support factors in online learning environments, teaching presence was found to be a significant positive predictor of the perceived satisfaction of online students' basic psychological need for competence. Social presence was still a significant positive predictor of the perceived satisfaction of competence. Based on the semi-partial correlation coefficients of social presence and teaching presence ($sr = 0.206$, $sr = 0.384$, $p < .001$) respectively, social presence uniquely explained approximately 4.2% of the variance in competence, while teaching presence uniquely explained approximately 14.7% of the variance in competence. The greater unique contribution of teaching presence than social presence to the prediction of the perceived satisfaction of the basic psychological need for competence was in line with our theoretical assumption that teaching presence, especially with its facilitation of student discourse and direct instruction and feedback components, would give online students a sense of achieving course goals and objectives and enable them to see and evaluate their strengths and weaknesses on the basis of timely and substantive online instructor feedback. Table 3 presents the HMR analysis findings regarding the relationship between teaching presence, social presence, and competence.

4.4. Relationship between social presence and relatedness

To address our final research question, we conducted a two-stage hierarchical multiple regression using relatedness as the dependent variable in order to assess the ability of social presence to predict perceived relatedness when controlling for perceived teaching presence. For the purpose of the last research question, teaching presence was entered into the first block to statistically control for its effect and social presence was entered into the second block since in this research question social presence (i.e., affective expression, open communication with others, sense of group cohesion) was theoretically assumed to be a more relevant predictor of online students' basic psychological need for relatedness. The first model (Model 1) in which teaching presence was the only predictor of relatedness was statistically significant, $F(1,460)=191.309$, $p < .001$, and this model explained 29.4 percent of the variance in relatedness. In this first model, teaching presence was found to be a statistically significant positive predictor of the perceived satisfaction of relatedness, which was theoretically meaningful since teaching presence, especially with its facilitation component, can also theoretically contribute to online students' sense of community and collaboration with others, thereby satisfying their need for relatedness.

The entry of social presence into the second model (Model 2) to predict the perceived satisfaction of the need for relatedness explained an additional 17% of the variance in relatedness over and above the effect of teaching presence as the other relevant online presence. This final model as a whole explained 46.3 percent of the variance in the basic need for relatedness, $F(2,459)=198.083$, $p <$

Table 2
Hierarchical Regression Results for Autonomy. *Note.* CI = confidence interval; LL = lower limit; UL = upper limit; social pre = social presence; teach pre = teaching presence; *p < .001.

Variable	*B*	95% CI for *B*		*SE B*	β	R^2	ΔR^2
		LL	UL				
Model 1						.403	.403*
Constant	1.577*	1.370	1.784	.105			
Social pre	.539*	.479	.599	.031	.634*		
Model 2						.470	.068*
Constant	.973*	.724	1.222	.127			
Social pre	.339*	.263	.416	.039	.399*		
Teach pre	.337*	.251	.424	.044	.351*		

Table 3
Hierarchical regression results for competence.

Variable	*B*	95% CI for *B*		*SE B*	β	R^2	ΔR^2
		LL	UL				
Model 1						.391	.391*
Constant	1.175*	.904	1.447	.138			
Social pre	.690*	.612	.769	.040	.625*		
Model 2						.539	.148*
Constant	.017	-.286	.319	.154			
Social pre	.307*	.214	.400	.047	.278*		
Teach pre	.647*	.542	.752	.053	.518*		

Note. CI = confidence interval; LL = lower limit; UL = upper limit; social pre = social presence; teach pre = teaching presence; *p < .001.

.001. When controlling for the effect of the teaching presence dimension of social-contextual conditions in online learning environments, social presence was found to be a significant positive predictor of the perceived satisfaction of online students' basic psychological need for relatedness. Teaching presence was still a significant positive predictor of the perceived satisfaction of relatedness. Based on the squared semi-partial correlation coefficients of teaching presence and social presence ($sr = .126$, $sr = .412$, $p < .001$) respectively, teaching presence uniquely only explained approximately 1.6% of the variance in relatedness, while social presence, the focal predictor of this model, uniquely explained approximately 17% of the variance in relatedness. The greater unique contribution of social presence than teaching presence to the prediction of the perceived satisfaction of the basic psychological need for relatedness was in line with the theoretical assumption that social presence, with all its subdimensions of emotional expression, open communication with other participants, and sense of group cohesion as an online learning community, would better give online students a sense of belonging, a sense of connectedness with others, and a sense of collaboration in their online courses, thereby satisfying their basic psychological need for relatedness. Table 4 presents the HMR analysis findings regarding the relationship between social presence, teaching presence, and relatedness.

5. Discussion

5.1. Major findings and their contributions to the literature

This study has empirically demonstrated the significant roles of both teaching presence and social presence in predicting satisfaction of the basic psychological needs for autonomy, competence, and relatedness in online learning environments. We found that both perceived teaching presence and perceived social presence positively influenced the perceived satisfaction of autonomy, competence, and relatedness. We deem our findings valuable because basic needs satisfaction has been consistently shown to positively influence student motivation, engagement, academic achievement, and other positive outcomes (Chen & Jang, 2010; Hsu et al., 2019; Niemiec & Ryan, 2009; Ryan & Deci, 2017; Wang et al., 2019).

As a significant contribution to the relevant literature, our study also provides a novel interaction of the CoI model with SDT by linking the two core CoI presences to SDT's three basic needs. This empirical linkage should provoke online education researchers to think about the importance and value of CoI presences not only from the perspective of cognitive learning outcomes but also from online student motivation through basic needs satisfaction. Our study highlights the possibility of satisfying online students' basic psychological needs by designing and maintaining online learning environments capable of providing contextual-social support mechanisms through teaching and social presences of the CoI model given that "online learners need a variety of support from instructors as well as their peers" (Wang et al., 2019, p.114). This should prompt online course instructors and designers to seriously consider creating such needs-supportive and CoI-based online learning environments where students can enjoy basic needs satisfaction and its associated positive outcomes. Our research has empirically shown that teaching and social presences could potentially help online practitioners to employ "effective online pedagogy that fulfills the three universal SDT needs" (Hsu et al., 2019, p. 2172).

Table 4
Hierarchical regression results for relatedness.

Variable	*B*	95% CI for *B*		*SE B*	β	R^2	ΔR^2
		LL	UL				
Model 1						.294	.294*
Constant	.984*	.689	1.279	.150			
Teach pre	.541*	.464	.618	.039	.542*		
Model 2						.463	.170*
Constant	.751*	.491	1.012	.132			
Teach pre	.169*	.079	.260	.046	.170*		
Social pre	.490*	.410	.569	.041	.555*		

Note. CI = confidence interval; LL = lower limit; UL = upper limit; social pre = social presence; teach pre = teaching presence; *p < .001.

5.2. Relationship between teaching presence and autonomy

We found that teaching presence significantly influenced the perceived satisfaction of autonomy. That is, when online students perceived that their instructor established and maintained their teaching presence, they also perceived their need for autonomy was optimally satisfied. This finding is consistent with both theory and prior research. According to SDT, autonomy is either satisfied or forestalled by social-contextual conditions including teachers' motivating styles and course structure which either support or control student learning (Jang et al., 2010; Reeve et al., 2004; Ryan & Deci, 2000a, 2000b). Prior research also showed that contextual support perceived by online students positively predicted the satisfaction of the basic psychological need for autonomy in online learning environments (Chen & Jang, 2010; Hsu et al., 2019). The findings of this study support these prior findings and further contribute to the relevant literature by examining social-contextual support from the lenses of the two core CoI presences. Social presence was also a significant positive predictor of autonomy, and it even made a stronger contribution than teaching presence, which was unexpected because the basic need for autonomy was theoretically assumed to be more relevant to teaching presence (e.g., providing learning goals and objectives, a clear course structure). However, it is worth noting that social presence with its indicators of comfortably conversing with others and feeling that one's ideas are recognized by others can also theoretically be viewed from the perspective of satisfying autonomy. This finding calls for more empirical research to examine the unique contributions of teaching and social presences to online students' autonomy perceptions. Overall, our finding that teaching presence and social presence predicted perceived autonomy points to the key roles of both presences as social-contextual support in satisfying the basic need for autonomy in online learning environments.

5.3. Relationship between teaching presence and competence

We found that teaching presence was a significant positive predictor of perceived competence. When online students perceived their instructor provided clear instructions on how to participate in and complete online tasks and activities, helped them understand course topics and ideas better, and provided feedback about their progress and success, they also perceived they were capable of learning new knowledge and skills in their online courses, thereby satisfying their need for competence. This finding is consistent with theory and research. According to the SDT, when the social-contextual conditions (e.g., teaching style, course structure, feedback) provide students with necessary information and support indicating their progress and capability, their need for competence is optimally satisfied (Niemiec & Ryan, 2009). Similarly, when online instructors provide progress information and feedback that helps students appreciate their strengths and weaknesses (Arbaugh et al., 2008; Anderson et al., 2001), they signal to students that they can achieve in their online course. This may in turn help online students experience a sense of progress and accomplishment, thus satisfying their need for competence. In addition, our finding implies that when online courses are designed and implemented with clear goals and instructions and with reasonable due dates, it may empower online learners with the capability to demonstrate how competent they can be in learning the course content, which in turn satisfies their need for competence. Our finding is supported by CoI studies of teaching presence indicating its positive relationships with online students' learning outcomes (Caskurlu et al., 2020). Social presence was also found to be a significant predictor of perceived competence. That is, when online students engaged in interactions with other course participants, formed distinct impressions about them, felt comfortable conversing with them, and perceived social presence in an online learning environment, they were more likely to perceive their need for competence to be satisfied. This finding is also supported by a large body of CoI research indicating the significant positive associations between social presence and perceived learning (Richardson et al., 2017). That is, when students perceived high social presence in their online learning environments, they were more likely to perceive that they gained skills in the content area (Arbaugh, 2008; Cobb, 2011; Richardson & Swan, 2003; Swan & Shih, 2005). Overall, our study underscores the value of considering both teaching presence and social presence as two core online presences for the purpose of optimally satisfying competence in online learning environments.

5.4. Relationship between social presence and relatedness

We found that social presence significantly predicted perceived relatedness. When online students perceived social presence through their interactions and relationships with others, they were more likely to feel a sense of relatedness. This finding is consistent with theory and prior research. According to the SDT, relatedness is either satisfied or forestalled by social-contextual conditions in learning environments including social interactions with peers and teachers, peer and teacher relationships, and teachers' autonomy support (Ryan & Deci, 2000a, 2000b; Standage et al., 2006). Similarly, perceived contextual support in online learning environments positively influenced students' perceptions of relatedness as a basic psychological need (Chen & Jang, 2010; Hsu et al., 2019). The empirical connection we found between social presence and relatedness in this study is also backed up by the extant research literature on sense of community in online learning environments. Prior research indicates the relationships between students' interactions and communications with others, which can be subsumed by the construct of social presence in the CoI framework, and their perceived sense of community in online learning environments (Dawson, 2006). Teaching presence was also found to be a significant predictor of perceived relatedness. This finding is consistent with the relevant literature indicating that course instructors can enhance online students' sense of community and connectedness through their instructional design and organization of online courses, their use of technology, their provision of feedback, and their facilitation of student discourse in online discussions (Ice et al., 2007; Shea et al., 2005, 2006). Overall, both presences made unique contributions to our understanding of the influence of online social-contextual support mechanisms and factors on perceived satisfaction of relatedness in online learning environments.

5.5. Tying it all together: teaching and social presences and basic psychological needs

Our findings indicating the positive influence of both teaching and social presences on online students' basic psychological needs satisfaction are noteworthy because basic needs satisfaction promotes intrinsic motivation and more self-determined forms of extrinsic motivation, which are in turn associated with positive outcomes including engagement and learning (Chen & Jang, 2010; Ryan & Deci, 2000a, 2000b, 2017; Standage et al., 2005; Wang et al., 2019). We believe our findings contribute to the still-growing online SDT motivation literature by providing further empirical evidence and insights into the examination of basic needs satisfaction as a significant component of SDT applied to online learning environments, which still has not been adequately investigated except by a few studies (e.g., Chen & Jang, 2010; Hsu et al., 2019; Wang et al., 2019). We also believe our findings offer a new dimension of the capability of the CoI as a theoretical framework and online education model to create effective online learning environments that enable learners not only to be successful but also to remain motivated to continue learning online.

We must note that although we theoretically associated teaching presence with the perceived satisfaction of the basic psychological needs for autonomy and competence while associating social presence with the need for relatedness, we did so just to provide empirical evidence regarding the unique contribution of each presence to each relevant basic psychological need for the specific purpose of our study. Our intent was not to account for either teaching presence or social presence because we acknowledge that both teaching presence and social presence must exist together to provide and maintain those need-supportive online learning environments that can enhance basic needs satisfaction.

5.6. Limitations and future directions for research

Despite our best efforts to enhance rigor, this study has its own limitations. The largest limitation of this study is that it was cross-sectional, collecting data only at one time point and the generalizability of our findings may be limited as only those online students who volunteered to participate in this survey study constituted the sample of the study. However, a wide variety of online courses and disciplines represented in the study still provided significant insights into a diverse population of online students. Second, due to the quantitative nature of our study, no qualitative information was available as to the specific designs, structures, and instructor characteristics of the online courses as well as actual student behaviors. Also, more rigorous measures of basic needs satisfaction specially validated in online learning environments are needed since certain items on the BPNS scale may need modifications to fit online learning environments (Wang et al., 2019). While we acknowledge these limitations, the current study empirically demonstrated the potential ability of CoI's teaching and social presences serving as social-contextual support online to satisfy SDT's basic psychological needs in online environments.

Future studies should further examine this potentially promising link between CoI presences and basic needs satisfaction in online learning environments across online courses, programs, and institutions. Online student engagement and academic achievement should also be examined as potential outcomes of basic psychological needs satisfied by these two CoI presences. The possible role of *cognitive presence* within these equations is also an area to be studied by future research. The sub-dimensions of teaching presence and social presence should also be further investigated to see whether each sub-component of teaching presence (e.g., design and organization) and social presence (e.g., affective/emotional expression) can individually predict the three basic psychological needs. Using this study and its findings as an initial step, future researchers should consider testing models of moderation and/or mediation. Using the initial findings from this study, future researchers should also consider testing theoretical models in the context of Structural Equation Modeling (SEM). Future researchers should also consider further exploring the distinctions between social presence and relatedness as two theoretically and empirically related constructs. Finally, although we collected demographic data to report participants' characteristics, age, gender, or any other demographic variable was not our interest in this study. However, future researchers should definitely consider the possible effects of such demographic variables as well in future studies. We hope that our study will open the doors for all further lines of inquiry regarding the potential relationships among CoI presences and SDT's basic psychological needs in online learning environments.

6. Conclusions

The current study indicates that both teaching presence and social presence as two key social-contextual support mechanisms in online learning environments positively influence the extent to which online students of higher education perceive the satisfaction of their basic psychological needs for autonomy, competence, and relatedness. Online course instructors and designers can use our findings in their design, organization, and implementation of online courses so that they can promote basic needs satisfaction and its positive outcomes. For example, online course instructors should provide autonomy-supportive goals, rationales, and choice, and competence-supportive instruction and feedback. They should also make sure they effectively interact with their students as well as enabling them to interact with peers in a socially and emotionally trusting and relatedness-supportive learning climate. The findings contribute to our understanding of effective online education and student motivation as informed by both CoI and SDT perspectives for the ultimate goal of high-quality online learning experiences for students.

Credit author statement

Murat Turk: Conceptualization, Methodology, Data curation, Formal analysis, Writing – review & editing. Benjamin C. Heddy: Conceptualization, Methodology, Data collection, Formal analysis, Writing – review & editing. Robert W. Danielson: Writing – review

& editing.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.compedu.2022.104432.

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