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Effects of role assignment in concept mapping mediated small group learning

Bo Cheng [a], Minhong Wang [a,*,1], Neil Mercer [b]

[a] KM&EL Lab, Faculty of Education, The University of Hong Kong, Hong Kong
[b] Faculty of Education, The University of Cambridge, UK

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ABSTRACT

Group interaction is a key component of group-based learning. However, its implementation in educational practice is inefficient. Previous studies have discussed the use of concept mapping as a knowledge representation tool to facilitate group communication and trigger shared cognition. Deficiencies in the collaborative use of concept mapping have also been recognized, mainly related to the coordination of group activities, especially in distance groups. Previous studies have proposed roles with different functions to coordinate group activities in concept mapping. However, there is no systematic view of role assignment and there have been no empirical studies examining the effectiveness of the role-based approach. This study addressed this research gap by assigning the roles of cognitive leader, metacognitive leader, and socio-emotional leader to students in concept mapping mediated small group learning. The study demonstrated the design and implementation of the role-based approach in an online learning environment. The evaluation results evidenced the feasibility of the role-based approach and its usefulness in improving socio-emotional experiences in small group learning. The insignificant effects of the approach on cognitive and metacognitive aspects of group interaction indicated the need to investigate the strategies for role assignment and implementation of role duties to determine whether and how these issues might affect the effectiveness of the role-based approach.

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1. Introduction

Collaborative learning is a common educational practice in which people learn or attempt to learn something together. It is often used as an umbrella term for a variety of approaches in education that involve joint intellectual effort by participants (Dillenbourg, 1999). Among these approaches, small group learning refers to learning taking place among a limited number of participants who work together to search for understanding or solutions, or to create an artifact or product of their learning (Springer, Stanne, & Donovan, 1999). In addition to group size, small group learning is characterized by the attention it pays to interaction processes and achievement of tasks (Mercer & Howe, 2011).

As a form of instruction, small group learning has been widely advocated in schools and has attracted constant attention in educational research (Webb, 2009). Compared with alternative forms of instruction, small group learning has a variety of advantages, such as providing equitable learning opportunities to students, improving academic achievement, sharing cognitive load, promoting positive affect in learning (e.g., attitudes, motivation, lower anxiety), and achieving positive social effects (AbuSeileek, 2012; Esmonde, 2009; Kirschner, Paas, & Kirschner, 2009; Kutnick, Ota, & Berdondini, 2008; Springer, Stanne & Donovan, 1999; Tolmie et al., 2010).

In group learning, student interaction is a key component of learning. The interaction process itself is considered to be an educational end that is as important as learning outcomes (Dillenbourg, 1999; Mercer & Howe, 2011; Mercer, Warwick, Kershner, & Staarman, 2010; Pifarré & Staarman, 2011; Rojas-Drummond & Mercer, 2003). However, true collaboration and productive interaction among students working in groups rarely happen in classroom practices (Blatchford & Kutnick, 2003; Kreijns, Kirschner, & Jochems, 2003; Mercer & Howe, 2011). Ineffective student group interaction has limited the value of group work in educational practices (Baines, Rubie-Davies, & Blatchford, 2009; Blatchford, Kutnick, Baines, & Galton, 2003; Mercer & Howe, 2011; Slavin, 2009; Webb, 2009).

To address this issue, researchers have proposed various pedagogical approaches to mediating peer learning and to structuring collaborative activities in groups. Various studies have discussed the use of concept mapping as a knowledge representation tool in group learning, together with its benefits to both interaction and learning, such as sustaining and mediating group discourses (van Boxtel & Veerman, 2001), elaborating and eliciting cognitive conflicts (Fischer, Bruhn, Gräsel, & Mandl, 2002),

* Corresponding author. Tel.: +852 28592474; fax: +852 28585649.
E-mail addresses: bob88708@hku.hk (B. Cheng), magwang@hku.hk (M. Wang), nmm31@cam.ac.uk (N. Mercer).
[1] Postal address: Faculty of Education, The University of Hong Kong, Pokfulam Road, Hong Kong.

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and improving achievements (Basque & Lavoie, 2006). The disadvantages of using concept mapping in distance groups have also been recognized, mainly related to the coordination of group activities (Adesope & Nesbit, 2010; Basque & Lavoie, 2006). Morris et al. (2010) found that assigning roles was an effective strategy to structure group collaborative activities, while Adesope and Nesbit (2010) proposed the integration of role assignment into concept mapping mediated group learning to support group interaction. However, there is a lack of research on how roles can be designed based on relevant theories and on the extent to which the role-based approach is effective in concept mapping mediated group learning.

This study aimed to address the research gap by proposing an intervention strategy of assigning roles to students in concept mapping mediated group learning to facilitate cognitive, metacognitive, and socio-emotional aspects of group interaction. An experimental study in an authentic teaching and learning setting of a college course was designed and implemented in an online environment to examine the effectiveness of the intervention strategy. *Learning in this study was defined as a small group of students working together on group tasks using concept mapping to discuss the tasks and to represent their solutions to the tasks.*

2. Related work

2.1. Group learning and social interaction

From a constructivist point of view, social interaction is the core of student developmental processes; collaborative learning reflects the inherent social nature of learning (Mercer & Littleton, 2007; Vygotsky, 1978). In group learning, interaction among students is a key factor in determining the presence and the magnitude of benefits that students can gain in the learning process. The mechanisms by which group interaction contributes to student learning have been investigated from various perspectives including cognitive elaboration, socio-cognitive conflict, guided participation, and the social construction of knowledge (Mercer & Littleton, 2007; Webb, 2009). In social interaction, students are involved in cognitive restructuring when they give and receive explanations. Activities such as argumentation, negotiation, and justification foster learning through the creation of socio-cognitive conflict. Moreover, social interaction provides opportunities for less-competent individuals to learn through the guidance of experts (Wang, Jia, Sugumaran, Ran, & Liao, 2011). Finally, interaction fosters the social construction of knowledge when group members contribute ideas and coordinate their efforts in joint activities.

While interaction has been shown to be of central importance in group learning, research and observations show that effective interaction among students fails to occur naturally in classrooms (Alexander, 2005; Blatchford & Kutnick, 2003; Mercer & Howe, 2011; Springer, Stanne & Donovan, 1999; Webb, 2009) or distance groups (Gunawardena, 1995; Hallet & Cummings, 1997; Hobaugh, 1997; Kreijns, Kirschner & Jochems, 2003). Typical problems reported in student interactions include unequal participation in discussion, group members ignoring one another, being highly competitive or personally irritating, not contributing in talk, or being uncritical and superficially accepting others' ideas (Wegerif & Scrimshaw, 1997). Ineffective group interaction has limited the value of group work in educational practices (Baines, Rubie-Davies & Blatchford, 2009; Blatchford, Kutnick, Baines & Galton, 2003; Mercer & Howe, 2011; Slavin, 2009; Webb, 2009). In a computer-supported collaborative learning environment, it is usually taken for granted that effective interaction automatically occurs just because technologies allow it (Kreijns, Kirschner & Jochems, 2003; Sun, 2011). However, media-poor environments such as text-based e-mail, forum and chat have been found to have little capacity for immediate feedback and rich communication due to the text-based communication in these environments (Kreijns, Kirschner & Jochems, 2003).

2.2. Concept mapping in group learning

Concept mapping is a way of representing and organizing knowledge in graphical formats. It was originally a technical tool to represent students' conceptual understanding in learning science concepts (Novak & Musonda, 1991). In a concept map, ideas are represented as nodes and the relationships between them as links with descriptive labels. With the support of computer technology, concept mapping is widely used and regarded as a rich tool for knowledge representation in terms of visualization, multi-modality, ease of manipulation, and storage for reuse (Wang, Peng, Cheng, Zhou, & Liu, 2011). Concept mapping has been applied in group learning contexts, where learners co-create the concept map, to facilitate social communication and trigger shared cognition (Fischer, Bruhn, Gräsel & Mandl, 2002).

Research has shown that concept mapping as a kind of *external representation* used in group learning settings has the affordance of a communicative function that triggers coordinated cognitive actions or shared cognition (Janssen, Erkens, Kirschner, & Kanselaar, 2010; Ploetzner, Fehse, Kneser, & Spada, 1999). Concept mapping also consists of *media rich* content in the form of a collection of user-created graphics, plain texts, and hyperlinks in a non-linear organization (Chua, 2003; Shaw, Chen, Harris, & Huang, 2009). Moreover, concept mapping is expected to serve as *a collaboration medium*, which contributes rich social context cues and thus builds high social presence in the learning environment (Kreijns, Kirschner & Jochems, 2003; Shaw, Chen, Harris & Huang, 2009; Sproull & Kiesler, 1986).

Empirical evidence for the usefulness of concept mapping in mediating group interaction has been widely reported in the literature. *First*, an important function of collaborative concept mapping is to *maintain a shared focus* during the group discourse (Roth & Roychoudhury, 1993; Sizmur & Osborne, 1997; van Boxtel & Veerman, 2001). Collaborative concept mapping has been shown to be useful in connecting, coordinating, and storing individual contributions in co-construction, helping to create a common frame of reference for discussion, and assisting in the formation of a joint problem space for exploration (Janssen, Erkens, Kirschner & Kanselaar, 2010). *Second*, another function of collaborative concept mapping is to foster *cognitive processes* in group learning (Chiu, Huang, & Chang, 2000; Fischer, Bruhn, Gräsel & Mandl, 2002; Gao, Thomson, & Shen, 2013). Collaborative concept mapping has been shown to help learners to elaborate conflicts and reasoning, shape discourse to reach shared understanding, and co-construct propositions. *Third*, collaborative concept mapping has been found to support *metacognitive processes* in the collaborative construction of knowledge, such as shared awareness of previous ideas, evaluation of understanding, and monitoring gaps in solutions (Koufou, Ergazaki, Komis, & Zogza, 2014; Suthers & Hundhausen, 2002; Suthers, Hundhausen, & Girardeau, 2002). *Fourth*, collaborative concept mapping has been found to facilitate *motivational and emotional experiences* in collaborative learning and lower participants' *anxiety* (Czerniak & Haney, 1998; Eppler, 2006). *Finally*, the learning benefits of collaborative concept mapping have been found to be closely related to learning outcomes including achievement, comprehension, problem solving, and recall (Adesope & Nesbit, 2010; Basque & Lavoie, 2006; Haugwitz, Nesbit, & Sandman, 2010).

Although concept mapping is recognized as a promising tool for mediating group learning, the collaborative use of concept mapping in distance learning faces some challenges. A major problem is that there is a need for managerial and coordination efforts in collaborative activities (Chiu, 2004). Previous studies have consistently found that a large proportion of group discourses in students' collaborative concept mapping are related to the managerial aspect of group work (e.g., task coordination and dialogue control) irrelevant to the deep processing of content (Komis, Avouris, & Fidas, 2002; Reinhard, Hesse, Hron, & Picard, 1997; Suthers, Hundhausen & Girardeau, 2002; van Boxtel & Veerman, 2001). These studies proposed potential approaches to supporting group coordination, such as predefined communication acts, scripted cooperation, and providing social protocols to impose explicit

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