Students' Consolidation of Knowledge Structures through Problem Posing Activities

Kyungwon Lee, Oh Nam Kwon
Seoul National University

This study explored a pedagogical way to contribute to students' consolidation of their newly formed mathematical knowledge. We applied problem posing activities in complex analysis course. Students posed a problem in a group and then solved this. In the process of these activities, we could observe three modes of consolidation in the students' mathematical knowledge and the epistemic actions emerging in aspects of problem posing. A problem posing activity can act as a practical way to stimulate students' consolidation.

Keywords: Consolidation, Problem posing, Complex analysis

Hershkowitz et al. (2001) introduced Abstraction in Context (AiC). AiC theory explains the process of the construction of mathematical knowledge. Since newly constructed knowledge is fragile, it needs to be consolidated. Consolidation is a process in which abstraction becomes so familiar that it is available to the learner in a flexible manner (Dreyfus, & Tsamir, 2004). Analyzing students' consolidation of knowledge structures can be a way to diagnose their understanding of newly constructed knowledge. However, there is little consideration of pedagogical ways to lead students to the consolidation phase. A problem posing activity can be a way to stimulate such consolidation. This is because problem posing extends students' perception of mathematics, and enriches and strengthens their knowledge of basic concepts (English, 2003). Also, to understand how problem posing can be enacted in classrooms, there is a need for analysis of practice (Cai et al., 2015). So, in this study, we conducted problem posing activities to explore students' consolidation.

The participants were 27 undergraduate students in a course on complex analysis. Two activities were carried out in groups of three. The first activity was posing a problem using the concepts of complex analysis, and the second was solving the posed problems. Two groups were selected for videotaping and post-activity interviews. All their discussions and interviews were transcribed. We analyzed students' individual utterances based on three modes of consolidation: B (Building-with), RfB (Reflecting on Building-with), and Rf (Reflecting) (Dreyfus, & Tsamir, 2004). Also, we traced the students' consolidation by determining their epistemic actions during the problem posing activities in the dimensions of task organization, knowledge base, heuristics and schemes, individual considerations of aptness, group dynamics and interactions, which are repetitive facets in the framework of Kontorovich et al. (2012).

Three modes of consolidation are shown by the students' utterances focusing on concepts and reviewing problems that they had previously solved. The students continued the mathematical discussion based on their own knowledge base and explored the condition of theorems in their group. Also, they discovered relations between their discussion and the concepts they had learned. In these problem posing aspects, we could observe that students consolidated their knowledge, and that problem posing stimulated epistemic actions that initially postponed students' consolidation but induced them to reach the consolidation phase before long. Therefore, problem posing in a group activity contributes to epistemic actions by students that lead to the consolidation phase. This means that this activity can provide an opportunity for students to reflect on their own learning process and enable them to apply mathematical contents in a flexible way.

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