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The Dynamic Jigsaw: Repeated Explanation Support for Collaborative Learning of Cognitive Science

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Research context

In order to disseminate the basic cognitive skills for everyday problem solving to a wider audience, we have been exploring collaborative instruction to teach college students introductory cognitive science. We report here the method we call the dynamic jigsaw that involves repeated, collaborative reading and explaining of short descriptions of basic research findings. This enables the students to form general or abstract implications from them to be applied in their everyday cognitive tasks in the future. Their collaborative activities were supported by a concept-mapping tool they could use through the Internet. The concept maps, term papers and the protocols of the students' explanations and the discussions have been analyzed to evaluate the course, as well as to reveal the micro-genetic patterns of their knowledge construction.

Teaching objectives

Cognitive science covers many functions and mechanisms of cognition using multi-disciplinary methodology. It is thus important to form an integrated view of findings to understand the implications of the field. To facilitate this process, we decompose it into the following three steps.

Step 1. Comprehend many research findings in terms of their themes, evidential data, and the conclusions.

Step 2. Form an initial or hypothetical "theory" to integrate the above findings in terms of implications.

Step 3. Find possible applications of the theory so that they are usable in the future.

Procedure

We have implemented these steps in a 13-class term for sophomores majoring in cognitive science in a Japanese university. The course involves collaborative understanding of 24 learning materials, each representing classic research of cognitive science. Step 1 was supported by the "expert" phase of the jigsaw. Each student is assigned to read a couple of readings of their choice carefully by using an electric concept mapping tool to identify their components. The second step was supported by the dynamically expandable jigsaw. The students first carefully compared and integrate the two, originally assigned pieces. Then each member is paired with a student who had read a different set, to exchange two research papers with other two. Through this 2 by 2 exchange, each student was expected to be able to integrate four, to exchange them with others who had studied yet other set of four. This was followed by two times of 8 by 8 exchanges to cover all 24. To support Step 3, the students were encouraged to think about how their integrated view would be used in their everyday problem solving situations throughout the course.

Data

The outcome of the course was measured on students' final concept maps as well as on their term papers using three indices. One index is the degree of integration, or the structural coherency, of the final concept maps the students created at the end of the course. Another index is taken from the term papers, measuring the conciseness and the correctness of the descriptions of the research findings. The final index is the relationship between the implications they drew from what they had learned and their possible usage in everyday life, which we call "extendibility." We are also surveying the student learning process by analyzing the students' transcribed conversations during the class.

Major outcomes

We have identified the following learning outcomes.

(1) Thirty-seven percent of the final concept maps were categorized as achieving high integrity, close to the performance of novice graduate students.

(2) All 24 learning materials were covered in 83% of the term papers, out of which 56% were identified as "concise descriptions" with necessary components. This indicates the students have learned both the basic contents as well as how to give concise summaries.

(3) The extendibility described above is found to be positively correlated with the quality of concept maps, indicating the learning activity of externalizing their integration efforts had a positive effect in fostering their thinking toward application of what they learned.

(4) The protocol analysis of the students' conversations during the class reveals that the students' explanations had become more concise. To take three students as a representative set, their first explanation of one research paper took 400 to 500 utterances on average, which decreased to 20 to 30 utterances toward the end of the term, without loosing necessary components.

(5) Their first explanations involved incorrect, vague, or confused statements. Such errors tended to be resolved during their conversation about how to integrate the materials, rather than during the explanations.

These data will be analyzed further so that we can identify conditions for effective knowledge construction of cognitive science that is applicable in the students' future problem solving.

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