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The effects of sentiments and co-regulation on group performance in computer supported collaborative learning

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ABSTRACT

Computer-supported collaborative learning (CSCL) is a widely acknowledged method to improve learning performance. Successful collaborative learning is closely associated with sentiments and inherently a group's co-regulatory capabilities in joint academic activities. This study explores the relationship between CSCL and sentiments, as well as the connection between CSCL and regulation, where we aim to establish that the quantitative estimates of these links in order to predict group performance. We conducted a study to examine the relationships among sentiments, co-regulation, and group performance in a synchronous, online, collaborative learning environment. The results show that insightful sentiments are positively related to group performance and, as a co-regulation strategy, orientation predicted group performance to a higher degree. We discuss the implications of our findings and practice in fostering productive online collaborative learning.

1. Introduction

In recent years, learners are increasingly connected via computer networks that offer ways of learning. Rather than functioning as passive communication in the traditional sense, contemporary learning networks are capable of goal-oriented guidance, sustainable social support, and personalized instruction, among other possibilities. With the aim of facilitating effective collaborative learning, the consequent challenge is to understand the interrelationships among cognition, sentiments, and social dimensions in groups.

Collaborative learning deals with instructional methods that promote education through collaborative efforts among students working on a given academic task. It could supplement a study environment to enliven and enrich the learning process. Interactive partners could be introduced in an instructional setting to create more realistic social contexts, potentially increasing the effectiveness of study processes. Such circumstances help sustain students' interests with assistance from ready, able, and willing collaborators and offer a natural habitat for absorbing new knowledge (Greer, Kumar, McCalla, Meagher & Tkatch, 1997; Greer, McCalla, Kumar, Meagher, & Vassileva, 1998; Hadwin, Oshige, Gress, & Winne, 2010; Kumar, Gress, Hadwin, & Winne, 2010).

As Piaget (1928, 1932) pointed out, collaborative learning plays a major role in constructive cognitive development. Piaget believed that collaborative interactions between pairs of people are equally shared, in contrast with adult-child or teacher-student interactions, where the former is usually in control, and the latter characteristically follows what the former one says. Vygotsky (1978) later reaffirmed the link between collaboration and cognition. Moreover, collaborative learning is characterized as a coordinated, synchronous activity with the aim of building and maintaining a shared understanding of a problem (Roschelle & Teasley, 1995). Common understanding among peers implies that they share an emotional connection (Rapisarda, 2002; Pekrun, Goetz, Titz, & Perry, 2002; Molinari, Chanel, Betrancourt, Pun, & Bozelle, 2013), which drives and/or derives the need to support aspirations, accommodate capabilities, and proactively engage a group's members.

Group members usually regulate their behavior by planning, monitoring, and evaluating cognition and sentiments (Järvelä, Järvenoja, & Veermans, 2008; Volet & Mansfield, 2006). Sentiments are different from emotions, moods, emotional traits, and affective states. Desmet (2002) identified four types of affective states: emotions, moods, emotional traits, and sentiments. Emotions are intentional and acute; they last a very short time, ranging from seconds to minutes at most. Moods are essentially non-intentional and relatively long-term. Emotional traits are characterized as moods typical for a certain person. Thus, emotional traits are not directed at a specific subject, but at the world in general. Sentiments are attitudes or opinions with respect to some topics or events (van Trevor, 2010). The attitude might be a judgment, affective state, or intended emotional communication (Hovy, 2015). Previous research categorized sentiments as positive, negative, and neutral (Li, Hoi, Chang, & Jain, 2010; Taboada, Brooke, Tofiloski, Voll, & Stede, 2011; Thelwall & Buckley, 2013). Identifying the levels of sentiments and the supporting learners who express them is a challenge in the field of educational technology. We investigated what

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types of sentiments influence group performance and a group's proactive nature.

Self-regulated learning (SRL) theories explain academic learning and achievement in terms of observing the processes individual learners use to regulate their own study behavior. Self-regulated learners are expected to actively participate in the learning process, as opposed to passively receiving information. Prevalent SRL theories agree that major factors of regulation include learners' motivation, goals, self-monitoring, volitional strategies, self-evaluation, and self-reflection behaviors (Hadwin, Järvelä, & Miller, 2011; Pintrich, 2000; Zimmerman, 2008). Popular models view SRL under broadly defined phases through which learners pass repeatedly as they perform an academic task (Brokenshire & Kumar, 2008, 2009).

The literature has discussed an extension of SRL in the form of co-regulated learning, whereby an entity (e.g., a friend, software agent, or social group) other than the student influences regulatory activities. A wide variety of studies have found that SRL positively influences learners' performance (Boekaerts & Corno, 2005; Cheng & Chau, 2013). However, studies that examine the impact of co-regulated learning on group performance are still lacking. Therefore, we investigated whether a similar influence is observable with co-regulated learning.

We contend that sentiments also relate to regulation since study pathways, constraints, and expectations of students may vary with respect to changes in sentiments. Since self-regulated instruction scaffolds study activities with prompts and feedback (Biesinger & Crippen, 2010; Kim & Pedersen, 2011; Lee, Lim, & Grabowski, 2010), we further explored the relationship between co-regulated learning and expressed sentiments.

The study of co-regulation in collaborative learning environments is a rather recent development in educational psychology (Hadwin et al., 2011). Extending this further, we explored causality, which might exist among sentiments, co-regulation, and performance in a learning environment. Causal relations can be established between observed variables using Graphical Causal Models (GCMs), graph-based techniques that represent causal relationships between variables of interest. They began as an outgrowth of Bayesian Belief Networks (BBNs) and retain similar semantics, though there are several varieties. GCMs can be used to calculate the likelihood of a study event's results, as well as the likelihood of a study event receiving an intervention (e.g., feedback) to engender another study event; this is of particular interest in the field of educational technology, where we wish to take steps to improve learning performance and not merely be aware of such steps as abstract concepts (Brokenshire & Kumar, 2008, 2009). Therefore, we explored causality among sentiments, co-regulation, and performance, as well as discriminating factors of sentiments and co-regulation strategies.

Group performance is a crucial issue in the evaluation of collaborative learning pursuits. Previous studies have considered the effects of the following elements on group performance: advanced technologies (Blasco-Arcas, Buil, Hernandez-Ortega, & Sese, 2013; Wu, Hwang, Kuo, & Huang, 2013), assigned roles (Strijbos, Martens, Jochems, & Broers, 2007), transactive memory (Michinov & Michinov, 2009), and knowledge awareness (Sangin, Molinari, Nüssli, & Dillenbourg, 2011). However, there is a lack of empirical studies investigating the connections among sentiments, co-regulation, and group performance. We analyzed the relationships among different kinds of sentiments, co-regulation strategies, and group performance.

The next section contextualizes our study based on our findings from the literature. Then, we explain the details of the experimental design and the datasets. Finally, we analyze the results and conclude with the findings.

2. Literature review

In order to explore various research questions, we conducted a literature review to identify prior studies on learner sentiments and co-regulation in the context of collaborative learning, and to situate the research we conducted for this study among previous efforts.

2.1. Sentiments and collaborative learning

Recent research reports highlight links between sentiments and learning. Sentiments deeply affect learning (Immordino-Yang & Damasio, 2007; Shen, Wang, & Shen, 2009). A sentiment is defined as a settled opinion reflective of one's feelings (Pang & Lee, 2008). As Imai (2010) reports, sentiments can facilitate and mediate an individual's inner cognitive functioning and development. Positive sentiments can also govern individual cognitive processes (D'Mello & Graesser, 2012). Preliminary evidence suggests that sentiments are strongly related to an individual's knowledge and higher-order activities (Molinari et al., 2013). However, Van Kleef (2009) reports that sentiments not only impact cognitive processes, but social interactions as well. As an important factor, sentiments can be used to regulate social activities, as well as influence the social activities of others (Van Kleef, 2009). Therefore, understanding the role of sentiments and how they affect learning is a critical issue in CSCL.

Research on sentiments in groups has elicited a growing interest in recent years. Reports have emerged that sentiments play an important role in online collaborative learning. For example, Dang-Xuan, Stieglitz, Wladarsch, and Neuberger (2013) examined the role of sentiments in information diffusion on Twitter, and indicated that sentiments had an impact on information sharing, not only with regard to quantity, but also with respect to the speed of sharing. Sentiments are also positively linked with team cohesiveness and performance (Rapisarda, 2002). Furthermore, Ortigosa, Martín, and Carro (2014) showed that knowing learners' sentiments helps detect their state and potential needs. However, previous research has not offered any conclusions regarding the causal directionality between sentiments and group performance. In our study, we focused on the causal directionality between sentiments and group performance in synchronous, online collaborative settings for learning.

In the context of CSCL, the main concern about sentiments centers on the connections among them, social-behavioral engagement, and regulation processes (Linnenbrink-Garcia, Rogat, & Koskey, 2011). With the aim of co-constructing shared understanding in CSCL, group members can regulate their sentiments collaboratively as well as individually (Järvenoja & Järvelä, 2009). Furthermore, Molinari et al. (2013) developed an emotion awareness tool to facilitate the sharing of emotions among group members and increase perceived transactivity.

In order to examine how sentiments influence social interaction and regulation processes, sentiment analysis becomes a necessary method to gauge users' opinions in online learning environments. Sentiment analysis has been widely applied in many fields such as marketing, politics, and education (Feldman, 2013). It is conceptualized as the computational study of opinions, emotions, and sentiments conveyed in texts (Liu, 2010). Analyzing learners' sentiments can serve as feedback for teachers, and help them recommend the most appropriate academic activities to students (Ortigosa et al., 2014). Researchers have proposed various models and systems to detect sentiment change in online learning environments. For example, Conati and Maclaren (2009) proposed a probabilistic model that allows an intelligent agent to detect users' sentiments when they interact with an educational computer game. Altrabsheh, Gaber, and Cocea (2013) developed a sentiment analysis system to detect students' positive or negative sentiments so as to provide real-time feedback. Analyzing sentiments can also support automatic group formation by minimizing the number of students who have negative feelings toward a task in online collaborative learning (Paredes, Ortigosa, & Rodriguez, 2010; Ortigosa et al., 2014).

Most studies categorize texts into three kinds of sentiments: positive, negative, and neutral (Pang & Lee, 2008; Liu, 2010). For example, the sentence “I like this book” transmits a positive feeling, whereas