Analysis of Preparation Group Work for Creating New Ideas in Collaborative Learning

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Abstract: This study aims to develop a method of analysis for learning as knowledge creation. In learning as knowledge creation, learners are required to create ideas, modify them, and generate knowledge; they should critically review authoritative information in preparation for knowledge creation. However, little attention has been given to this interim process. The proposed method seeks to analyze and differentiate this process. The results demonstrated that learners try to understand instead of merely memorizing material.

Keywords: knowledge creation, group work, preparation, Socio-Semantic Network Analysis

Introduction

We have been witnessing increased interest in learning through design. Designing artifacts is an important part of learning as knowledge creation (Paavola, Lipponen, & Hakkarainen, 2004; Scardamalia & Bereiter, 2014), in which learners are required to create ideas, modify them, and generate new knowledge. As one of the models of learning as knowledge creation, knowledge building has two types of learning modes. In the "design mode," learners create better ideas; in the "belief mode," learners criticize and analyze the truth (Scardamalia & Bereiter, 2017). Scardamalia and Bereiter (2014, 2017) popularized a set of 12 knowledge building principles that require from learners the "constructive use of authoritative information." In other words, it has been recommended that learners critically review authoritative information in preparation for knowledge creation. This preparation activity has an important role in knowledge creation, even in the belief mode.

However, little attention has been given to preparatory group work as a process or phase. The "belief mode" tends to play a supporting role in design-mode thinking, which is synonymous with idea improvement—a key concept of knowledge building (Scardamalia & Bereiter, 2017). For example, design-mode thinking and epistemic agency can be considered key components of knowledge creation, and can be analyzed effectively using various analysis toolkits (Chen & Zhang, 2016). Well-designed artifacts are based on not only learners' design-mode thinking, but also their improved knowledge. That is, to create quality knowledge, the usability, portability, reliability, and variability of knowledge are important. If learners lack portable knowledge, for example, they cannot use it in "design mode." Learners may be able to create portable knowledge with better understanding if they modify their acquired knowledge while preparing for knowledge creation. Consequently, this study expands the discussion on the transformation of knowledge for knowledge creation.

With the goal of improving design learning environments, I sought to develop a method to analyze both knowledge creation and preparation work for knowledge creation. The main objective of this study was to investigate whether the proposed method can differentiate between knowledge from educational materials and knowledge from students as they go through the process of preparing for knowledge creation. Specifically, the research question for this study is, "How do students use the knowledge that is provided in educational material in the preparation work?"

Methodology and analysis

The proposed method is based on Socio-Semantic Network Analysis (SSNA), which analyzes clusters of keywords as ideas and allows changing ideas to be tracked. It taps on the analysis tool for SSNA—the Knowledge Building Discourse Explorer (KBDeX)—to better understand knowledge creation (Oshima, Oshima, & Matsuzawa, 2012). The proposed method in this study has three steps. First, extract important words from the educational materials as keywords for analysis. Second, analyze the educational materials and discourse data of the preparation group work and calculate degree centralities of the keywords network using KBDeX. Lastly, compare keyword clusters to observe their transitions in degree centrality—which measures the total number of connections of a node—between educational material and discourse data. The maximum score of degree centrality of keywords is 1.0; it implies that a keyword is connected to all used keywords. The score of the word decreases when new keywords are used without connection to the original keyword. As these scores change, we can see how keyword clusters—and by extension, ideas—change.

To answer the research question, I applied the concept of the jigsaw method. This is a method for collaborative learning with two group activities: the "expert activity" and the "jigsaw activity." In the "expert activity," each group studies different educational material (e.g., Group A studies material A; Group B studies

material B). Members from different groups then come together to participate in the "jigsaw activity" where, as a small new group, the learners develop their ideas to solve the main problem by using information obtained from the expert activity. In this paper, I focus on analyzing "expert activity" as a preparation activity to create ideas, unlike earlier studies that analyzed "jigsaw activities" to understand learning as knowledge creation (e.g., Oshima, Ohsaki, & Oshima, 2017).

Nine participants participated in the experiment. Participants were recruited from different learning environments, including a university, graduate school, and teaching faculty. The main problem in this experiment was, "How does an air conditioner keep a room cool?" Being students and teachers with no science or engineering background, the participants had little to no familiarity with this technical problem. Educational material A about "Heat flow in an air conditioner" was written especially for Group A (n=3), the target group of this study. I recorded the group activities with a voice recorder, and the recordings were later transcribed. The number of utterances by Group A was 92.

Results and discussion

I compared the transitions in degree centrality of keywords in educational material A, and the transitions in degree centrality of keywords of discourses in Group A. First, 44 keywords were selected from educational material A for analysis. Second, SSNA revealed that the two words "Flow (1)" and "Heat" formed a network in the first sentence. Their scores were 1.0, implying that these words were connected to all keywords. However, by the fourth sentence, only "Heat" maintained a score of 1.0, implying that "Heat" remained a key topic at these points. By the last sentence, the four words "Flow (1)," "Heat," "Refrigerant," and "Outdoor" each scored more than 0.5. In Group A's discourses, the first network, at eighth utterance by student A1, was composed of 16 keywords: "High temperature," "Pipe," "Circulation," "Low temperature," "Air," "Out," "Law," "Together," "Low," "Indoor," "Material," "Refrigerant," "Room," "Flow (1)," "Heat," and "Through (1)." The scores of these words were 1.0. These were the only words found to have marked more than half of the maximum score by the last utterance. Of the 16 keywords, seven, namely, "Pipe," "Circulation," "Low temperature," "Air," "Together," "Indoor," and "Material" had the same score, meaning they were always used together. However, the discourse data confirmed that these words were used at only one utterance. Specifically, the analysis results showed that the main topics in Group A were "High temperature," "Out," "Law," "Low," "Refrigerant," "Room," "Flow (1)," "Heat," and "Through (1)." Lastly, I confirmed the differences and similarities between educational material A and Group A by comparing those results. The seven keywords were the main features in the group activity, besides the words "Heat" and "Refrigerant," which were used in both.

The results showing that keyword clusters from the discourses differed from those of the educational material suggest that the students tried to understand the concepts instead of merely memorizing the material. Of course, this study has limitations as it is still a work in progress. The next step of this research would be to explore the conditions of other groups, and the relationship between preparatory group work and knowledge creation work.

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Acknowledgments