Computers & Education 57 (2011) 2535–2547

Contents lists available at ScienceDirect

Computers & Education

journal homepage: www.elsevier.com/locate/compedu

Enhancing non-task sociability of asynchronous CSCL environments

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ARTICLE INFO

Article history:
Received 10 May 2010
Received in revised form
14 February 2011
Accepted 1 June 2011

Keywords:
Computer supported collaborative learning
Non-task interactions
Sociability
Sense of community
Student's adaptability

ABSTRACT

While from a technological perspective Computer Supported Collaborative Learning (CSCL) systems have been improved considerably, previous studies have shown that the social aspect of the CSCL is often neglected or assumed to happen automatically by simply creating such virtual learning environments. By distinguishing between students' non-task social interactions from on-task interactions, and through a content analysis, this paper demonstrates that non-task interactions do occur frequently in CSCL environments. Furthermore, by conducting a self-reported survey, the present study operationalizes non-task sociability of CSCL environments and determines factors that affect them. The findings from the survey revealed that the sense of cohesion and awareness about others significantly impact the non-task sociability of CSCL. Furthermore, the study demonstrates that the perception of self-representation and perception of compatibility affect the sense of cohesion and awareness about others and indirectly contribute to the perceived non-pedagogical sociability of the environment. The findings of this paper can be used in future research for investigating the relationship between the non-task sociability of CSCL and other CSCL factors. The study also provides the CSCL lecturers and facilitators with a conceptual model by which sociability can be explicitly addressed in their course planning and delivery processes. And finally, this study develops and validates an instrument that guides required changes in current CSCL systems to improve the non-task social functionality of the environment.

1. Introduction

Over recent years asynchronous Computer Supported Collaborative Learning (CSCL) systems have improved technologically. Yet, studies have shown that the key future challenges in development of online communities are not simply technological, but also sociological (Dewiyanti, Brand-Gruwel, Jochems, & Broers, 2007; Kollock, 1996) and that the social aspects of CSCL has often neglected or assumed to occur automatically simply by creating virtual learning environments (Kirschner et al., 2004; Kreijns, Kirschner, & Jochems, 2003). Previous findings also indicate that although virtual learning environments provide a variety of benefits, learners' isolation and lack of sociability in the virtual space are emerging as the key pitfalls for the effectiveness of CSCL environments and should be considered in future systems development activities (McPherson & Nunes, 2004).

Social interactions play a vital role in the CSCL environments. Such interactions contribute both to the level of students' participation as well as their learning achievements. Yang, Li, Tan, and Teo (2007) have stressed that without effective students' participation, full utilization of the online discussion forums would not be achieved. Balacheff, Ludvigsen, Jong, Lazonder, and Barnes (2009) reviewed two decades of the CSCL research and found that affective and social issues influence learning outcomes in CSCL environments and more attention should be paid to these issues. Muilenburga and Berge (2005) have investigated current barriers in online learning environments and found that a lack of social interaction is the most significant barrier to learning in such environments. These authors have pointed out that social interactions strongly relate to the online learning pleasure, effectiveness of learning online, and the likelihood of taking another online class, and therefore must be critically evaluated in the online learning research and practice.

Students' social interactions in CSCL environments have been broadly categorized as on-task (pedagogical) and non-task (non-pedagogical) interactions (Mcneil, Robin, & Miller, 2000). The former includes instructional and learning activities such as group learning and group processing, whereas the latter embraces activities which are not directly learning related such as greetings, social support, and friend

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doi:10.1016/j.compedu.2011.06.002

making. The distinction between the non-task and on-task interactions is essential; and as Muilenburga and Berge (2005) mentioned, a lack of non-task interactions has been perceived as one of the most severe barriers in the CSCL environments.

Non-task interactions in CSCL environments do not take place automatically. The preceding findings have warned that putting students in a computer supported environment with several technological features would not necessarily lead to productive collaboration and social interactions (Hakkinen, 2004; Kreijns et al., 2003). Rather, deep investigation is needed to analyze sociability of CSCL environments and to determine the degree to which such environments are capable of providing a non-pedagogical social environment for the individuals (McInnerney & Roberts, 2004). Such investigation would offer guidelines for CSCL to fulfill the human desire for non-pedagogical social interactions, which in turn, would lead to improved learning outcomes (Abedin et al., 2011; Hron & Friedrich, 2003; Kreijns, Kirschner, & Jochems, 2002; Wegerif, 1998; Yang et al., 2007).

Despite the growing attempts in defining and characterization of the sociability of CSCL environments, it still requires further elucidation and operationalization (Balacheff et al., 2009; Preece, 2001). Wright, Varey, and Chesney (2005) argue that measuring sociability is still in its infancy and future studies should attempt to operationalize this notion and should propose techniques to address 'non-task' aspect of social interactions in online communities. The objective of the present study is to firstly determine existence of non-task interactions in the CSCL environments and will answers the following research question:

RQ1: Do non-task social interactions exist in the asynchronous CSCL environments?

Secondly this paper aims to operationalize the notion of non-task sociability of the CSCL and also to determine factors that may influence it. This will assist CSCL lecturers and facilitators to both facilitate and control socialization and non-task discussions among students which in turn is expected to lead to more effective participation and learning achievements. Accordingly, this paper is seeking the answer for the following research questions:

RQ2: What factors cause non-task sociability in asynchronous computer supported collaborative learning environments as perceived by students, and how can these factors be measured?

RQ3: What are the indicators for operationalization of those factors?

The rest of this paper is organized as following: firstly the literature on non-task sociability of CSCL and the factors that may influence the latter is reviewed and the research model and hypotheses are demonstrated. A content analysis of online messages in a CSCL environment is then conducted to assess the significance of the present study. This is followed by a pilot study to develop and test a self-developed questionnaire, to remove unnecessary items, to explore underlying factors of the latent constructs, and to initially test the research hypotheses. Then, the main survey study is conducted in order to test the significance of the research hypotheses. The reliability and validity of the findings of the main study are then examined and demonstrated. Lastly, the implications of the findings are discussed and findings.

2. Literature review

According to Laffey, Lin, and Lin (2006), sociability is the ability of computer supported collaborative learning systems to provide an environment in which individuals can interact socially. Laffey et al. pointed out that when the computer technology affords a socially meaningful and satisfying interaction, the CSCL system will encourage social benefits and facilitate learning satisfaction.

The need for sociable CSCL systems has recently been emphasized by many researchers. Fairclough (2008) argued that the next generation of computer technology has to provide a dynamic sociable environment where individuals can socially interact with one another and openly exchange social and motivational expressions. Other studies have shown that sociability of the environment is strongly related to: (i) the online learning enjoyment, (ii) the level of learners' participation, and (iii) effectiveness of learning (e.g., Muilenburga & Berge, 2005). Clark (2003) has discussed the advantages of sociable environments and pointed out that sociability is integrated with learning content. He states that sociability is important as it facilitates non-task discussions and learning. Soller (2001) and Soller et al. (1998) introduced an intelligent collaborative learning model to support social interactions. These studies emphasize the role of individuals' participation and social interaction for effective online collaborative learning, and demonstrate how their model can facilitate social interactions. Barab, Barnett, and Squire (2002) developed an Inquiry Learning Forum (ILF). ILF is a web-based professional development tool designed to support a community of teachers creating, sharing, and improving inquiry-based pedagogical practices. They emphasized the role of sociability of their tool and defined three major sociability themes: (i) the need to build structures that support group collaboration and work, (ii) the need to provide structured tasks (goal sets) for engaging with the E-ILF and ILF community, and (iii) the need to provide more visible connections with people, conversations, and artifacts of interest to each ILF member.

Previous findings indicate that although virtual learning environments provide a variety of benefits, learners' isolation and lack of non-task sociability in the virtual space are emerging as the key pitfalls for the effectiveness of CSCL environments and should be considered in future systems development activities (McPherson & Nunes, 2004). To address this problem, the focus of the present paper is therefore on the non-task aspect of interactions and the factors that influence non-task sociability of the CSCL environments.

3. Research model and hypotheses

This section develops the research model and hypotheses, and also reviews factors that may influence non-task sociability of the CSCL. These factors are divided into two groups: (i) *sense of community*, and (ii) *individuals' communicative behavior adaptability*. In addition, a set of control factors have also been considered to assess the impact of the above factors on individuals' communicative behavior adaptability and sense of community.

3.1. Sense of community

The notion of community is at the heart of learning (Nichani & Hung, 2002) in general, and distance learning (Brown, 2001; Wallace, 2003; Wrescha, Arbaugha, & Rebstock, 2005), in particular. A sense of community is defined as "the opposite of the sense of being out

there on your own" (Walker, 2008; page 20). Earlier studies have recognized sense of community as a major factor impacting the perceived social environment of online and collaborative learning environments and students' learning performance (Lear, 2007). Walker (2008) mentioned that students with a strong sense of community are more likely to continue and succeed in their CSCL experience than those who feel separated from the cohort. Burke (2005) has explained the formation of sense of cohesion and community in online learning groups as a mutual dependence between group members. Burke further argues that group members validate and assess their own identities in the group and also help other group members to validate their identities. This constant validation and assessment process helps formation of the sense of community and cohesion in a collaborative group. Rovai, Wightinga, and Lucking (2004), Rovai (2002, 2001) stressed the importance of a sense of community and avoidance of a sense of isolation in collaborative learning environments and observed that strong feelings of community enhance the flow of information among students, social support, commitment to group goals, and consequently satisfaction with the learning experience.

The above discussion demonstrates the importance of the sense of community in CSCL environments. The current study therefore hypothesizes that:

H1: The level of students' perception of the sense of community positively affects their perception of the non-pedagogical sociability of the CSCL environments.

3.2. Individuals' communicative behavior adaptability

The second factor impacting non-task sociability of the CSCL environments is the *individuals' communicative behavior adaptability*. Social information processing (SIP) theory suggests that participants in online discussions develop individual impressions of others through accumulated CMC (Computer-Mediated Communication) messages and interactions and consequently may develop relationships through textual or verbal cues (Walther, 1992, 1995). According to the SIP theory, through message accumulation, individuals can adapt verbal and paralinguistic behaviors to communicate in CMC environments. Based on this theory, Walther and Burgoon (1992) conclude that CMC groups could adapt their verbally transmitted or textual messages in order to exchange social information. They emphasize the essence of human adaptation in interaction with others and mentioned that patterns of adaptation and adjustment shape the foundation of interaction and social order.

Review of previous studies in the context of CSCL and CMC suggests presence of a potential relationship between individuals' communicative behavior adaptability and sense of community as well as non-task sociability.

3.2.1. The relationship between individuals' communicative behavior adaptability and non-task Sociability

Social information processing (SIP) theory has emphasized the adaptive use of CMC systems for transmitting and exchanging social information to develop impressions and to facilitate sharing personal information (Walther, 1996). According to the SIP, through message accumulation, CMC communicators could adapt their verbal or textual messages in order to exchange social information, which in turn may lead to an improved sense of sociability in the CMC environment. Lopez-Fernandez and Rodriguez-Illera (2009) investigated students' adaptation to a digital leaner course portfolio and concluded that when students realized how the portfolio system works, their perception started to be more positive and gradually they could adapt their online activities and communicative behavior to better utilize the portfolio system. The above authors observed that while in the beginning of the semester students expressed ambiguity toward the innovation and perceived advantages/disadvantages, they started to perceive the portfolio as a useful learning and assessment tool as they adapted themselves to the environment and became more familiar with features of the portfolio. The essence of individuals' adaptation to the CMC environment for social communications with others is also supported by Riva (2002). Riva pointed out that "action is not the execution of a ready-conceived plan, but the subject's adaptation to [the] context" (Riva, 2002: 588). The above authors mentioned that the adaptation to the context improves the level of use of technology and perceptions of the social environment of the CMC system. According to the above findings, the current study hypothesizes that:

H2: The level of individuals' communicative behavior adaptation to the computer medium positively affects their perception of the non-task sociability of the CSCL environments

3.2.2. The relationship between individuals' communicative behavior adaptability and the sense of community

Social identification/deindividuation effects (SIDE) theory (Walther, 1992, 1995) explains that, in the absence of face to face cues in CMC environments, people judge one another based on group similarity or difference. The theory posits that when an individual is deindividuated or depersonalized, his or her social identity is salient (Lea & Spears, 1995). If a social identification is salient, that is when people perceive a sense of community, this social identity leads one to assume similarity among members and to experience socializing with them in the environment. In addition, Lee's (2007) study suggested that communicative behavior adaptation may lead to a sense of community in CMC environments. Lee (2007) pointed out that according to social comparison theory, individuals in CMC activities want to self-represent them and to be different from others. Yet, as people do not know others' position in the environment, they tend to express moderate opinion and personal information in the beginnings of discussions. But when they adapt their communicative behavior to the medium over discussions with others and they perceive the social tendency shared by the other people, they start to feel more connected to the community and therefore they will share more personal opinions. The findings of the above study also indicate that when people adapt to the CMC medium, they try to become aware of the activities of others in the environment, which leads them to feel more connected to the group and fosters interactions between group members. Handley, Sturdy, Fincham, and Clark (2006) evaluated communities of practice and point out that through participation, individuals adapt various tools, language as well as various implicit relations and tacit conventions in order to extend awareness of the community, and to develop sense connectedness to others in the community. Therefore, the third hypothesized of the present study is:

H3: The level of individuals' communicative behavior adaptation to the computer medium positively affects their perception of the sense of community in the CSCL environments

3.3. Control factors

Review of the literature revealed that certain factors exist that impact various aspects of CSCL. These factors include the characteristics of the learner, the course, the instructor, and the computer technology (Brandon & Hollingshead, 1999). A review of the literature was conducted to identify the effects of these characteristics on individuals' communicative behavior adaptability and sense of community. Results of the review are summarized in Table 1.

Based on the above review, Fig. 1 shows the conceptual research model of the study.

4. Instrumentation

A questionnaire was developed to capture student's perception of non-task sociability, sense of community, and communicative behavior adaptability in a CSCL environment. As the first step of developing this questionnaire, the previous instruments for each of the above constructs have been reviewed. A summary of this review is demonstrated in Table 2.

Through a selection process, existing indicators for non-task sociability, sense of community, and students' communicative behavior adaptability from the reviewed questionnaire were selected. Indicators of the reviewed instruments were separately listed in a table for each latent construct. Then, similar indicators were consolidated. The indicators were merged when two or more indicators had exact or similar name and/or definition, or their corresponding definition reflected the same concept. For the non-task sociability construct, task-related indicators were removed from the list of chosen items. This is because earlier sociability instruments had not distinguished on-task from non-task indicators. Non-task sociability indicators were identified and then removed from the pool of items. For example, 'problem solving' is an item mentioned by Finn (1999), which was not considered as a non-task sociability item in the present study because this items has been defined as an exchange of ideas where people offer specific advice to solve specific working problems, which reflects an on-task sociability behavior. As another example, Kreijns et al. (2004) used 'development of working relationships' as an indicator in their sociability instrument. This item was also excluded from the present study as it reflects an on-task behavior. As a result, the final questionnaire consisted of demographic information, thirteen items for non-task sociability, twelve items for sense of community, fifteen items for students' communicative behavior adaptability, and thirteen items as control factors.

5. The environment under study

Data were collected from a postgraduate management degree offered by a large Australian university called MBT (The Master of Business and Technology). Community of practice was an underlying practice in the MBT. All facilitators undertook training for teaching CSCL and developing communities of practice, as also mentioned by Wegner (2007). Entry to this degree program is based on appropriate work experience, a prior degree, and being employed full-time. Full-time study in the program is not permitted as being currently employed full-time is an important component of the learning model in the program. Most students study one to three courses per semester, and courses are offered over three semesters each year. Courses are offered both online and face-to-face. Online presentation does not require students to attend any face-to-face learning activities. Eighty percent of students have chosen to study in the online mode each session with the remaining 20% attending face-to-face classes. The majority of the student cohort (92%) are domiciled in Australia with the remaining 8% are located outside of Australia. On average, 65% of students were male and 35% were female. The average age of students was 36 and the average work experience of the cohort was 10 years.

The Learning Management System (LMS) used in the program was developed in house by the university. The options available to students from the navigation bar include:

- Notice Board: Course and class administrative notices are posted here
- Seminar Room: It is in the seminar room that the learning activities take place. The class facilitator is responsible for initiating and facilitating discussions. Learning activities are scheduled around the 12-week term (6 weeks in summer). The learning modes available in the seminar room are: discussion; brainstorm; informal argument; responding to a case study; responding to a task; responding to a question; formal debates; voting on a proposition; quizzes.

Table 1
Control factors.

Construct	Indicators	Study
Learners' characteristics (LC)	Students' experience with the computer technology	(Dewiyanti et al., 2007); (Tolmie & Boyle, 2000); (Dutton & Dutton, 2002); (Brandon & Hollingshead, 1999)
	Employment status	(Dutton & Dutton, 2002)
	Enrollment status	(Dutton & Dutton, 2002)
	Age	–
Course characteristics (CC)	Clarity of online tasks and materials	(Tolmie & Boyle, 2000); (Brandon & Hollingshead, 1999)
	Number of enrolled courses	(Muilenburga & Berge, 2005)
	Number of dropped courses	
	Level of the degree	(Dutton & Dutton, 2002)
Technical characteristics (TC)	The level of technical support	(Tolmie & Boyle, 2000); (Benbunan-Fich & Hiltz, 2003; Brandon & Hollingshead, 1999); (Mcmahon, Gardner, Gray, & Mulhern, 1999)
	The level of technical training	(Mcmahon et al., 1999)
Instructor characteristics (IC)	Level of available information for online facilities	(Mcmahon et al., 1999)
	The level of instructor's support	(Benbunan-Fich & Hiltz, 2003); (Daradoumis, Nez-Mone'Sb, & Xhafa, 2006)
	Perceived instructor's behavior	(Brandon & Hollingshead, 1999)

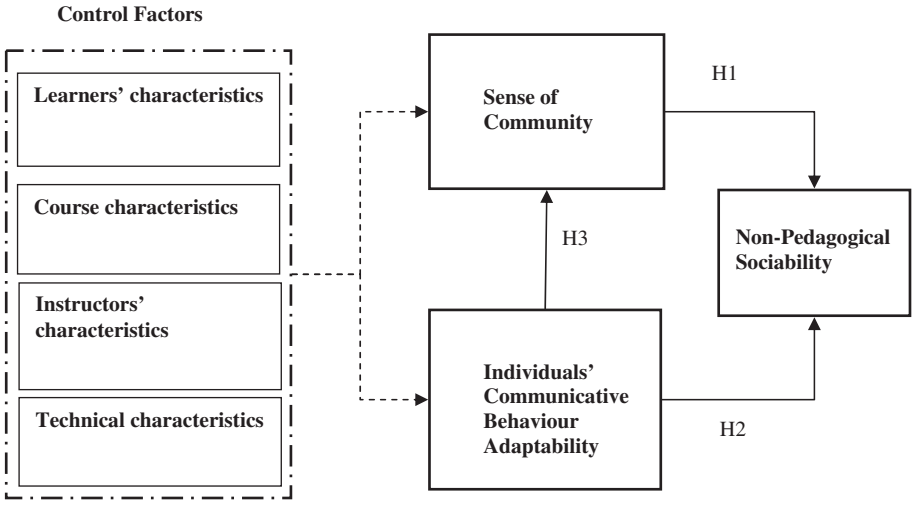

Fig. 1. The conceptual research model.

- Coffee Shop: The Coffee Shop is an informal environment where discussion can be started by both students and facilitators. Discussions in the coffee shops are lead by the person who started a topic. All students are encouraged to use the Coffee Shop to provide support for each other.
- Gallery: The gallery lists the university email of all participants and also includes a class and general profile of students, coordinator and facilitator. It was voluntary for students to post a photo of themselves on their profile. They were also permitted to load any other non-offensive picture/photo. As most students posted pictures of their children or pets it was not possible to identify someone from their profile picture.

Table 2
Previous instruments for sociability, sense of community, and students' communicative behavior adaptability.

Study	Brief overview
Sociability	
(Schepers, Jong, Wetzels, & Ruyter, 2008)	The instrument measures psychological safety, which is defined as "the feeling of a student that he is able to show and employ himself in his tasks without fear of negative consequences to self-image, social status or school career, which also encompasses a sense of being valued and comfortable in that setting"
(Laffey et al., 2006)	Sociability is defined as the ability of the computer-mediated system to provide an environment where individuals can interact socially. Three factors of sociability are identified as: social navigation, social presence, connectedness
(Kreijns, Kirschner, Jochems, & Buuren, 2004)	Sociability is the ability of the CSCL environment to facilitate emergence of a social space. The self-reported instrument is based upon group awareness, communication, and potential for facilitating the creating a community of learning
(Gunawardena, Lowe, & Anderson, 1997)	Based upon social presence approach, the objective of the instrument is understanding individuals' reactions on a range of feelings toward the computer-mediated communications
(Lin, 2004)	The instruments measures social presence for online collaborative learning environments.
(Fiedler, 1967) &(Fiedler, 1962)	The instrument reflects leader attitudes, group climate, and group creativity and Measures perceived atmosphere of a group
(Finn, 1999)	Assessing an online social support group. The instrument categorizes socioemotional-related functions.
Sense of community	
(Rovai, 2002)	This instrument measures the sense of community in online classes
(Salisbury, Carte, & Chidambaram, 2006)	The study investigates and measures sense cohesion by team members of CMC environments.
(Cadieux, 2002)	To measure the sense of community in online community college
(Brook & Oliver, 2002)	The study assesses communities in online learning and extends previously developed Sense of Community Index (SCI) for CMC communities.
(Summers et al., 2005)	The study develops the instrument for measuring the sense of community in traditional environments, with two components to measure (1) the extent to which students feel connected to others in the campus and (2) in the class
(Mccoll, Davies, Carlson, Johnston, & Minnes, 2001)	To measure integrity of a community
Students' communicative behavior adaptability	
(Schepers et al., 2008)	This study considers two traditionally frequently used factors to be important in students adoption to collaborative educational computer technologies: ease of use and perceived usefulness
(Karahanna & Straub, 1999)	The instrument measures Pre and Post beliefs in Information Technology adoption across time in CMC environments.
(Duran, 1983)	To measure the degree to which individuals' adapt their communicative behavior adaptability to interaction withothers in the surrounding environment
(Rogers, 1995)	The instrument identifies key factors that affect adapters' perception of innovation
(Duran & Spitzberg, 1995)	Assessing mental processes that make one adapt himself to his surrounding environment
(Shelley, 1998)	To investigate factors that affect adoption and use of email in CMC environments

- Participant Network: This is a Networking site for current students and alumni. Participation in seminar room learning activities is required by all students. Participation in online activities carries an assessment weighting of 10–15%.

6. Pilot study

The summer semester of the MBT program with 200 enrolled students was considered for the pilot study. The summer semester ran for ten weeks from November 2008 till February 2009 including a three-week break for Christmas and New Year holidays. Only experienced students who had completed a minimum number of courses are permitted to enroll in summer courses due to the accelerated presentation mode.

The pilot study was conducted in two parts: a content analysis, and a survey. In the first part, the contents of the online messages were analyzed to demonstrate the existence of non-task interactions. The results further justified the significance of the present study and also provided answer to the secondary research question.

In the next stage, the initial version of the questionnaire was pre-tested. The objectives of such pre-test were (i) to perform an exploratory factor analysis for discovering underlying constructs of the indicators and removing unnecessary indicators, (ii) to examine interrelationships between constructs for developing research hypotheses, and finally (iii) to initially examine the validity and reliability of the findings.

6.1. Content analysis of MBT classes

Fahy, Crawford, and Ally (2001) developed an analytical tool called Transcript Analysis Tool (TAT) for analyzing interaction patterns in online distance education, with inter-rater reliability varying from 0.70 to 0.94 (Fahy, 2001). TAT is a tool for demonstrating interaction patterns and examining different communication styles and online behavioral preferences among participants in computer-mediated communication environments (Fahy, 2003). Among other things, the TAT instrument provides a useful set of categories for messages and patterns of interaction (Wever, Schellens, Valcke, & Keer, 2006) and it also distinguishes non-task interactions from on-task interactions. The present study used the latest version of TAT which allows for analyzing the contents of students' exchanges in terms of fourteen non-task behaviors.

Data were collected from both the seminar rooms and the coffee shops of three randomly selected online summer term classes. Each class contained 20 students. Due to the elaborate nature of much of the discussions, capturing non-task interactions using strict syntactic rules was not possible. NVivo software was used to partially automate the analysis of discussions. To examine inter-rater reliability of the analysis, a full instruction about TAT was provided to a recent PhD graduate who had no previous involvements in the present study. This assistant was asked to randomly select twenty percent of the total messages and to code them based on instructions provided. Results showed a Cohen's kappa of 0.81, which falls into the accepted level reported by (Fahy, 2001).

According to the TAT methodology, a 'support ratio' is to be calculated in order to obtain the level of non-task social activities in the environment. Support ratio is the support score divided by the total number of messages. Support score in turn is calculated as the sum of all sentences coded in TAT's fourteen non-task behaviors.

Table 3 shows the support ratios for the three courses. Support ratio in this table reflects the extent to which supportive behaviors were emerged in all messages in a specific room. Some examples of supportive behaviors in these courses are: *I don't consider 40 to be old*; *My wife is originally from Shanghai so we have been visiting her relatives here*; *Good luck measuring trust:-)*.

Support ratios in this table reflect the extent to which supportive behaviors emerged in all messages in a particular seminar room. As shown in Table 3, while support scores of the three seminar rooms are higher than those of coffee shops, the support ratios of the three coffee shops are higher than those in the seminar rooms. This indicates that coffee shops have higher level of intensity, yet lower aggregated quantity of non-task social messages when compared to the seminar rooms. Perhaps one reason is the fact that students were more active in seminar rooms than in the coffee shops and exchanging learning related messages provided more opportunities for non-task-related interactions. For all task/learning purposes, students were required to interact in the seminar room. Whereas interactions in coffee shop were optional. During their task/learning interactions in the seminar room, students also socialized with each other; they did not switch to coffee shops simply for socialization purposes. Therefore it can be inferred that non-task interactions evolve more within the context of on-task activities, rather than in non-task environments. Table 3 also shows that there has been at least one non-task communication in almost every message posted in the seminar rooms, which is an indication of the existence of non-task contents in all discussions in the on-task/learning environment.

6.2. The survey

A questionnaire with 56 questions was developed and its face validity was assessed in order to assure integrity, meaningfulness and clarity of the questions. This version of the questionnaire was emailed to the students and after one week a reminder was sent to them. Forty one completed responses were collected, which showed a reasonable response rate of 20%. Of the 41 survey responses, 97.5% were enrolled part-time and employed full-time; 66% were male and 34% were female. Also 30% of them were single and 70% were married. The average age of participants was 37.5, ranging from 27 to 54, and the average work experience was 17.7, ranging from 8 to 30 years. The level of study for 73% of participants was a Master degree, for 19.5% was a Graduate Diploma, and for 7.5% was a Graduate Certificate.

Table 3
Support ratio for the three courses.

Course name	Course 1		Course 2		Course 3	
	Coffee shop	Seminar room	Coffee shop	Seminar room	Coffee shop	Seminar room
Total number of messages	19	229	47	260	25	442
Support score	43	350	201	249	113	497
Support ratio	2.63	1.53	4.28	0.96	4.52	1.12

The Bartlett's tests of sphericity as well as the Kaiser–Meyer–Olkin test were performed on the non-task sociability, sense of community, and students' communicative behavior adaptability to assess appropriateness of performing the factor analysis. The results of these tests indicated the existence of correlations among indicators (with Sig. = 0.000) and showed appropriateness of factor analysis for selecting the indicators of the three latent constructs.

As there has been no prior theory or model explaining the interrelationship among the set of items of non-task sociability, sense of community, and students' communicative behavior adaptability, an exploratory factor analysis (EFA) was conducted to uncover underlying structure of the items of these constructs. To perform the EFA, SPSS version 15.0 was used. As there has been no prior knowledge about possible correlation between constructs, a common factoring extraction method with the PROMAX rotation solution (with Kappa = 4) was chosen for this analysis. The EFA analysis was carried out in three steps: First, indicators with the extraction and initial commonalities less than 0.5 were nominated to be excluded from the analysis. This was to ensure items with a high level of explained variances by the extracted construct have been chosen (Fabrigar, Maccallum, Wegener, & Strahan, 1999). Second, the extracted factors that had less than three indicators with the loadings greater than |0.4| were removed from the analysis. This criterion prevents selection of poor factors representing only one or two indicators Gorsuch (1997). The corresponding indicators of the removed factors were then assigned to a remaining factor with a higher loading than other factors. Third, the reliability of the extracted factors was examined. For each extracted factor, the indicators which either had negative effect or did not have large positive effect on the reliability were excluded from the analysis. This criterion prevents selection of items that do not contribute highly in the reliability of the corresponding factors (Moore & Benbasat, 1991). The authors then examined the content validity of constructs to ensure that removing indicators from each of the constructs would not negatively impact the content validity of the latent constructs. Lastly, each extracted factor was named with the indicator(s) with higher loading having more influence on naming the associative factor.

Three factors were extracted from the exploratory factor analysis (EFA) for *students' communicative behavior adaptability*, two factors for *sense of community* and one factor for *non-task sociability*. Table 4 shows high levels of reliability for the extracted factors (all above 0.6) as well as for the total explained variances of these factors.

The EFA extracted three underlying factors for individuals' communicative behavior adaptability. The first factor, the perception of self-representation, reflects individuals' perceptions of their image and social status amongst others. This factor implies that people care about how they represent themselves in front of others. The second factor, the perception of compatibility, reflects that individuals are keen to adapt their communicative behavior when they realize the communication technology provides notable advantages for them. Such advantages are in the form of doing jobs faster and more efficiently compared to the traditional learning systems, and having better access to learning materials. The perception of the use of computer and communication technologies is the third underlying factor of individuals' communicative behavior adaptability. This factor reflects individuals' enthusiasm to adapt their communicative behaviors to the CSCL system when they find the CSCL technology easy to deal with. Since all interactions in this study were online and computer based, students could only use the computer to communicate with other students. Therefore, we believe the more they find technology easy to use, the better they can use it for effective communication.

Furthermore, the EFA uncovered two factors for the sense of community. While many earlier researches have operationalized the sense of community in CSCL environments, they have not distinguished the underlying factors of the sense of community. In contrast, the present study has unveiled individuals' sense of cohesion and awareness of others as the two underlying constructs of the sense of community. A sense of cohesion addresses individuals' emotional ties with group members such as liking, caring, and connectedness. This bonds students together and creates a sense of belonging to the CSCL community. An awareness of others represents an individual's perception of the degree to which participants are sensitive to the actions initiated by other individuals in the community.

Both the research model and the hypotheses were revised based on the results of the EFA in Fig. 2 and Table 5. PLS was used to initially estimate the relationships between the factors. PLS computes the *t*-values, *R*-square, and AVE values through the bootstrapping technique which enables testing validity and fitness of the model (Gefen & Straub, 2005). PLS has been chosen for this pilot study as it produces accurate results for studies with small sample size and also it does not require any pre-specified data distribution assumptions (Fornell & Bookstein, 1982).

The results of the PLS estimation at the significance level of 0.05 are summarized in four parts. Firstly, the model estimation revealed the existence of a significant impact of the perception of compatibility and self-representation on the sense of cohesion with the path coefficients of 0.570 and 0.199, respectively. Moreover, the perception of self-representation and compatibility shows significant relationship with the awareness of others at the path coefficients of 0.326 and 0.272, correspondingly. These findings show the presence of the hypothesized relationship between individuals' communicative behavior adaptability and the sense of community. However, the perception of the use of computer technology does not affect other constructs. Perhaps one reason for this weak relationship is rooted in students' experience with computers. By looking at the descriptive statistics, which ranged from 1 to 5, we found that the minimum score of computer proficiency is 3 and the average score is 4.49. This may imply that when individuals have strong computer proficiency, their perception of sociability and the sense of community is not affected by their perception of the use of computer technology.

Secondly, the results indicate that the sense of cohesion and awareness of others significantly impact the non-task sociability with path coefficients of 0.401 and 0.609 respectively. This means that a higher perception of the sense of cohesion and awareness of others in the CSCL

Table 4
Reliability and the total explained variance.

Latent construct/factors	Individuals' communicative behavior adaptability (ICBA)			Sense of c ommunity (SoC)		Non-pedagogical sociability (NPS)
	Perception of self-representation	Perception of compatibility	Perception of use of computer technology	Sense of cohesion	Awareness of others	NPS
Reliability (α)	0.741	0.758	0.626	0.909	0.886	0.871
Total explained variance by extracted factors	68.19%			75.49%		63.35%

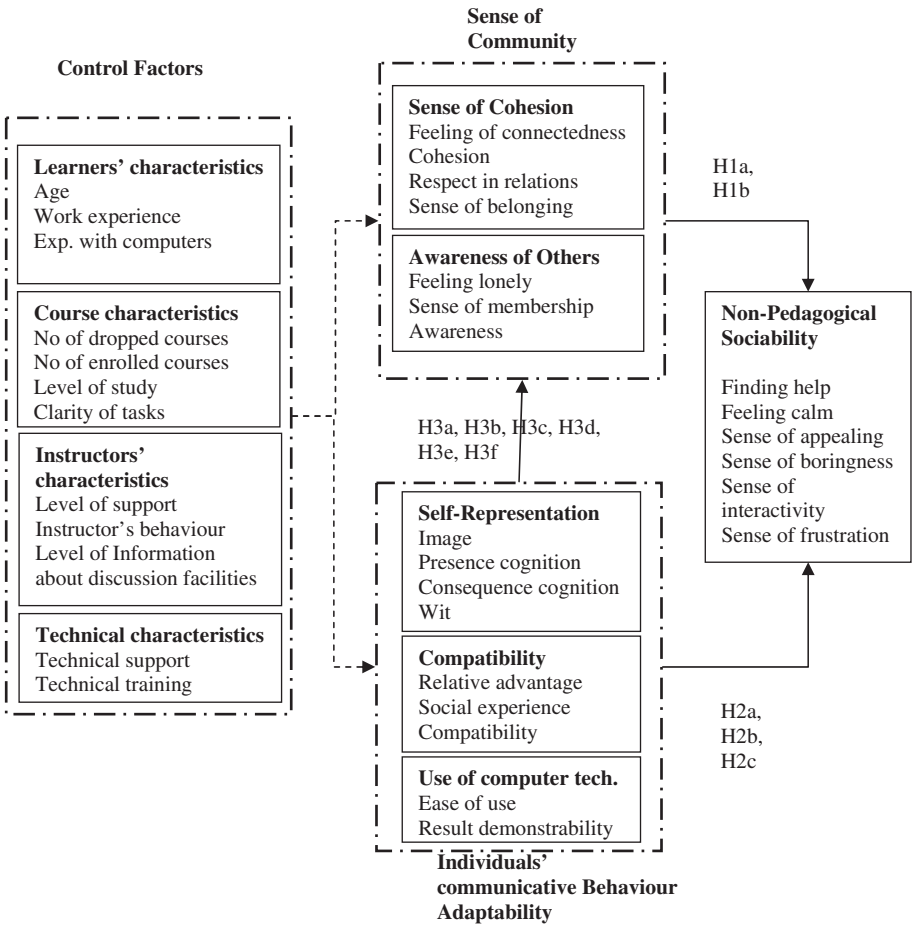

Fig. 2. The revised research model based on findings of the EFA analysis.

environment leads to a higher perception of non-task sociability of the environment. As the sense of cohesion and the awareness of others represent the sense of community, the above finding supports the hypothesized relationship between the sense of community and non-pedagogical sociability.

Thirdly, the perception of self-representation, compatibility, and perception of the use of computer technology does not significantly impact the non-task sociability. These three factors represent individuals' communicative behavior adaptability and therefore the results of

Table 5
Summary of results of hypotheses testing in the structural model.

Research Hypothesis	Result
H1a: The level of students' perceived sense of cohesion positively affects their perception of the non-pedagogical sociability of the CSCL environments	Supported
H1b: The level of students' perceived awareness of others positively affects their perception of the non-pedagogical sociability of the CSCL environment	Supported
H2a: The level of students' perception of self-representation positively affects the level of their perception of the non-pedagogical sociability of the CSCL environments	Rejected
H2b: The level of students' perception of compatibility of CSCL system positively affects their perception of the non-pedagogical sociability of the CSCL environments	Rejected
H2c: The level of students' perception of the use of computer technology positively affects students' perception of the non-pedagogical sociability of the CSCL environments	Rejected
H3a: The level of students' perception of self-representation positively affects their perceived Sense of cohesion in the CSCL environments	Supported
H3b: The level of students' perception of self-representation positively affects their perceived awareness of others in the CSCL environments	Supported
H3c: The level of students' perception of compatibility of CSCL system positively affects their perceived sense of cohesion in the CSCL environments	Supported
H3d: The level of students' perception of compatibility of CSCL positively affects their perceived awareness of others in the CSCL environments	Supported
H3e: The level of students' perception of the use of computer technology positively affects their perceived sense of cohesion in the CSCL environments	Rejected
H3f: The level of students' perception of the use of computer technology positively affects their perceived awareness of others in the CSCL environments	Rejected

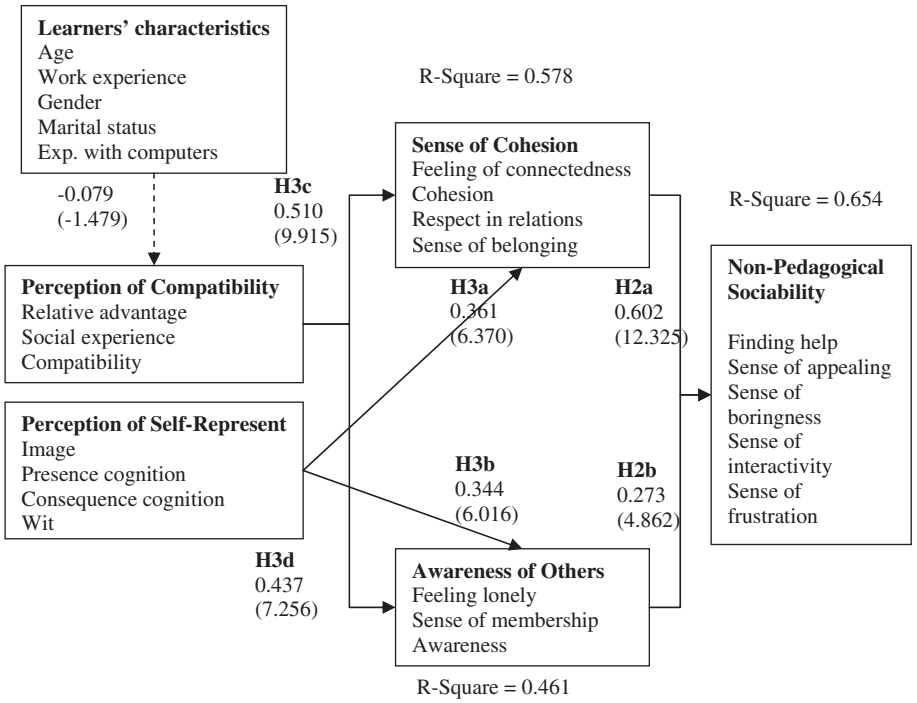

Fig. 3. Estimation of the research model ($\alpha = 0.05$).

the pilot study do not support the hypothesized relationship between individuals' communicative behavior adaptability and the non-task sociability. Yet, this finding does not change theoretical positions discussed earlier. Since few studied have previously applied SIP and SIDE theories in the field of social relationships in the CSCL, two alternative hypotheses were proposed to empirically examine how these two theories can explain the relationship between individuals' communicative behavior adaptability and social aspects of the CSCL. Thus, while the second hypothesis (H2a, H2b, and H2c) has not been empirically supported, the results support the first hypothesis (H1a, H1b).

Given the support for the third hypothesis, it is then conceivable that individuals' perceptions of non-pedagogical sociability of the environment are affected by their perceptions of the sense of community rather than adaptation to the CSCL system. On the other hand, people's sense of community is influenced by their level of communicative behavior adaptation to the environment. This in turn shows the development of individuals' perceptions toward non-pedagogical sociability: as the individuals adapt their communicative behaviors to the environment, they feel connected to the CSCL community and as this increases, individuals' perceptions of sociability of the CSCL environment also increase.

Lastly, the results show that except for the learners' characteristics, the rest of control factors do not have a significant relationship with the independent constructs in the research model. It is only the learners' characteristics that significantly affect the perception of compatibility. Similar findings have been reported in previous studies. Karahanna and Straub (1999) investigated the psychological origins of ease of use and perceived usefulness of CMC technologies and found that facilitating conditions such as the availability of technical training and support for the use of technology had no effect on the perception of ease of use and usefulness of the technology. Shea, Li, and Pickett (2006) also assessed the social environment of asynchronous CSCL environments and found that course characteristics as well as demographic data, such as age, gender, course structure, enrollment and employment status, do not influence students' sense of connectedness and adoption of the CSCL system. This is because the CSCL environment satisfies different needs and expectations of people from different backgrounds. Therefore, for example, while convenience and flexibility for older people may be considered as an advantage of CSCL, the net-generation students are more familiar with online environments and the CSCL interactions (Shea et al., 2006). As another example, where some people may be new to online environments and may require technical training, most online students are familiar with the standard features and capabilities of online environments.

Table 5 shows summary of the results of hypothesis testing in the structural model.

7. Main study

The second round of the questionnaire was conducted with a sample size of 210. The objectives of this study was (i) to confirm the factor structure and the loadings in the measurement model; (ii) to examine the research hypotheses and interrelationships between constructs in the structural model; (iii) to verify model estimations in terms of goodness of fit, significance of loadings, and the power of analysis; and (iv) to assess the convergent and discriminant validities as well as the reliability of the constructs.

Table 6
The AVE value of constructs in the research model.

Construct/Factor	Non-pedagogical sociability	Sense of cohesion	Awareness of others	Perception of compatibility	Perception of self-representation
AVE	0.64	0.63	0.54	0.64	0.50

Table 7
The result of the discriminant validity.

	Non-pedagogical sociability	Sense of cohesion	Awareness of others	Perception of self-representation	Perception of compatibility
Non-pedagogical sociability	**0.80**				
Sense of cohesion	0.75	**0.79**			
Awareness of others	0.61	0.56	**0.73**		
Perception of self-representation	0.47	0.38	0.58	**0.70**	
Perception of Compatibility	0.516	0.68	0.50	0.31	**0.82**

The revised version of the questionnaire with 28 items was considered for this study. The questionnaire was made available from the 12th of May 2008 for three weeks and a reminder was sent in the beginning of the third week. A total of 229 responses were received. Among those, twelve students had participated in the summer survey and their corresponding data sets were excluded from the study. Six respondents only completed the demographic information and left other questions unanswered. The corresponding data sets for these responses were also removed. Therefore, 210 responses remained for statistical analysis. Amongst participants, 98.8% were enrolled part-time and 99.5% were employed full-time; 26% were female and 74% were male. Also 26.7% of them were single and 73.3% were married. The average age of the respondents was 37 with 16 years working experience. The level of study for 70% of participants was at the masters level, 17.6% in the graduate diploma, 12.4% in the graduate certificate.

A confirmatory factor analysis (CFA) was performed to re-examine factor loadings of the chosen items achieved in the pilot study. Visual-PLS was used to estimate factor loadings and the bootstrapping was executed to calculate factor loadings as well as the *t*-values. The result showed that 'feeling calm' was the only indicator that did not significantly load on non-task sociability. Except for this item, all other indicators significantly loaded on their associative factors and had a loading above 0.60.

Next, the relationship between factors in the research model was assessed. The objective was to determine whether the relations derived from the pilot study can be confirmed with the new set of data in the main study. Visual-PLS was used to estimate the model at a significance level of $\alpha = 0.05$. Fig. 3 shows the result of estimation of the research model.

Numbers inside the parentheses in Fig. 3 indicate the t-values and numbers above the parentheses indicate the correlation coefficients. If a *t*-value is higher than 1.96, then the corresponding coefficient and the relationship between the two constructs is statistically significant at $\alpha = 0.05$. Appendix 1 shows the questions associated to the factors with significant coefficients.

The findings of the above analysis indicate that all relationships are significant, except the relationship between learners' characteristics and the perception of compatibility. Thus, this relationship is removed from the model. This finding shows that learners' characteristics, as one of the control factors, does not have a significant relationship with the perception of compatibility. A similar finding has also been reported by Shea et al. (2006). These authors have assessed the social environment of asynchronous CSCL environments and found that student and course characteristics, such as age, gender, course materials, enrollment and employment status, do not affect the students' sense of connectedness.

Furthermore, the results of model estimation indicate an *R*-square level of 0.654 for the non-task sociability factor. This value indicates that sense of cohesion and awareness of others explained 65.4% of the variances of the non-task sociability. The PLS method does not directly measure the power of analysis, therefore the present study used the approach introduced by Goodhue, Lewis, and Thompson (2006) to compute the power of analysis. Accordingly, all relationships between constructs in Fig. 3 were considered and *t*-values for the sample size of 200 were calculated. The number of insignificant *t*-values was then counted. The power for each relationship was achieved by dividing this number by 200. The average of the power of all relationships was calculated, which in turn indicated the power of the analysis. The achieved power is 0.975, which satisfies the recommended level of 0.80, suggested by Hair, Black, Babin, Anderson, and Tatham (2006). The achieved power of the analysis for the present study indicates high probability of detecting statistically significant relationships in the research model, when the relationships actually exist.

The above results support the hypothesized relationships between the sense of cohesion and awareness of others with the non-pedagogical sociability, H2a and H2b. The *R*-square showed these two independent constructs explain 65.4% of the variances of the non-pedagogical sociability of CSCL. In addition, the results also support the hypothesized relationships between the perception of compatibility and self-representation with the sense of cohesion and awareness of others – H3a, H3b, H3c, and H3d. The levels of the achieved *R*-square for the sense of cohesion and awareness of others were 0.578 and 0.471, which shows that the perception of compatibility and self-representation highly predict the sense of cohesion and awareness of others.

8. Validity and reliability analysis

The findings of the main study were examined against convergent and discriminant validity tests. The convergent validity tests whether items are most closely associated with their corresponding constructs (Straub, Boudreau, & Gefen, 2004). According to Gefen and Straub (2005), the convergent validity is proven when items significantly load on their corresponding construct. The findings of the main study showed that all items significantly load on their corresponding factors, with loadings higher than 0.60. In addition, Hair et al. (2006) point out that convergent validity is evidenced when the AVE values are 0.5 or higher. As Table 6 shows, the AVE values of all constructs are higher than 0.50.

Table 8
The reliability analysis.

	Non-pedagogical sociability	Sense of cohesion	Awareness of others	Perception of compatibility	Perception of self-representation
Reliability	0.83	0.80	0.59	0.75	0.65
Nominated indicators to be dropped	–	–	–	–	–
Final reliability	0.83	0.80	0.59	0.75	0.65

Therefore, the above results confirm that convergent validity is present, which indicates the selected items for each factor highly correlate with one another.

The discriminant validity indicates the extent to which a construct differs from other constructs when theoretically it should not be (Straub et al., 2004). To assess the existence of the discriminant validity, Gefen and Straub (2005) mention that two criteria must be tested: Firstly, each item must load highly on its corresponding factor. As the findings of the main study showed, items highly load on their corresponding factors, with all loadings above 0.60. Secondly, the square root of the AVE values of each construct should be higher than any correlation amongst any pairs of factors. The square roots of AVEs for each latent construct are the diagonal values in Table 7. As this Table shows, the discriminant validity is present, since the square root of the AVE value of each construct is larger than its correlation with other constructs.The AVE values are shown in bold in Table 7.

Furthermore, the Chronbach's α was used to measure the reliability of constructs in the research model. As Table 8 shows, all the constructs achieved the acceptable reliability level of 0.6 or higher, as recommended by (Hair et al., 2006).

9. Discussions and conclusion

The need for more sociable CSCL systems has been strongly emphasized in recent years and earlier studies have shown that sociable environments relate strongly to online learning enjoyment, the level of participation, and effectiveness of learning. Previous findings indicate that although virtual learning environments provide a variety of benefits, learners' isolation and lack of non-task sociability in the virtual space are emerging as the key pitfalls for the effectiveness of CSCL environments and should be considered in future systems development activities (Mcpherson & Nunes, 2004). This paper identified the knowledge gap in the current literature in CSCL environments in relation to the non-task interactions by students. The findings of the study contribute to the body of knowledge of CSCL through both demonstrating the existence of a substantial amount of non-task exchanges in the CSCL environment, as well as by operationalizing and examining factors that impact non-task sociability of CSCL environments.

This paper has distinguished non-task sociability from the task-related aspect of sociability. Such distinction deemed important as these two aspects of CSCL carry different meanings and contribute differently to the outcomes of the CSCL. Given this distinction, the first finding of the study is the operationalization of non-task aspect of sociability of CSCL by five indicators: finding help, sense of appealing, sense of boringness, sense of interactivity, and sense of frustration. This finding is an early attempt to address the need that had been recognized by other researchers (e.g., Wright et al., 2005 and Fairclough, 2008) for the operationalization and further investigation of sociability of CSCL environments. Furthermore, the above findings can be used in future research for investigating the relationship between the non-task sociability of CSCL and other factors in the area of online collaborative learning, such as learning performance and satisfaction.

Secondly, the findings of this study revealed factors that impact the non-task sociability of the CSCL. As discussed earlier, the sense of cohesion and awareness of others positively influence the non-pedagogical sociability of CSCL. This implies that students perceive the CSCL environment as sociable when they feel connected to others and also are aware of activities of other people in the environment. Furthermore, the results indicate that the perception of compatibility and self-representation – factors representing individuals' communicative behavior adaptability – positively impact the sense of cohesion and the awareness of others; the latter are factors representing the sense of community. This is in line with the predictions made by SIP theory. This theory suggests that participants in online discussions develop individuating impressions of others through accumulated CMC messages and consequently they may develop relationships through textual or verbal cues. In addition, these theories suggest that individuals or groups do not just receive the technology passively; rather they adapt their behavior in order to benefits from the technology. Therefore, it can be inferred that as students actively adapt their communicative behavior to the CSCL system, they develop social relations with others and can establish a stronger sense of community in the CSCL environment. This finding is important as it determines factors that lead to the non-task sociability in the CSCL environment, which in turn, as has been stressed by Muilenburga and Berge (2005), will improve students' enjoyment of the educational experience and will encourage more effective participation.

Thirdly, the present study quantitatively demonstrates the existence of non-task interactions of students in a CSCL environment. While the presence of such interactions has been reported earlier in the CSCL literature, few attempts have explicitly distinguished between the task and non-task interactions. Demonstrating the presence of non-task interactions in the CSCL environments not only supports significance of this study, but also shows that more attention should be given to facilitating and directing socialization in online courses.

Lastly, as a potentially practical outcome of the present study, an instrument was developed and validated for measuring the dependent and independent constructs of the research model. This instrument was tested with two independent samples with different sizes and has reflected a high level of validity and reliability in both tests. By providing a clear-cut list of indicators, such an instrument assists CSCL facilitators and developers to determine non-task social functionality. Furthermore, this instrument guides the change management in the CSCL for improving non-pedagogical social functionality of the environment.

Appendix 1. The questions associated to the items remained in the final model.

Question	Answers				
	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Perception of Compatibility					
I think WebTeach is consistent with my communication needs in order to develop social relationships with my classmates					

Appendix (*continued*)

Question	Answers				
	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
I found WebTeach has some advantages in developing relationships with my classmates					
Socializing with various students in the WebTeach environment is enjoyable and fun					
Perception of self-represent					
I feel my activities in the WebTeach environment give me recognition among my classmates					
When I first enter a new discussion in the WebTeach environment WebTeach enables me to monitor who is collaborating with whom					
Using the WebTeach environment the majority of students can clearly follow the outcome of their discussions					
I think the WebTeach environment allows people to be witty					
Sense of cohesion					
I feel connected to my classmates in the WebTeach environment					
I feel a sense of cohesion in the WebTeach environment					
In the WebTeach environment people respect each other					
I feel I belong to the WebTeach environment					
Awareness of others					
I feel lonely in the WebTeach environment					
I think people are aware of what happens in the WebTeach environment					
The WebTeach environment enables me to know who is who					
Non-pedagogical sociability					
I feel CSCL-Tool is a helpful and supportive environment					
I feel CSCL-Tool is a calm environment					
I think CSCL-Tool is an appealing environment					
I feel CSCL-Tool is a boring environment					
I have found CSCL-Tool to be an interactive environment					
I feel CSCL-Tool is a frustrating environment					

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