The Effects of Social Presence Visualization based on a Community of Inquiry Framework

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Abstract: There is growing interest in collaborative learning in higher education. Collaborative learning requires the active participation of students, and thus fosters high-end learning skills. CSCL is one popular tool used to enhance learning outcomes through collaboration among learners. However, to enhance learning performance through CSCL, effective CSCL design such as functions for monitoring and reflection are required. This study aims to investigate the effects of the visualization system of social relationships among learners on perceived social relationships, cognitive learning sense, and contribution to project collaborative work using a Community of Inquiry framework. The results indicated that the perceived effects of the visualization directly affected the enhancement of social relationships and promoted the perceived cognitive learning sense and contribution to project work indirectly.

Keywords: Social Presence, Community of Inquiry framework, Visualization

1. Introduction

In the age of technological innovation, Computer-Supported Collaborative Learning (CSCL) is one powerful tool to support collaborative work. However, there are several challenges to the implementation of collaborative learning in educational settings such as the difficulty in tailoring collaborative learning schedules around learners' various other class commitments. To solve this problem, appropriate CSCL design should be investigated based on theories on the formation of human relations.

The background of CSCL is based in socio-constructivist pedagogical theory, which posits that knowledge should be constructed and re-constructed through interaction between learners or between learners and artifacts (Scardamalia & Bereiter, 1993). To support collaborative work through CSCL, it is important to consider how to enhance interaction between learners who work collaboratively in a virtual setting in the design thereof. The advancement of information technology allows us to understand collaboration, context, and level thereof, and visualize this information. The Community of Inquiry (CoI) framework is useful for the evaluation of learning activities and behaviors in a learning community. This study aims to evaluate the effects of the visualization of CSCL based on social presence to enhance learning motivation and achievement in support of collaborative learning programs.

2. Community of Inquiry Framework

Garrison and Anderson (2003) constructed a CoI framework in which teachers and learners interact in text-based, online communication. The CoI framework consists of three elements: social presence, cognitive presence, and teaching presence. Social presence is defined as "the ability of participants to identify with the community, communicate purposefully in a trusting environment, and develop interpersonal relationships by projecting their individual personalities" (Garrison & Anderson, 2003). Social presence is regarded as a necessary element for creating a secure environment for interpersonal communication to foster an open environment conducive to discussion. Shea and Bidjerano (2009) suggest social presence as a fundamental factor in predicting the level of cognitive behaviors. They found that high cognitive learners treated low cognitive learners by responding to them using social presence. Cognitive presence is defined as "a vital element in critical thinking, a process and outcome that is frequently presented as the ostensible goal of all higher education" (Garrison et al., 2000). Teaching presence is defined as the design, facilitation, and direction of cognition and social processes to realize personally meaningful and educationally worthwhile learning outcomes (Gunawardena & Zittle, 1997). Integrating the three presences above into the learning environment design promotes CoI (Shea et al., 2010), as it promotes metacognition for collaborative learning (Akyol & Garrison, 2012) and learning performance (Goda & Yamada, 2012). Several studies have tried to design and develop a CSCL system based on CoI or comprised of CoI components (e.g., Yamada et al., 2016). The present study aims to evaluate social presence visualization, which is

based on the social presence CoI element.

Enhancing social presence is effective in promoting learning satisfaction (Gunawardena & Zittle, 1997) and cognitive learning behavior (Shea & Bidjerano, 2009). To enhance social presence, a reflective system in which learners monitor and adjust the current degree of social presence is needed (Yamada & Goda, 2012), because it is an unconscious feature. This means that learners are not always engaged in collaborative learning with the consciousness of social presence. Social perspectives (e.g., self-introduction, saying thank you/good-bye, and referring to other opinions), which are formed in collaboration, are difficult features to support using groupware (Phielix et al., 2010). Several researchers tackled this challenge by using visualization. Mochizuki et al. (2007) developed and evaluated a visualization system called "ProBo Portable," which visualizes the situation and progress of each group member's task on a mobile phone. Visualization seems to effectively enhance social presence through monitoring learners' level of social presence. This research reveals that visualization of the situation and progress in collaborative circumstances is effective in monitoring each other and enhancing the learning community as a reflective feature.

3. System Used in this Study

The CSCL system "C4" (Yamada et al., 2016) was used in this study. This system was developed as a Moodle plugin (Version 2.8.X, 2.9.X, 3.1.X) and consists of two parts. One is social presence visualization, and the other is the function for social and cognitive communication "CD-Map." Figure 1 shows the interface for social presence visualization. The system stores every comment written by each user into a chat group thread and calculates three types of Social Presence Scores: (a) Score of a user to a group, (b) Score of a user's reply to another user, and (c) Score of a whole group. The calculation of score (a) is based on every comment written by a user in a chat group thread. The calculation of score (b) is based on every reply made by one user in response to the comment of another user. To calculate score (b), the visualization system collects the data of the user name that sent the messages as the variable name "MENTION." That is, the "Reply Symbol" means that a symbol appears in a text when a user replies to another user's comment in the proposed system. Only when the symbol appears in a text is the first value in the score set as 1; otherwise, the value is 0. The calculations of score (c) are based on every comment written by every user in a chat group.

The proposed system has a national language processing (NLP) module to analyze a text written by each user as a comment in a chat group. The core part of the system is implemented using PHP so that the system can be easily implemented to cooperate with Moodle. Only the module is implemented using Python, because Python has many helpful libraries that support NLP. "Stanford CoreNLP" (Manning et al., 2014), a popular NLP library for analyzing documents written in English, is used in the module for the text analysis. The procedure to calculate the Social Presence Score starts with the core system's passing of one text written by a user into the module, followed by the module's calculation of a Social Presence Score of the text, which is based on several rules and explained in the next section.

Figure 2 shows the interface of a chat system in the concept map tool "CD-Map." After learners click the chat module link in the course, they can move to the social presence visualization page displayed in Figure 1. When learners click the "CD-Map" button, they can move to CD-Map, which consists of two functions: chat and the concept map. The chat function allows learners to post their messages using emoticons and to share the file. Learners can mark other posts as a "favorite" by pushing the "like" button. In the concept map, leaners can click and drag a posting object in the chat area to the concept map area, and then show the relationships between postings using arrow lines. The concept map function as a group cognitive tool enables learners to index the information on the concept map. Therefore, it is effective for the improvement of group memory (Hoppe & Gaßner, 2002). The researchers indicated that the system used in this research might be effective in enhancing social presence and improving the quality of the discussion (Yamada et al., 2016).

4. Method

4.1. Subject and Procedure

The participants in this research were 160 second-year students in two classes (Departments of architecture, and information technology) at a university. These students had the minimal computer skills and knowledge (such as keyboard typing) required to participate. The online discussion activities provided students additional opportunities to practice their English communication skills in and out of class. The discussion topic, "The country in which you want to live," was selected considering students' interest in enhancing motivation, being engaged, and relating previous knowledge and/or experiences to the issue. Students were required to set a task schedule and divide the

labor. All students were required to participate in all activities. Each group consisted of three or four students. Students were randomly assigned to each group. Students were required to submit the information matrix that described viewpoints and an evaluation pertaining to the country and report through the learning management system.

Figure. 1. Interface for social presence visualization (Yamada et al., 2016)

4.2. Data Collection

The CoI questionnaire, perceived contribution (one question), and perceived effects of the visualization interface (two questions) survey was conducted at the end of the class two weeks later to measure the level of CoI and learning behavior. In Swan et al. (2008), the CoI survey displayed in Appendix A consists of 34 five-point Likert scale items. However, in this study, 21 items were employed in the investigation of social and cognitive presence, because the instructor did not attend the online discussion. Students were also required to answer questions pertaining to their perception of their contribution to collaborative tasks in numeric format (min 0 to max 100). This score was set as the dependent variable for the system evaluation. We included two statements on the perceived effects of the visualization interface as follows. Q1: The interface allowed me to easily understand the level of group activity. Q2: This interface was intuitive for me to understand the level of group activity.

5. Results

Of the 160 participants, 120 students responded to the CoI questionnaire. First, group effects were analyzed for further research. To do this, the data of one student was eliminated, because she was the only student that answered the questionnaire in her group. Therefore, 119 datasets were used in this study. The score of social and cognitive presence was calculated. Table 1 provides the descriptive data. Three scores for the dependent variable "perceived contribution" were calculated to consider the group effects on individual perception of the system: Interclass correlation coefficients (ICC1 and ICC2) and the design effect. If these three scores satisfy the criteria (ICC1 and ICC2 are more than 0.1, design effect more than 2), then a multilevel analysis should be employed to investigate the group effect on individual perception. The results indicate that not all scores met the criteria (ICC1:

0.011, design effect: 1.023, ICC2: 0.033), demonstrating that the group effects on individual perception were very slight, and that a multilevel analysis is not appropriate for the data in this study. To investigate the effects of this system, the relationships among the perceived effects of the interface, social and cognitive presence, and perceived contribution were investigated using sequential equation modeling (SEM). Figure 3 provides the results. Model fitting parameters (CFI, TLI, RMSEA, χ 2) are acceptable for validity. The results indicated that the perceived effects of the interface indirectly enhanced the perceived contribution to collaborative task in this class. First, the perception of an intuitive interface enhanced perceived social presence, and social presence promoted perceived cognitive presence and contribution. All relationships among the variables are positive.

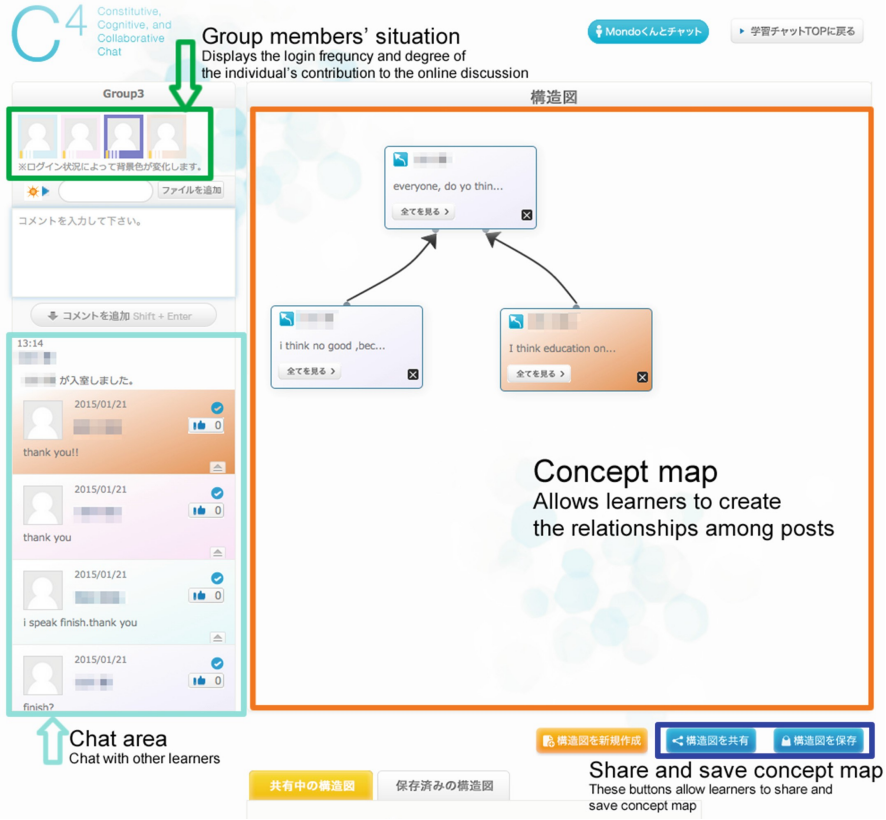

Figure 2. Interface for CD-Map

Table 1. Descriptive data of social and cognitive presence, perception of contribution to collaborative task, and perceived effects of the visualization interface

Questionnaire	Mean	SD
Social presence (9–45)	26.95	6.40
Cognitive presence (12–60)	34.15	8.62
Perceived contribution (0–100)	37.36	19.80
Interface Q1	3.05	1.35
Interface Q2	3.16	1.33

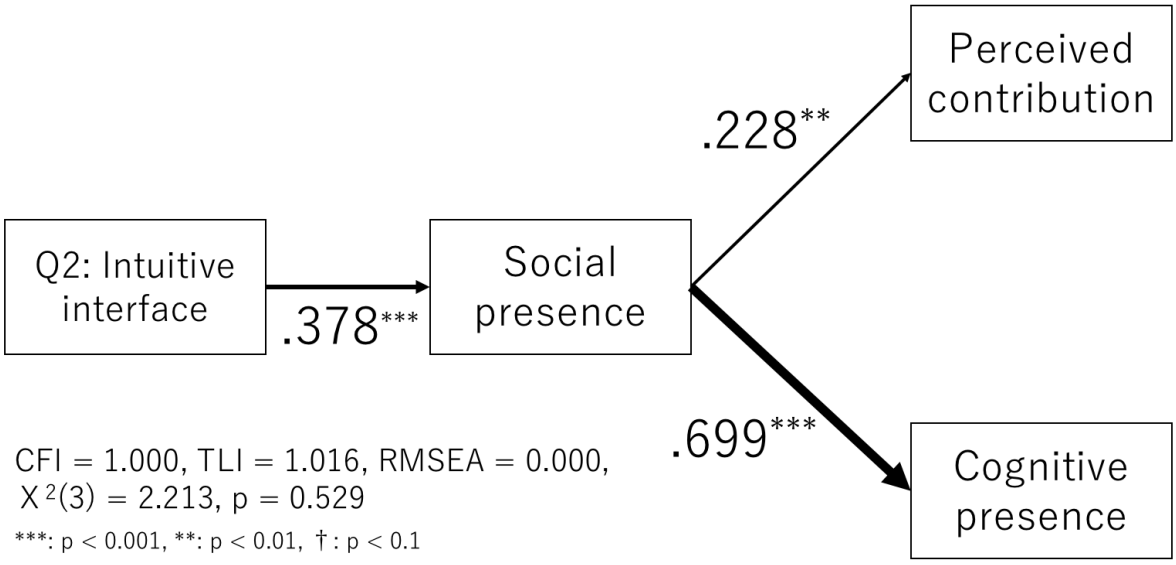

Figure 3. Results of SEM

6. Discussion

The results indicated that social presence visualization was effective in the enhancement of social presence directly, and cognitive presence and perceived contribution indirectly. Previous research such as that by Shea and Bidjerano (2009) and Yamada et al. (2016) support the findings of this research. Social presence is a fundamental element in the enhancement of cognitive learning behavior (Shea & Bidjerano, 2009). The results of this study also show the central role of social presence in enhancing fruitful collaboration and promoting awareness of contributions. The system developed in this study, in particular visualization, can support the perception of collaborative tasks. Yamada et al. (2016) show that the functions that enhance acknowledgement by other members promote perceived social presence as well as social and cognitive learning behaviors. Social presence visualization seems to have a reflective feature to understand the level of individual and group activity.

However, the relationship between perceived cognitive presence and sense of contribution was not confirmed in this study. Possibly, this is because students did not engage in deep discussion. An analysis of the dialogues reveals that while students decided on the division of labor and shared and integrated the learning outcomes group members accomplished, they did not suggest the direction of project work and critical viewpoints or ask other members on the system questions about learning outcomes. Therefore, students seemed to have fewer opportunities to critically consider their learning outcomes, finding it difficult to recognize other members' contribution to self-tasks.

7. Conclusion and Future Research

The findings of this research indicated that social presence visualization can enhance perceived social presence and indirectly perceived cognitive presence and contribution. Three points for future examination need to be highlighted here. One is to analyze the dialogue based on the CoI framework. Yamada and Kitamura (2011) suggested three types of social presence: effects of media, perceived social presence, and utterance of social presence. The relationships among the perception and behaviors of social and cognitive presence should be investigated in terms of the design of this system. Second is to conduct a comparative study to clarify the effects of this system. Finally, a function should be added for mobile devices. While students can use this system on a mobile phone, the interface is not yet appropriate.

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