

Fostering Interdisciplinary Knowledge Construction in Computer-Assisted Collaborative Concept Mapping

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Abstract. Research has argued that the way learning activities are sequenced over different social levels has an effect on learning effectiveness. This study investigates the effect of embedding an individual preparation phase prior to collaborative concept mapping (CCM) on the epistemic and social dimension of the CCM process. Using a quasi-experimental design, a multi-disciplinary group of 24 3rd year bachelor students were put into two different conditions: one with individual preparation phase (WIP) and one without individual preparation phase (WOIP). The students worked on a collaborative assignment about macro trends analysis using computer-assisted CCM. For the epistemic dimension, students in the WIP condition showed more occurrences of utterances seeking clarification and positioning one's perspectives. In the social mode of knowledge construction, students in the WIP condition displayed more conflict-oriented and integrated consensus building statements to negotiate shared knowledge.

Keywords: Collaborative concept mapping, Interdisciplinary knowledge integration, Social modes of knowledge co-construction, Epistemic dimension of knowledge co-construction.

1 Introduction

Contemporary problems are often transcending the boundaries of a single discipline. This implies a need to integrate knowledge from different professional fields [1]. According to Songer and Linn [2] knowledge integration could be perceived as synthesizing concepts and ideas from different disciplines into a coherent whole. To this end, collaborative knowledge construction (CKC) could play an instrumental role [3]. However, coordination, communication and interaction challenges ensue when individuals from various disciplines construct shared meaning and knowledge [4]. In this regard Novak and Cañas's [5] study showed the pivotal role of collaborative concept mapping (CCM). CCM enhances coordination and communication within groups, which in turn, facilitates a more integrated conceptual framework [6]. Notwithstanding the plethora of research on CKC and the use of CCM to facilitate this

process, there remains paucity of empirical works on interdisciplinary knowledge constructing using CCM. Hence, this study investigates how the sequencing of learning activities, i.e., embedding an individual preparation phase prior to collaborative work, could have an effect on the interdisciplinary knowledge co-construction process during collaborative concept mapping.

1.1 Challenges of Collaborative Knowledge Construction

Learning is a social process and knowledge is a negotiated product of a collaborative discourse [7, 8]. Hewitt and Scardamalia [9] liken the CKC process to “distributed cognition” where “each person’s individual cognitions are continually reorganized in an effort to construct meaning out of the other person’s speech acts” (p.79). Beers et al. [1] captured the challenges of CKC in four main stages: knowledge externalization, internalization, negotiation and integration (see Fig.1).

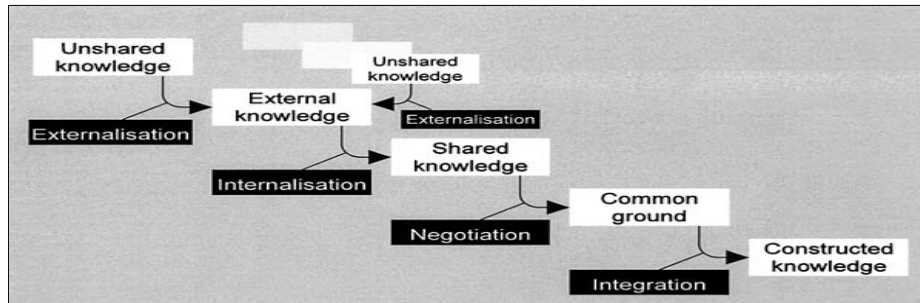


Fig. 1. From unshared knowledge to constructed knowledge (Beers et al., 2006)

1.2 Facilitating Interdisciplinary Knowledge Construction with Concept Maps

Concept mapping scaffolds knowledge externalization and internalization more effectively than text [6, 10]. The explicit representation of mental models facilitates the grounding process where concepts and relationships can be more effectively negotiated [11, 12]. Research showed that concept maps structure the collaborative discourse and fosters more in-depth and productive interaction [13]. The three main theoretical arguments for an individual concept mapping preparatory phase are: 1) more room for personal reflection and development of an individual mental model; 2) better preparation for knowledge negotiation; and 3) more openness to the contributions of group members [14, 15, 16]. The theoretical arguments for CCM without an individual concept mapping preparatory phase are: 1) peer scaffolding; 2) preventing fragmented thinking; and 3) preventing defensive reasoning [17, 18]. This study addresses the following research questions:

RQ 1. To what extent does with- or without-individual preparation phase (WIP & WOIP) affect the epistemic dimension of interdisciplinary knowledge construction in computer-assisted collaborative concept mapping?

RQ 2. To what extent does with- or without-individual preparation phase (WIP & WOIP) affect the social dimension of interdisciplinary knowledge construction in computer-assisted collaborative concept mapping?

2 Methodology

2.1 Sample and Design

A total of N=24 third year bachelor students, distributed among four groups of six participated in a quasi-experimental field study. Four of the participants were female and twenty - male. The groups were randomly assigned to one of the two experimental conditions (WIP - with individual preparation phase and WOIP - without individual preparation phase), that is 12 for each condition. In each group students from different disciplines such as marketing, industrial engineering, multimedia design, Business IT and management, and computer science were represented.

2.2 Learning Environment

Students worked on a collaborative assignment about macro trends using CCM. They first got a plenary lecture about macro trends, concept mapping and the opportunity to practice concept mapping with CmapTools [19]. Subsequently the WIP groups got 30 minutes to prepare an individual concept map before proceeding to CCM for 45 minutes. The WOIP groups started directly to create CCM for an hour and 15 minutes. Students in both conditions observed the same duration and undertook a similar task.

2.3 Data Analysis

To investigate the effects of the two experimental conditions on the epistemic and social dimension in the CCM process, data for the analysis was derived from audio recordings of the collaborative discourse. Each unit may contain one or more statements depending on the discussion threads, ideas and turn of talks. For the epistemic dimension, there was a total of 580 units of analysis for the WIP groups and 318 for the WOIP groups. For the social dimension, there was a total of 490 units of analysis for the WIP groups and 359 for the WOIP groups. The coding scheme for the epistemic dimension is adapted from Beers et al. [1] and includes the following categories: contribution, verification, clarification, elaboration, and positioning.

Of equal significance is the analysis of the social dimension of the collaborative discourse during the CCM process. The five coding categories of the social dimension are: externalisation, elicitation, quick-consensus building, integrated consensus building and conflict-oriented consensus building [16].

3 Findings

Figure 2 shows the means of the frequency of the occurrences of statements for both experimental conditions in regard to RQ1.

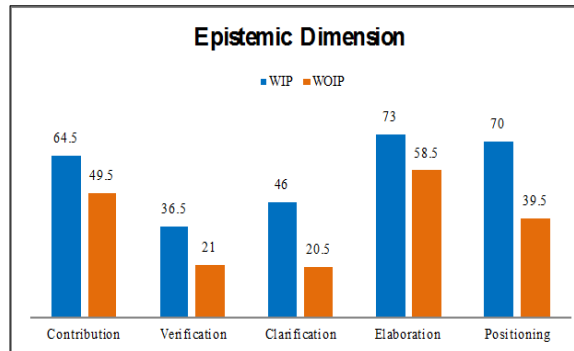


Fig. 2. Means of the five categories in the Epistemic mode of knowledge co-construction.

Overall, the findings indicate that the WIP groups showed higher occurrences of statements for all categories in the epistemic dimension than the WOIP groups. Two distinguished differences lie in the occurrences of clarification and positioning statements. The WIP groups generated almost twice as many statements on clarification and positioning than the WOIP groups. These statements are instrumental in CKC and negotiation of shared meaning and understanding. The findings are best understood when examined against the effects of WIP and WOIP on the social modes of CKC in the succeeding segment (RQ2).

Figure 3 shows the means of the frequency of the occurrences of statements in the social mode of knowledge co-construction for the two experimental conditions (Note: Consensus = quick-consensus building, Integration = integration-oriented consensus building, Conflict = conflict-oriented consensus building).

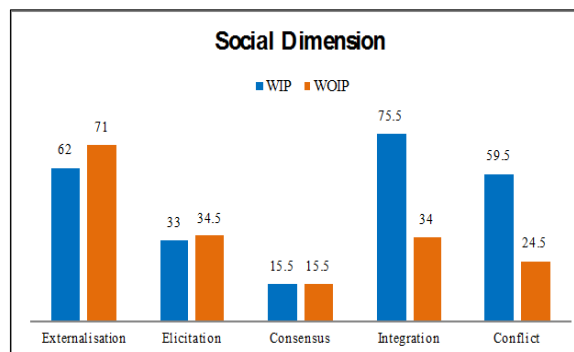


Fig. 3. Means of the five categories in the social mode of knowledge co-construction.

The two groups in both conditions displayed almost similar tendency in eliciting contributions and ideas from peers, as well as in seeking quick-consensus building. However, it is evident that there were more integrated- and conflict-oriented consensus building statements for the WIP groups, as compared to the WOIP groups. The findings on the social modes of the knowledge co-construction also illustrate the quality of the collaborative discourse. Higher occurrences of the integrated- and conflict-oriented consensus building indicate that there was more in-depth discourse for the two groups in the WIP condition.

4 Discussion and Conclusions

This study investigated the effect of the WIP and WOIP conditions on the epistemic and social dimension of CKC during the CCM process. The overall findings suggest that an individual preparation phase prior to CCM led to better interdisciplinary knowledge co-construction because it facilitates the grounding process where new knowledge is questioned, contended and verified. The WIP groups were more engaged and more forthcoming with ideas: resulting in more in-depth discourse as exemplified by the higher occurrences of clarification, positioning statements in the epistemic dimension, as well as more integrated- and conflict-oriented building statements in the social modes of CKC. As evident in the findings, there was higher occurrences of externalization and elicitation of contributions and ideas in the WOIP condition, as compared to the groups in WIP condition. Peer scaffolding accentuated the element of interdependency to achieve shared goals and provided individuals transitory support during the CKC process. In the epistemic dimension, students in the WOIP condition were also less forthcoming with statements to seek clarification and to question positioning of peer's perspectives and ideas.

Although we witnessed some interesting patterns in the epistemic and social dimension of the knowledge co-construction during the CCM process, we acknowledge that there are certainly inherent limitations in the attribution of effects to the two conditions (WIP & WOIP). However, we believe that the interesting findings from this research study have been insightful on how the sequencing of activities at different social levels might have an effect on the type and depth of collaborative discourse, the collaborative knowledge construction and interdisciplinary knowledge integration process.

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