Title	Assessing learners' perceived readiness for computer-supported collaborative learning (CSCL): A study on initial development and validation
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Assessing Learners' Perceived Readiness for Computer-Supported Collaborative Learning (CSCL): A Study on Initial Development and Validation

Abstract

The main purpose of this study was to develop an instrument that assesses university students' perceived readiness for computer-supported collaborative learning (CSCL). Assessment in CSCL research had predominantly focused on measuring "after-collaboration" outcomes and "during-collaboration" behaviors while "before-collaboration" assessment was rarely studied. Given the nature of high learner agency and self-directness necessary in CSCL contexts, it was assumed that a sufficient level of student readiness for CSCL could promote positive attitudes and behaviors during the collaborative learning process and subsequent learning outcomes. Considering the importance of a before-collaboration status, this study proposes the new notion of Students' Readiness for CSCL (SR-CSCL) and presents a set of criteria to theoretically define and empirically measure the perceived level of SR-CSCL. Drawing on prior research on CSCL and readiness issues, we developed the SR-CSCL instrument with a three-dimensional framework consisting of: (a) motivation for collaborative learning, (b) prospective behaviors for collaborative learning and (c) online learning aptitude. The SR-CSCL instrument was validated with the university students in China in the pilot study (N=120) and the main study (N=295). Overall, the results showed some evidence of reliability and validity for the proposed instrument. This study presents an empirical assessment tool that can help instructors and researchers better understand and investigate how to assess and increase students' readiness levels in order to enhance their learning experiences in CSCL environments.

Keywords: Readiness; CSCL; Collaboration; Online learning

Introduction

Deutsch (2011), Johnson and Johnson (1999), and others in the literature have suggested that both collaborative learning (CL) and computer-supported collaborative learning (CSCL) depart from the direct transmission model of learning by creating opportunities to co-construct knowledge and be engaged in mutual meaning-making. More specifically, computer-supported collaborative learning (CSCL) focuses on the study of how people learn together with the support of computers, and it is this computer support for intersubjective meaning-making that makes the field unique (Stahl, 2006). Koschmann (2002) defined CSCL as "…a field of study centrally concerned with meaning and practices of meaning-making in the context of joint activity, and the ways in which these practices are mediated through designed artifacts" (p.18). The phrase "practices of meaning-making in the context of joint activity" is closely related to the concept of knowledge co-construction in social constructivism. Miyake (2007) argued for a socio-cultural perspective of CSCL, stating that learning in CSCL is a social process where individuals take the responsibility for constructing their own understanding and knowledge through social interaction. From a socio-cultural perspective of CSCL, learners in CSCL environments are usually given high autonomy to determine group goals, monitor group processes, and co-construct group products.

Given the nature of high learner agency and autonomy in CSCL, a sufficient level of readiness for CSCL is essential to promote meaningful learning experiences. As observed by Phielix, Prins and Kirschner (2010), not all students are able to harness the potentials of the socio-constructivist environment, as seen from the research studies that reported an array of pitfalls related to CSCL. These include increased cognitive dissonance, longer time to reach consensus, and lower

participation rates. Learners who are not ready for CSCL are likely to be non-contributing free-riders as commonly described in literature, significantly impeding collaborative learning results (Shumar & Renninger, 2002). Capdeferro and Romero's (2012) study on learners' frustrations in online collaborative learning environments also highlights "commitment imbalance" (p.32) as a major source of displeasure. Other sources of tension include unshared goals, communication difficulties and negotiation problems.

An extensive review conducted by Gress, Fior, Hadwin and Winne (2010) on empirical studies on CSCL revealed that previous CSCL research had predominantly focused on measuring "after-collaboration" outcomes and "during-collaboration" process. The aspect of "before-collaboration" assessment had been rarely studied despite the importance of ensuring a learner's readiness for CSCL. Within the limited pool of studies that mentioned "before-collaboration" assessment, most only focused on basic descriptive information. More specifically, of the 186 relevant literature studies reviewed by the authors, there were only 12 that examined before-collaborative measures such as students' attitudes toward collaboration, collaboration skills, prior experience, and social networks from prior collaboration. As a corollary, the authors concluded that a research gap exists in this area.

Indeed, little is known about systematically screening students' psychological readiness before engaging in computer-mediated collaborative activities, although instructors and researchers might be aware of the importance of readiness factors in learning process and outcomes. Given that few research studies to date have investigated students' readiness or suggested systematic approaches to assess the state of students' readiness in CSCL contexts, we argue that there is a critical need to propose a set of criteria to empirically evaluate Students' Readiness for CSCL (SR-

CSCL hereafter). The twofold purpose of this study was, therefore, to: (a) conceptualize the construct of SR-CSCL that emerged from literature; and (b) examine and confirm the underlying dimensions of SR-CSCL through an instrument validation process. This study helps bridge the gap in understanding the nuances of SR-CSCL and provides practical guidelines for measuring learners' readiness. Further, the SR-CSCL instrument can be used to assist instructors who wish to assess students' readiness levels and to employ pre-intervention measures and appropriate pre-activities for improving students' readiness, eventually enhancing students' learning process and outcomes in CSCL contexts.

Literature Review

Research on Learner Readiness Issues

Readiness research has been widely conducted in many fields, such as students' school readiness (Blair, 2002) in the field of childhood education, psychological readiness to change living habits in medical therapy (Carey, Purnine, Maisto, & Carey, 1999), physical activity readiness (Marcus, Rakowski, & Rossi, 1992) in physical exercises, and community readiness in social culture (Beebe, Harrison, Sharma, & Hedger, 2001). The concept of "readiness" in these studies shares a common meaning to some extent, which is the degree of psychological or physical preparedness for some actions, either to change personal behaviors or to improve personal qualifications to satisfy some pre-set criteria.

Readiness studies concerning the issue of collaboration have also been conducted in the fields of social communication (Nardi, 2005) and development of collaboratories (a combination of "collaborative" and "laboratories") (Olson, Teasley, Bietz, & Cogburn, 2002). Nardi (2005) proposed several criteria to evaluate the state

of communicative readiness, which includes three dimensions of connection, namely *affinity*, *commitment,* and *attention*. This three-dimensional assessment provides a set of guidelines for promoting communication readiness among collaborators. Similarly, Olson et al. (2002) pointed out that there are some critical success factors for collaboratories development, including collaboration readiness, collaborative infrastructure readiness, and collaborative technology readiness. They had further identified several components of collaboration readiness, which are motivation to collaborate, shared principles of collaboration, and experiences with the specific elements of collaboration. These criteria are used to evaluate the readiness conditions of collaboratories.

Learner Readiness in Online Learning

Readiness-related factors have been studied in the context of online learning. Kemery's research (2000) suggested that students' readiness to engage in online collaboration could be identified with students' capabilities to engage in online dialogues in terms of their technology literacy and cooperative learning skills. Additionally, Vonderwell and Savery (2004) argued that promoting students' readiness is essential for successful online learning experiences. They identified students' self-regulation, motivation, and awareness of change of roles in an online learning context as indicators of students' readiness for online learning.

Some research studies investigated online learners' readiness by identifying the internal structure of the proposed instruments. For instance, Smith and colleagues (Smith, 2005; Smith, Murphy, & Mahoney, 2003) validated the *Readiness for Online Learning Questionnaire (ROLQ)* developed by McVay (2000). They administered the instrument first to 107 undergraduate students from the United States and Australia, and then to another sample of university students from Australia. They identified a

two-factor model by conducting factor analysis. The two factors, namely "comfort with e-learning" and "self-management of learning," accounted for 48.5% and 42.2% of the variance in the two studies respectively.

Kerr, Rynearson, and Kerr (2006) developed the *Test of Online Learning Success (TOOLS)* by employing a comprehensive scale development approach, which yielded a five-dimensional instrument, including (a) computer skills, (b) independent learning, (c) dependent learning, (d) need for online learning and (e) academic skills. Kim and Bateman (2007) used the TOOLS instrument to investigate the effects of students' readiness for online learning on their participation patterns in an asynchronous online discussion board. However, the results showed no clear correlation between students' scores in TOOLS and their participation patterns. Other instruments measuring learner's readiness in online learning include the *Online Learner Readiness Self-assessment Instrument (OLRSAI)* by Watkins (2004), the *Tertiary Students' Readiness for Online Learning Survey (TSROL)* by Pillay and co-researchers (2007), and *the Students' Readiness to Adopt Online Learning* by Valtonen and colleagues (2009).

While several instruments have been developed to measure student readiness in online learning contexts, Hung and co-researchers (2010) argued that the previous instruments for assessing online learners' readiness were not comprehensive because some important components, such as the Internet/computer self-efficacy and learners' self-control skills, were ignored. They developed a five-scale instrument named *Online Learning Readiness Scale (OLRS)*, and validated it by conducting confirmatory factor analysis. The five scales of OLRS include (a) computer/Internet self-efficacy, (b) self-directed learning, (c) learner control, (d) motivation for learning, and (e) online communication self-efficacy.

While these studies inform us about the potential indicators of SR-CSCL, the factors associated with online learning readiness cannot be used directly to assess SR-CSCL. Factors should be adapted and integrated to construct a comprehensive framework for assessing SR-CSCL, given the collaborative and autonomous nature of CSCL environments. The methodology we used will be elaborated in the next section.

Scale Development Method and Results

Adapted from the process proposed by DeVellis (2011), the scale development in this study was conducted through four main phases as shown in Figure 1: (a) item generation, (b) item refinement by gathering feedback from experts and target users, (c) a pilot study to administer the instrument to a sample of university students, and (d) a validation study to further refine and examine the internal structure of the pilot-tested instrument using a larger sample of university students.

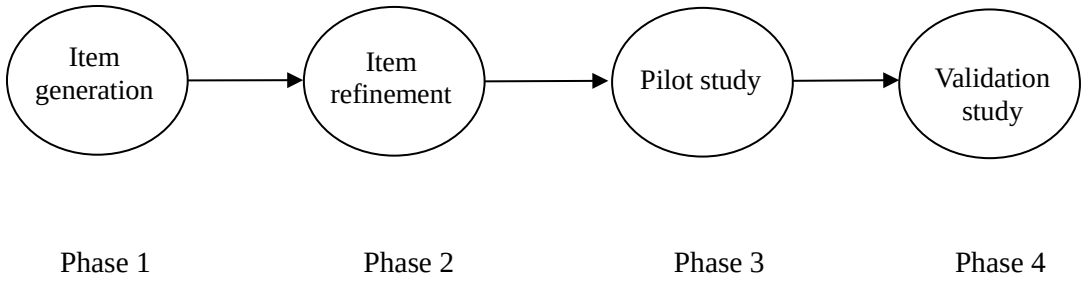

Figure 1. Instrument Development Process

Phase 1: Item Generation

The process of item generation began with conducting a comprehensive literature review on empirical studies that examined the indicators of learner readiness in CSCL contexts. In this review process, we conducted a broad search of research studies on collaborative learning in both online and face-to-face interaction contexts as we believe there is transferability of conceptual understanding on collaborative

readiness from both contexts. The literature review gave us some preliminary insights on how to study the dimensions related to collaborative readiness and provided conceptual understanding on the development of items. According to the research purposes and focus of this study, only factors associated with learners' perceptions about collaborative learning were considered. Factors associated with instructional and infrastructural aspects were not taken into account. Factors measuring students' unchangeable traits, like demographic profiles and personalities, were not considered as indicators of SR-CSCL either, since we focused on the collaborative readiness factors that could be changed or improved through instructional or other intervention strategies.

We conducted a comprehensive literature search to identify relevant prior research that contained items measuring some of the above constructs. From the literature search, indicators of leaners' readiness for CSCL could be grouped into three constructs, namely: (a) *motivation for collaborative learning*; (b) *prospective behaviors for collaborative learning*; and (c) *online learning aptitude*. The first two constructs addressed students' psychological readiness and perceived capabilities on collaborative learning while the last construct centered on students' adaptability in online learning environments. Stahl (2011) cautioned that, although technology is undisputedly important, it is easy to fall into the trap of technological rationality if one focuses too much on technology without taking social needs into account. A networked technological infrastructure does not necessarily lead to a networked community of learners. Kreijns, Kirschner and Vermeulen (2013) argued that the social bonds among individuals in a CSCL environment and their willingness to internalize values and regulations can greatly influence the interaction patterns of the community. In view of this, we included the individual motivation aspects as well as

the social aspects of collaboration in the proposed framework. We are aware that the three dimensional framework is by no means exhaustive. However, we believe these three components are highly related to student perceptions' of readiness in collaborative learning and deserve a systematic investigation to construct the notion of SR-CSCL.

Figure 2 presents the major constructs and sub-constructs that conceptualize the initial development of SR-CSCL instrument. Overall, items were generated by means of adapting existing items from the related previous research and by creating new items when necessary**,** as discussed in detail in the following sections.

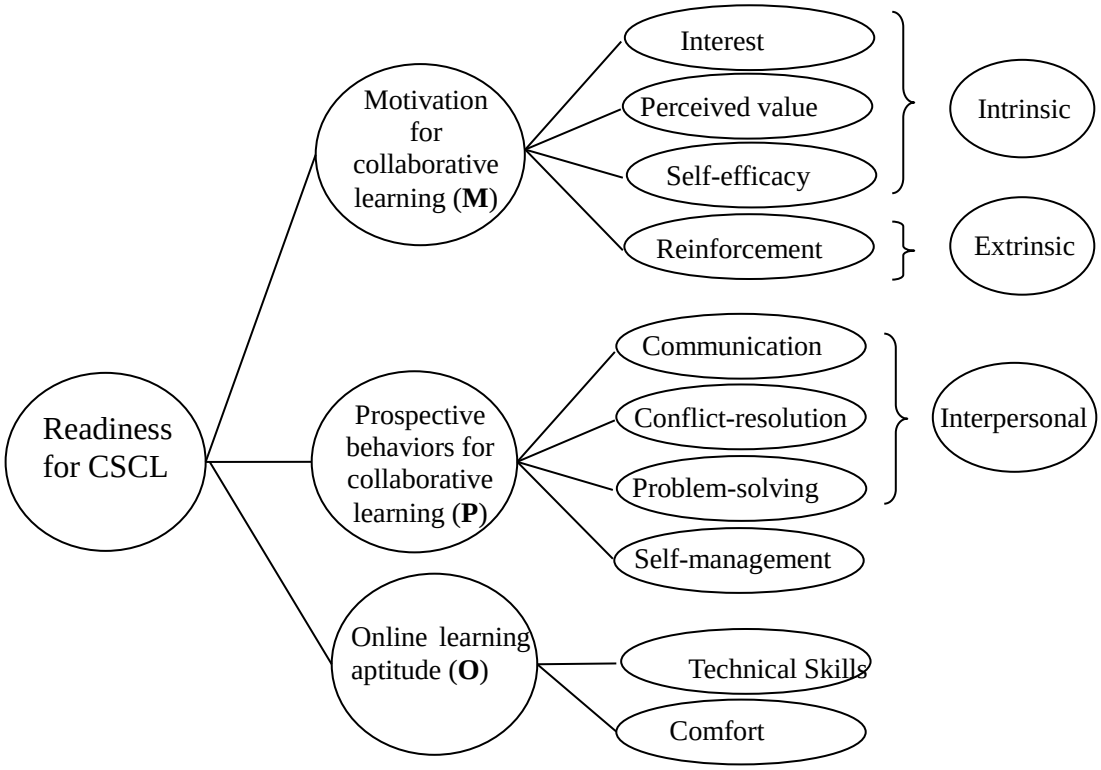

Figure 2. Proposed Constructs of Students' Readiness for CSCL

Motivation for Collaborative Learning

"Motivation for collaborative learning" focuses on *learner's psychological readiness* to engage in collaborative learning activities. The concern for motivational

aspects has been increasingly studied in the CSCL area (Dillenbourg, Järvelä, & Fischer, 2009). Researchers have reported positive relationships between learners' motivation and the quality of their collaboration in terms of participation levels (Chow & Law, 2005; Xie, Debacker, & Ferguson, 2006), perceived achievements and enjoyment (Gomez, Wu, & Passerini, 2010), and knowledge acquisition (Schoor & Bannert, 2011) in CSCL contexts. Drawing on self-determination theories on motivation, the elements that stimulated students' psychological inclination to engage in collaborative learning were placed into two main categories, namely extrinsic and intrinsic aspects of motivation.

We adapted items from Schoor and Bannert (2011), Xie, DeBacker and Ferguson (2006), and Chow and Law's studies (2005). We considered Schoor and Bannert's (2011) research as they adopted an integrative model for measuring motivation. Schoor and Bannert (2011) employed an integrative model to study motivation in CSCL, which included both expectancy and value constructs. Their research findings suggested that student motivation contributed to their learning outcomes in CSCL scenarios. Guided by self-determination theory, Xie et al. (2006) reported a strong correlation between learners' interest and level of participation in online discussion. In 2005, Chow and Law developed the Collaborative Inquiry-based Project Questionnaire (CIPQ) with five motivation factors, namely project work, social learning, task, reinforcement and social pressure, and found a significant relationship between the five factor scores and the level of student engagement in CSCL projects.

This "motivation for collaborative learning" scale comprises 22 items covering four subscales: (a) interest, (b) perceived value of collaborative learning, (c) self-efficacy and (d) reinforcement. Among the four subscales, "interest," "perceived

value of collaborative learning," and "self-efficacy" fall under the category of *intrinsic* motivation while "reinforcement" belongs to *extrinsic* motivation. By addressing both intrinsic and extrinsic aspects, we attempted to develop an integrated and comprehensive understanding of students' motivation to engage in collaborative learning. Specifically, all sub-constructs were operationalized as follows: *interest* is a person's intrinsic inclination to do and enjoy something when doing it; *value of collaborative learning* is the benefit that a person perceives to experience from participating in collaborative learning than in other learning approaches; *self-efficacy* is one's belief about self-capabilities to render appropriate actions to effectively achieve certain objectives (Bandura, 1997); and *reinforcement* is the external stimulus or force for a person to conduct certain actions. Table 1 presents sample item statements for each scale. All the items are five-point Likert type scale (i.e., 1 for "strongly disagree", and 5 for "strongly agree") and the item stem was "The possible reason I would like to participate in collaborative learning is…"

Table 1. "Motivation for Collaborative Learning" Scale and Sample Item Statements

Subscales	Sample Item Statement	Items Adapted from
Interest	Because I enjoy the experience of working together with classmates.	Schoor & Bannert (2011); Xie, et al. (2006); Chow & Law (2005)
Value of collaborative learning	Because working in groups allows me to tackle more complex topics than working individually.	
Self-efficacy	Because I believe I can do well in the group work.	
Reinforcement	Because I hope to receive praise from teachers and classmates about my good performance.	

Prospective Behaviors for Collaborative Learning

The “prospective behaviors for collaborative learning” scale examines the learner’s anticipation of their capabilities to engage in collaborative learning. Different from the motivational aspects aforementioned, this scale seeks to measure learners’ self-evaluation of their expectations of performance when engaging in collaborative learning. It is an important indicator of students’ readiness that measures whether a learner can foresee him- or herself as an active participant and contributor in collaborative work.

We adapted items mainly from Stevens and Campion (1994) who derived 14 specific knowledge, skills, and abilities (KSAs) required for teamwork, drawing from the extensive literature on group research in social psychology. We adopted the KSAs framework since the framework is comprehensive and covers both interpersonal and intrapersonal aspects of collaboration as well as managerial skills. This KSAs framework was validated in several follow-up studies, which reported that the correlations between collaboration KSAs and team autonomy or team efficacy are significant (Leach, Wall, Rogelberg, & Jackson, 2005; McClough & Rogelberg, 2003; Stevens & Campion, 1999).

This “prospective behaviors for collaborative learning” scale consisted of 27 items in four sub-scales, namely: (a) communication, (b) conflict resolution, (c) problem solving, and (d) self-management. Among the four subscales, the first three sub-scales cover *inter-personal* aspects of collaborative learning while the last scale focuses on an *intra-personal* aspect. Phielix, Prins, and Kirschner (2009) contended that social interactions promulgate both cognitive processes such as reasoning, reflection, critical thinking, and negotiating for shared meanings; as well as non-task social processes such as building collegiality and fostering a sense of community. These are vital ingredients for knowledge construction, conflict mediation, and

collaborative problem solving. Shi, Frederiksen, and Muis (2013) explained that when individuals want to refute opinions or maintain their own goals, they may demonstrate individually-oriented self-regulated learning dispositions, and when they want to meet the needs of members, they adopt socially-oriented self-regulated learning dispositions in a CSCL environment. The tinkering process to decide which strategy to adopt is often mediated by the cultural expectations of the group in which one is situated.

We included an additional "self- management" subscale as a prospective behavior of collaborative learning, by adopting Smith's (2005) proposition that individuals who exhibit readiness for online learning are able to self-manage their learning trajectories. We contend that when students are engaged in collaborative learning activities, both interpersonal interactions among group members in terms of their communication, conflict resolution, collaborative problem solving, and individual self-management within the group are important components to predict the effectiveness of collaboration. Table 2 presents each sub-construct with sample item statements. All the items are five-point Likert type scale with 1 for "strongly disagree" and 5 for "strongly agree."

Table 2. "Prospective Behaviors for Collaborative Learning" Scale and Sample Item Statements

Subscales	Sample Item Statement	Items Adapted from
Communication	I would engage in ritual greetings and small talks with my group members even if it has nothing to do with the group task.	Stevens & Campion (1994); Smith (2005)
Conflict-resolution	I would be able to implement an appropriate conflict resolution strategy.	

Problem-solving	When my group encounters difficulties, I would discuss together with my groupmate about how to solve the problem.
Self-management	I would be able to complete assignments on time.

Online Learning Aptitude

As the computer is an inevitable component in CSCL environments, students should adapt to the online collaborative learning environment (Miyake, 2007). In this study, online learning aptitude refers to the *learner's adaptability to online environments* in mainly two aspects: (a) perceived technical skills of online learning and (b) comfort level with online learning environments (Table 3). First, *technical skill*, often indicated as computer and Internet self-efficacy, refers to students' skills to use technical tools in an online learning environment, and students' perceived abilities for using online communication and other online technologies that are particularly related to online collaboration. In the prior studies that investigate students' technical skills in CSCL settings, learners' technology efficacy has been found to influence their collaborative gaming behaviors (Paraskeva, Mysirlaki, & Papagianni, 2010), intentions to use e-collaboration systems (Padilla-Meléndez, Garrido-Moreno, & Del Aguila-Obra, 2008) and the frequency of participation in online collaborative discussion (Prinsen, Volman, & Terwel, 2007).

Second, *comfort with online learning* refers to students' willingness and inclination to work online in a group. In general, in CSCL contexts, students are often required to perform certain tasks online within a group context. We suggest that "comfort with e-learning" is an important factor to assess online learners' readiness level (McVay, 2000; Smith, 2005; Smith et al., 2003). Prior studies showed that learners' willingness to participate in online discussions impacts the effectiveness of

online learning in contexts that require students to co-construct meaning and understandings (Harasim, Hiltz, Teles, & Turoff, 1995; Kemery, 2000).

We adapted items from Hung et al. (2010) and Kerr et al. (2006) to measure technical skills; and Smith (2005) to measure comfort with online learning. As mentioned earlier, both Hung et al. (2010) and Kerr et al. (2006) developed the instruments to empirically measure students' levels of readiness in online learning environments, and included technical skills, such as computer and Internet self-efficacy, as one of the critical factors affecting students' readiness and success in online learning. To construct relevant items measuring comfort with online learning, we adapted items from Smith (2003; 2005) that developed and validated the *Readiness for Online Learning Questionnaire (ROLQ)*, including "comfort with e-learning" as one of the critical factors affecting students' readiness with online learning. Table 3 presents each sub-construct with sample item statements. All the items are five-point Likert type scale with 1 for "strongly disagree" and 5 for "strongly agree."

Table 3. "Online Learning Aptitude" Scale and Sample Item Statements

Subscales	Sample Item Statement	Items Adapted from
Technical skills	I am good at using the Internet to find and gather relevant information for group work.	Hung, et al. (2010); Kerr, et al. (2006)
Comfort	I am comfortable about communicating with group members electronically (e.g., using email, Facebook, MSN, Skype, etc.).	Smith (2005)

Phase 2: Item Refinement

The items generated in Phase 1 were refined through two stages before pilot testing the instrument. First, the initial item pool was reviewed by experts for content

validation. Five experts reviewed the initial item pool to determine the content appropriateness. The invited experts were professors in the universities with research experiences for at least 5 years in the field of CSCL and psychological measurements. In the review form sent via email, the experts were asked to provide their comments freely on both the theoretical framework and the items for each of the scales. Based on the experts' comments received, five items were deleted because of inappropriate wording and ambiguity in meaning. Other items were rephrased slightly to improve the semantic appropriateness and clarity.

Second, the translated Chinese version of items was reviewed by a group of Chinese students to verify the appropriateness and understandability of each item. Since the targeted sample was university students in China, the instrument was translated into Chinese by the first author who is a native Chinese speaker. Then, the initial Chinese version of the instrument was reviewed by a group of seven Chinese university students who were asked to verify the accuracy and appropriateness of each item. According to their feedback, minor changes were made to improve the accuracy and understandability of the items. After the expert and student reviews, a total of 55 items were retained for a pilot testing.

Phase 3: Pilot Study

Data Collection

We conducted a pilot study to test the reliability of the instrument. The Chinese version of the instrument was administered to a sample of university students from three universities in China. Participation in the pilot study was voluntary. Course instructors invited around 300 students to participate in the study, and 120 students completed the survey.

Participant Characteristics

The participants included 50 female students (41.7%) and 70 male students (58.3%). Students' age ranged from 16 to 27 years old with a mean age of 21.05 years old. Regarding the field of majors, 62.5% participants were engineering students while 37.5% students were majoring in arts and humanities. A vast majority of the students reported that they had spent some time on both face-to-face and online collaborative learning.

Data Analysis and Results

The first step in data analysis was to identify the items that contributed negatively to the construct reliability (Downing & Haladyna, 2006). SPSS syntax was used to conduct item analysis (Lei & Wu, 2007). Specifically, we used item analysis of polytomous items because Likert-scale items were polytomously scored. Two indices were used to evaluate each item: *corrected item-total correlation* and *Cronbach's alpha if item deleted*. "Corrected item-total correlation" is the correlation between the item score and the total score of all other items with lower correlation indicating weaker relation between the item and the construct. "Cronbach's alpha if item deleted" is another index that examines the overall construct reliability if the item is deleted. We compared the "Cronbach's alpha if item deleted" with the Cronbach's alpha of the overall construct. If "Cronbach's alpha if item deleted" is higher than the original Cronbach's alpha, the corresponding item should be examined.

The item analysis resulted in removing some items with weak relations with the associated construct. For the motivation scale, four items did not function well with the "low corrected item-total correlations" and increased Cronbach's alpha if item deleted. These four items were related to external reinforcement measuring

participants' social pressure to conform. Since it appeared that the external pressure did not function well in determining participants' motivational status, we decided to remove the four items in the motivation scale to achieve a higher overall reliability of the scale. All of the negatively worded items in the three scales of "motivation for collaborative learning," "prospective behavior for online learning," and "online learning aptitude" were examined, and those that did not function well were also removed. In sum, a total of 47 items out of 55 were retained based on the item analysis.

Phase 4: Validation Study

Purpose

According to the literature on validity, validity is defined as the degree to which a testing score can be interpreted as representing the intended underlying construct (AERA, APA, & NCME, 2014; Cook, 2006; Cronbach & Meehl, 1955). The standards proposed by joint committee (AERA, APA, & NCME, 2014) outlined five types of evidence as possible supporting sources, namely: (a) evidence based on test content, (b) evidence based on response process, (c) evidence based on internal structure, (d) evidence based on relations to other variables, and (e) evidence based on consequences of testing.

The validation process is to gather evidence to support the interpretation and use of measurement results, which is the accumulation of evidence. As the current study is the first attempt to theorize the notion of SR-CSCL and develop the SR-CSCL instrument, it is important to verify whether the internal structure of the instrument is consistent with the proposed structure as shown in Figure 1. In Phase 2 of Item Refinement, we have gathered evidence from experts to verify the content of

the instrument. In this section, we are trying to provide empirical evidence from statistical analyses to support the proposed structure of the instrument. Although additional validity evidence may further support the use of the instrument, the purpose of the validation study in this section attempts to provide some preliminary evidence of validity by testing the factor structure of the three-dimensional instrument.

Data Collection

After the pilot-test, we administered the refined instrument to university students newly recruited from three Chinese universities. The data collection was done via an online platform. We recruited around 400 students to participate in the survey, and 369 students responded to the online survey. Among them, 295 participants completed and submitted all their responses, which yielded a completion rate of 79.9%. Uncompleted responses were excluded from subsequent data analysis.

Participant Characteristics

Participants in the main study were university students from three universities in China. Two of the universities are located in the central part of China with one university focusing on financial/business education and the other on science and engineering education. The third university is located in the southwestern part of China, mainly focusing on art and humanities education. We selected the three universities in order to obtain a representative sample of university students because the three universities have different student populations in terms of their majors of study. The participants included 126 female students (42.7%) and 167 male students (56.6%). Students' age range was from 18 to 33 years old with a mean age of 22.9 years old. In spite of the differences in students' disciplines of study, the participant characteristics of the three universities are more or less consistent. In addition, most

participants reported having spent some time in both face-to-face and online collaborative learning environments.

Data Analysis and Results

We conducted both exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). As our hypothesized structure is hierarchical as shown in Figure 2, EFA was first conducted to test the factorial structure within each scale. After that, a second-order CFA model was estimated to examine the model fit of the overall hypothesized model.

EFA, specifically a principal component analysis (PCA) with oblique rotation, was conducted to determine the underlying structure of the three scales: “motivation for collaborative learning,” “prospective behaviors for collaborative learning,” and “online learning aptitude” respectively. The purpose of this step was to identify the problematic items within each scale. In addition, the Kaiser-Meyer-Olkin measure of sampling adequacy (KMO) and Bartlett’s test of sphericity were checked each time before conducting EFA. A minimum KMO value of .6 and a significant Bartlett’s test were set as the prerequisites of conducting EFA (Snedecor & Cochran, 1989; Tabachnick & Fidell, 2001).

Eighteen items in the scale of “motivation for collaborative learning” were included for exploratory factor analysis. Three items were deleted one by one due to loadings on different factors from the hypothesized model. The final scale included fifteen items under the four factors as shown in Table 4. In total, the four factors accounted for 60.5% of the total variance.

Table 4. Factor Loadings for "Motivation for Collaborative Learning" Scale

Statement	Factor			
Item stem: *The possible reason I would like to participate in collaborative learning is,*	MI	MV	MS	MR
MI1. because I like to work with my classmates in group activities.	**.847**	-.137	.030	.042
MI2. because I enjoy the experience of working together with classmates.	**.846**	.045	-.122	.009
MI3. because it is fun.	**.713**	.035	.103	-.084
MI4. because it is important for me to do group work.	**.564**	.282	-.006	.002
MV1. because comparing with doing individual assignments, it is more effective to learn by doing group work.	.021	**.851**	-.170	-.012
MV2. because it can help my academic learning.	-.017	**.758**	.103	-.095
MV3. because working in groups allows me to tackle more complex topics than working individually.	.039	**.722**	.015	.017
MV4. because there are many opportunities for discussion and sharing ideas by working in groups.	-.020	**.595**	.131	.090
MS1. because I believe I can do well in the group work.	.123	-.188	**.893**	-.084
MS2. because I believe I can help my groupmates in some way.	-.222	.140	**.804**	.047
MS3. because I believe I can play an important role in the accomplishment of the group task.	-.001	.089	**.742**	.021
MS4. because I believe I can work well with my groupmates.	.250	.003	**.476**	.064
MR1. because I hope to achieve a good grade for this course (assuming that the participation level is one of the evaluation criteria).	-.097	-.056	-.060	**.904**
MR2. because I hope to receive praise from teachers and classmates about my good performance.	-.014	.024	.053	**.742**
MR3. because I hope to have a good relationship with my groupmates.	.186	.020	.026	**.650**

Note. MI = interest; MV = perceived value; MS = self-efficacy; and MR = reinforcement.

As for the scale of "prospective behaviors for collaborative learning," we included twenty items in the initial analysis. Five items were loaded on different factors from the hypothesized model, and were deleted one by one subsequently. The

final scale included fifteen items under the four factors as shown in Table 5. The four factors accounted for 62.5% of the total variance.

Table 5. Factor Loadings for "Prospective Behaviors for Collaborative Learning" Scale

Statement	Factor			
Item stem: *If I am doing group work,*	PC	PP	PM	PCR
PC1. I would listen to other members' ideas.	**.797**	.092	.177	-.315
PC2. I would like to share my ideas with others.	**.783**	-.021	-.214	.177
PC3. I would be open to new ideas.	**.781**	.127	.037	-.185
PC4. I would be tolerant of different ideas when doing group work.	**.718**	.126	-.118	.035
PC5. I would engage in ritual greetings and small talks with my group members even if it has nothing to do with the group task.	**.700**	-.345	.150	.173
PC6. I would be able to express what I think in an appropriate way, not harming other group members.	**.477**	.138	-.027	.333
PP1. I would participate in the negotiation to achieve a consensus with my group members.	-.124	**.926**	.030	-.061
PP2. I would encourage my group members to negotiate to solve the problem.	-.007	**.790**	-.004	.130
PP3. When my group encounters difficulties, I would discuss together with my groupmates about how to solve the problem.	.191	**.524**	.029	.054
PP4. I would exercise appropriate participation accordingly.	.123	**.467**	.018	.144
PM1. I would be able to provide feedback on overall team's performance.	.048	.059	**.806**	.019
PM2. I would be able to provide feedback on individual team member's performance.	-.007	.109	**.800**	-.057
PM3. I would be able to monitor my group's progress.	-.064	-.106	**.772**	.186
PCR1. I would be able to implement an appropriate conflict resolution strategy.	-.008	.108	-.031	**.810**
PCR2. I would be able to recognize the source of conflict confronting my group.	-.038	.021	.171	**.769**

Note. PC = communication; PP = problem-solving; PM = self-management; and PCR = conflict-resolution.

Finally, exploratory factor analysis was conducted with nine items in the scale of "online learning aptitude." All of the nine items were retained as shown in Table 6. The results showed that the two factors account for 63.7% of the total variance.

Table 6. Factors and Factor Loadings for "Online Learning Aptitude" Scale

	Factor	
	OS	OC
OS1. I am able to learn new technologies quickly.	**.993**	-.311
OS2. I am confident in my skills of managing software to do group work.	**.732**	.071
OS3. I am good at using the online communication tools to do the group work with my group members.	**.722**	.173
OS4. I am good at using the Internet to find and gather relevant information for group work.	**.720**	.093
OS5. I am good at using the Internet to effectively communicate with others.	**.679**	.167
OC1. I think online collaboration is of at least equal convenience to face-to-face collaboration	-.183	**.859**
OC2. I am comfortable about communicating with group members electronically (e.g., using email, Facebook, MSN, Skype, etc.).	.011	**.829**
OC3. I am willing to actively communicate with my classmates and instructors electronically.	.119	**.748**
OC4. I am willing to use online communication tools to do group work with my groupmates.	.364	**.435**

Note. OS = skill; and OC = comfort.

The three-dimensional instrument with thirty-nine items was further tested by estimating a second-order CFA model with the lowest level being the specific test items within each scale, the higher level being the latent sub-constructs within the three major constructs (i.e., interest, perceived value, self-efficacy and reinforcement within the motivation scale; communication, problem-solving, self-management and conflict-resolution within the prospective behavior scale; and online skill and comfort

level within the online aptitude scale) and the highest level being the three constructs (e.g., motivation, prospective behaviors, and online aptitude).

Specifically, we used robust maximum likelihood estimation (MLE), specifically MLE with Satorra-Bentler (S-B) scaled statistics, because robust MLE works better than normal MLE and weighted least square (WLS) estimation with a non-large sample and ordinal data (Kline, 2011). Model fit was tested using several indices. First, it was assessed using the ratio of the minimum fit function χ^2 to its degree of freedom (χ^2/df), with a range of less than 2.0 as acceptable fit (Hu & Bentler, 1999). As different indices reflected different aspects of model fit, three additional fit statistics were used to further assess the model fit: (a) the comparative fit index (CFI) with values more than .95 to be acceptable, (b) the root-mean-square error of approximation (RMSEA) with values less than .06 as acceptable fit, and (c) the standardized summary of the average covariance residuals (SRMR) with values less than .08 to be acceptable (Hu & Bentler, 1999; Kline, 2011).

As shown in Table 7, all the fit statistics were within the acceptable range, indicating a good model-fit. The estimated model also showed that all factor loadings were significant (see Tables 8-10 that all the t-values are greater than the critical value of 1.96). Both intrinsic and extrinsic motivation contributed significantly to the latent variable "motivation for collaborative learning," "self-management," and "conflict-resolution" appeared to have smaller factor loadings than "communication" and "problem-solving." In addition, both "online skill" and "comfort level" contributed significantly to the latent variable "online learning aptitude." The three highest-order constructs were also correlated with each other. Overall, the CFA results strongly supported the hypothesized model.

Table 7. Model Fit Statistics for the Second-Order CFA Model

S-B Scaled χ^2	df	χ^2/df	CFI	RMSEA	SRMR
939	689	1.36	.987	.037	.08

Table 8. Results of the Confirmatory Factor Analysis (Motivation Scale)

Item	Standardized Estimate	t-value	R^2
MI			
MI1	0.764	--	0.584
MI2	0.753	9.929	0.567
MI3	0.707	10.177	0.500
MI4	0.704	8.980	0.495
MV			
MV1	0.628	--	0.395
MV2	0.651	8.195	0.424
MV3	0.734	9.097	0.539
MV4	0.691	7.760	0.477
MS			
MS1	0.733	--	0.538
MS2	0.712	10.829	0.507
MS3	0.798	11.232	0.637
MS4	0.651	11.468	0.424
MR			
MR1	0.626	--	0.392
MR2	0.766	8.866	0.586
MR3	0.714	8.555	0.510

Second-order			
MI	0.760	9.025	0.577
MV	0.795	8.669	0.632
MS	0.861	11.129	0.742
MR	0.705	7.900	0.497

Note. MI = interest; MV = perceived value; MS = self-efficacy; and MR = reinforcement.

Table 9. Results of the Confirmatory Factor Analysis (Prospective Behavior Scale)

Item	Standardized Estimate	t-value	R^2
PC			
PC1	0.896	--	0.802
PC2	0.676	6.443	0.457
PC3	0.886	14.435	0.785
PC4	0.727	7.618	0.528
PC5	0.552	7.217	0.305
PC6	0.619	8.439	0.383
PP			
PP1	0.755	--	0.570
PP2	0.812	11.648	0.659
PP3	0.688	6.942	0.473
PP4	0.592	6.828	0.351
PM			
PM1	0.930	--	0.865
PM2	0.755	10.179	0.570
PM3	0.711	9.439	0.506

PCR			
PCR1	0.800	--	0.639
PCR2	0.803	6.785	0.646
Second-order			
PC	0.814	11.487	0.663
PP	0.876	8.603	0.768
PM	0.571	7.545	0.326
PCR	0.570	5.790	0.325

Note. PC = communication; PP = problem-solving; PM = self-management; and PCR = conflict-resolution.

Table 10. Results of the Confirmatory Factor Analysis (Online Aptitude Scale)

Item	Standardized Estimate	t-value	R^2
OS			
OS1	0.634	--	0.402
OS2	0.688	13.422	0.474
OS3	0.946	10.975	0.895
OS4	0.752	10.192	0.566
OS5	0.914	10.811	0.835
OC			
OC1	0.575	--	0.330
OC2	0.823	8.993	0.677
OC3	0.836	8.655	0.699
OC4	0.716	7.330	0.512
Second-order			
OS	0.895	9.535	0.800

OC	0.905		8.429	0.820

Note. OS = skill; and OC = comfort.

Discussion

General Discussion

The aim of this study was to provide a conceptual framework for developing an instrument to measure university students' perceived readiness for CSCL. In order to investigate the underlying dimensions of SR-CSCL, we proposed a three-dimensional framework including "motivation for collaborative learning," "prospective behaviors of collaborative learning," and "online learning aptitude." To establish the reliability and validity of the factorial structure of the scales, we tested the instrument with two different samples of university students for both the pilot study and the validation study. The results provided some evidence to support both the reliability and validity of the hypothesized framework with the three-dimensional structure.

Regarding the latent variable "motivation for collaborative learning," it appeared that both intrinsic and extrinsic motivations have a great impact on students' motivational levels, which is consistent with the findings reported in existing literature (Ryan & Deci, 2000; Xie et al., 2006). For the scale "prospective behaviors for collaborative learning," all four aspects encompassing students' communication, conflict resolution strategies, problem solving and self-management, played important roles to determine students' prospective behaviors for collaborative learning. This finding is also consistent with Stevens and Campion's (1994) argument that students' interpersonal and self-management skills are critical prerequisites for successful teamwork. The two-dimensional structure of "online learning aptitude" revealed that

both students' online skills and comfort level with online learning had a significant bearing on their perception of online learning aptitude.

The final version of the instrument consists of 39 items (see Appendix) with higher cumulative scores implying higher readiness levels for CSCL. While a further validation of the scale is necessary to verify the stability and applicability of the instrument in different cultural and language contexts, the validation process in this study has operationalized and conceptualized the issue of "students' readiness" in CSCL contexts. Another value of the three-dimensional framework proposed here lies in that it provides quantifiable measures for instructors and researchers to assess students' readiness for CSCL before engaging in CSCL activities. By examining students' readiness levels in the three areas—motivation, collaboration, and online learning—instructors may be able to determine whether students are at a high- or low-level of readiness. Armed with such information, instructors may also re-think group configuration to minimize potential conflicts or leverage students' collective or differentiated expertise. Dillenbourg et al. (2009) noted that students with different "socioemotional orientations" (p.10) would have different interpretations about novel CSCL environments, leading to myriad behaviors, which present social opportunities or challenges. Hence, once certain students or groups are identified as not ready for CSCL activities, follow-up actions should be applied to augment their readiness levels.

Implications for Education

Several strategies have been suggested in the literature to promote students' readiness levels for CSCL. For example, students with little motivation for collaborative learning should be given more autonomy in group formation and topic selection (Kemery, 2000). Additionally, instructors can use warm-up pre-activities to promote group cohesion and to increase students' motivation for future learning

(Kolodner et al., 2003). Warm-up activities can take various forms such as simplified collaborative problem-solving activities and subject-related team-building activities as a kick-start. Instructors can apply various collaboration platforms to equip students with collaboration know-how, given that collaborative expertise can be developed through experiencing different forms of collaboration (Barron, 2003). Modeling good collaborative practices can also promote students' collaborative expertise by learning from the model (Rummel, Spada, & Hauser, 2009). Finally, technical training should be provided for students, especially when they are required to use unfamiliar technical tools. With that, they would encounter fewer technical obstacles, which otherwise may impede their collaboration efforts.

Gress et al. (2010) suggested that learners need to "identify different aspects of their learning processes" (p.811). We believe that this assessment of collaborative readiness can provide learners with insights about their learning orientations prior to collaborative work. However, it is also important to note that "readiness" is not a static construct. It can change temporally based on learners' lived experiences of collaboration. Thus, in addition to learners' identifying aspects of their learning processes, we also propose that learners and instructors/facilitators can interpret information related to before-collaboration readiness as well as during and after-collaboration experiences in totality. Together, they have the potential to provide both synchronic and diachronic reflexivity about one's collaborative practices and the underlying reasons of why one's perceptions or practices related to CSCL change over time.

Limitations of the Study

Some limitations of the present study should be noted. First, we did not use a random sampling method while specific care was taken to include participants from

different years of study and academic majors. Future research can attempt a representative sample from a randomized or stratified sampling method or in different cultural contexts. Second, the current study primarily focused on providing some preliminary evidence on supporting the proposed framework of SR-CSCL. Additional evidence could further support the use of the instrument. For example, other variables, such as students' participation, performance, and outcomes in CSCL activities, need to be addressed to test the predictive validity of the proposed scales. Third, the current study focused on general perceptual measures of students' readiness for CSCL without reference to a specific learning context and content. Adding contextualized items measuring specific CSCL tasks and groups may be more informative for a specific CSCL context, but doing so at the same time compensate for the generic nature of this instrument.

Conclusion and Future Research

The SR-CSCL instrument was designed with the focus on how an individual may function in a group based on perceived readiness. Such predispositions towards collaborative learning do not tell us how knowledge is actually constructed or how learning takes place in-situ within the group. The complex interplay between structural and emergent socio-cultural factors will influence or have mediating effect on the predicted behavior of collaboration since group dynamics is irreducible to individual characteristics (Stahl, Koschmann, & Suthers, 2006). Hence, other dimensions of CSCL need to be considered to triangulate the concept of SR-CSCL. As proposed above, in-situ and after collaboration practices can be studied in totality to give us a fuller picture of baseline information as well as the dialectical interaction of individual knowing and social collectives. In future studies, qualitative measures

such as contextual observations and in-depth interviews should be taken into account to construct a comprehensive understanding of this concept SR-CSCL. As for other research possibilities, the study on CSCL readiness can also be extended to teachers who need to facilitate CSCL sessions. Such baseline studies can provide us with insights about teachers' epistemological orientations and the content of targeted professional development program.

In conclusion, given that there is little research directed at students' readiness for CSCL, this study on students' readiness and the initiation of the three-dimensional theoretical framework is pivotal to both instructors and researchers. The three-dimensional factorial structure was supported by the empirical data. We believe it sets the stage for a more concerted effort to assess and increase students' readiness for CSCL in order to enhance their learning experiences in CSCL environments.

Appendix: SR-CSCL Instrument (39 Items)

Motivation for collaborative learning (15 Items)

Statement: *The possible reason I would like to participate in collaborative learning is,*

1. (MI1) because I like to work with my classmates in group activities.
2. (MI2) because I enjoy the experience of working together with classmates.
3. (MI3) because it is fun.
4. (MI4) because it is important for me to do group work.
5. (MV1) because comparing with doing individual assignments, it is more effective to learn by doing group work.
6. (MV2) because it can help my academic learning.
7. (MV3) because working in groups allows me to tackle more complex topics than working individually.
8. (MV4) because there are many opportunities for discussion and sharing ideas by working in groups.
9. (MS1) because I believe I can do well in the group work.
10. (MS2) because I believe I can help my groupmates in some way.
11. (MS3) because I believe I can work well with my groupmates.
12. (MS4) because I believe I can play an important role in the accomplishment of the group task.
13. (MR1) because I hope to achieve a good grade for this course (assuming that the participation level is one of the evaluation criteria).
14. (MR2) because I hope to receive praise from teachers and classmates about my good performance.
15. (MR3) because I hope to have a good relationship with my groupmates.

(Note: MI = interest; MV = perceived value; MS = self-efficacy; and MR = reinforcement)

Prospective behaviors for collaborative learning (15 Items)

Statement: If I am doing group work,

16. (PC1) I would listen to other members' ideas.
17. (PC2) I would like to share my ideas with others.
18. (PC3) I would be open to new ideas.
19. (PC4) I would be tolerant of different ideas when doing group work.
20. (PC5) I would engage in ritual greetings and small talks with my group members even if it has nothing to do with the group task.
21. (PC6) I would be able to express what I think in an appropriate way, not harming other group members.
22. (PP1) I would participate in the negotiation to achieve a consensus with my group members.
23. (PP2) I would encourage my group members to negotiate to solve the problem.
24. (PP3) When my group encounters difficulties, I would discuss together with my groupmates about how to solve the problem.
25. (PP4) I would exercise appropriate participation accordingly.

26. (PM1) I would be able to provide feedback on overall team's performance.
27. (PM2) I would be able to provide feedback on individual team member's performance.
28. (PM3) I would be able to monitor my group's progress.
29. (PCR1) I would be able to implement an appropriate conflict resolution strategy.
30. (PCR2) I would be able to recognize the source of conflict confronting my group.

(Note. PC = communication; PP = problem-solving; PM = self-management; and PCR = conflict-resolution.)

Online learning aptitude **(9 Items)**

1. (OS1) I am able to learn new technologies quickly.
2. (OS2) I am confident in my skills of managing software to do group work.
3. (OS3) I am good at using the online communication tools to do the group work with my group members.
4. (OS4) I am good at using the Internet to find and gather relevant information for group work.
5. (OS5) I am good at using the Internet to effectively communicate with others.
6. (OC1) I think online collaboration is of at least equal convenience to face-to-face collaboration
7. (OC2) I am comfortable about communicating with group members electronically (e.g., using email, Facebook, MSN, Skype, etc.).
8. (OC3) I am willing to actively communicate with my classmates and instructors electronically.
9. (OC4) I am willing to use online communication tools to do group work with my groupmates.

(Note. OS = skill; and OC = comfort)

Compliance with Ethical Standards

We declare that there are no potential conflicts of interest. We complied with the ethical standards of research involving human subjects. Informed consent was obtained from all individual participants included in the study.

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