

# Change in Students' Internal Scripts for Knowledge Building: A Challenge for Capturing Epistemic Agency

Jun Oshima, Ritsuko Oshima, Shizuoka Univ., 3-5-1 Johoku Naka-ku Hamamatsu-shi JAPAN 432-8011

Email: joshima@inf.shizuoka.ac.jp, roshima@inf.shizuoka.ac.jp

Knowledge Forum@ Japan Research Group(1), kfjp@inf.shizuoka.ac.jp

**Abstract:** The purpose of the study was to develop the assessment tool to capture learners' epistemic agency (Scardamalia, 2002). By referring to studies on scripted cooperation, we developed the *script completion task* for pairs of elementary school students to engage in. Students' developed scripts for collaboratively solving a socio-scientific problem in two consecutive lesson units were analyzed by the four commitments of knowledge building discourse (Bereiter, 1994).

## Background and Purposes

Knowledge building (kb) is a *deep* constructivism that is focused on learning as a process in which learners collaboratively build objective knowledge based on conceptual artifacts, whereas the *shallow* constructivism is directed at learning as a process in which learners make effort to deeply understand knowledge objects that have been created by others. Although the kb perspective provides us with a new direction of designing lessons in the classroom, it is still not easy to develop classrooms as kb communities. Many studies have attempted to establish pedagogical design principles based on necessary conditions to sustain the kb community (i.e., Scardamalia, 2002). In particular, recent studies pay more attention to a specific condition for the kb community, the epistemic agency. The epistemic agency is described in Scardamalia (2002) as follows:

Participants set forth their ideas and negotiate a fit between personal ideas and ideas of others, using contrasts to spark and sustain knowledge advancement rather than depending on others to chart that course for them. They deal with problems of goals, motivation, evaluation, and long-range planning that are normally left to teachers or managers.

While studies have been challenging lesson designs for students to take over the epistemic agency from teachers, there have not been many studies that develop the assessment tools to capture students' epistemic agency. There are found two assessment approaches to the epistemic agency. First, some cases can be described in detail that a group of students engage in knowledge building with exerting their epistemic agency. Oshima, Oshima, Murayama, Inagaki, Takenaka, Yamamoto, Yamaguchi, & Nakayama (2006) described how a group of students reflected on their own and others' previous works for the purpose of inventing new experiments to figure out how alum crystals are created in aqueous solution. Second, we can ask students to evaluate their learning processes with a specific criterion. van Aalst and Chan (2007) proposed the *knowledge building portfolio* approach as a formative assessment for learners to reflect upon their activities from the kb perspective. They found that students using the *knowledge building portfolio* recognized the effectiveness of kb perspective on their own learning as well as significantly improved conceptual understanding. Although these approaches provide us with insights on how well students treat their own learning *while they are appropriately instructed to do so* (i.e., Students are instructed to exert their epistemic agency under appropriately designed environments.), we further need a new assessment approach to evaluating *how their developed epistemic agency would be transferred in future contexts of learning*. In this work, we developed a new evaluation approach to capturing epistemic agency in future learning contexts, and applied the evaluation in our two consecutive kb lesson units for elementary school students in Japan.

## Evaluation of Students' Epistemic Agency through Two kb Lesson Units Script Completion Task as an Assessment Tool for Epistemic Agency

Referring to *internal script* research (e.g., Kollar, Fischer, & Slotta, 2005), we developed a procedure to evaluate each student's *personal script* for argumentation in kb. Kollar, et al. (2005) asked students to evaluate two different qualities of scripts (high and low level) and explain which script was better than the other. Based on students' explanations, Kollar, et al. evaluated each student's *personal script* for collaboration. We extended their approach for the purpose of evaluating epistemic agency as follows: First, we asked students to *actually create their scripts* rather than evaluate and explain given different levels of collaboration scripts. Since our aim was at capturing students' epistemic agency, we had to facilitate students' intentional use of their *personal scripts*. Second, we gave students an incomplete script where two characters (a stray cat and a wild cat) were debating a socio-scientific issue (Do we need zoos?), and asked a pair of students to create further scripts.

The socio-scientific issues require students of handling different perspectives simultaneously for generating their solutions. We thought that such a task requirement was necessary for students to exert their epistemic agency. Finally, since arguments that students created here appeared as discourse between the two characters, we evaluated students' commitments to their discourse based on the four kb discourse commitments (Bereiter, 1994).

## Analysis Design

We examined students' epistemic agency by using the *script completion task* in the pre- and post-test paradigm. The target lesson unit was on nuclear power generation. Students were engaged in progressive problem solving in groups using Knowledge Forum®, a CSCL technology for facilitating progressive discourse. Before and after the lesson unit, the script completion task was administered. Students in pairs engaged in the task. They wrote down their scripts following the two characters' discourse on the zoo in a worksheet. Their scripts (16 pairs in pre-test, and 15 pairs in post-test) were evaluated by two independent scholars with three-point scales of four kb discourse commitments (Bereiter, 1994): (1) mutual understanding commitment; (2) empirical testability commitment; (3) expansion commitment; and (4) openness commitment. The agreement between the scholars was over 85%. Disagreements were resolved through their discussion. Besides the change in students' epistemic agency from the pre-test to the post-test within one lesson unit, we were also concerned with the influence of students' previous kb lesson experiences. One third of students in the target 6th-grade classroom had kb lesson experience in their previous year (genetically modified foods). We therefore further examined the influence of previous kb lesson experience on the change in students' epistemic agency by comparing between the previously experienced students and the others.

## Results and Discussion

In the comparison between the pre- and the post-test, we found that students' epistemic agency was improved in empirical testability ( $\chi^2 = 2.62, p = .10$ ) and openness commitments ( $\chi^2 = 5.04, p < .05$ ). Results suggested that students' experiences in the kb lesson unit made them prepared for exerting their epistemic agency for kb in new context, particularly being more concerned with evidences for supporting their claims and possible rebuttals for their claims. Further comparison between more kb experienced students and less experienced ones showed an interesting phenomenon. It was found that *proportion of students who improved the empirical testability commitment was higher in more kb experienced students*, whereas *proportions of students who improved the openness commitment were almost the same* between more and less kb experienced ones. Taking results together, we can propose a possible developmental trajectory of epistemic agency that students first become able to recognize openness to challenge their beliefs, and developed a methodology to test their belief with evidence. Results in this study and the proposed developmental trajectory of the epistemic agency would require at least two direction of further research. First, the developmental trajectory of openness before empirical testability may be contradictory to results of scientific reasoning research such as the positive feedback bias suggesting empirical testability before openness. Second, we did not find any critical developmental shift in mutual understanding and expansion commitments that are more based on collective nature of kb discourse. Further research is needed to examine whether we need more time to see the developmental change that can be captured by the assessment tool or need another assessment tool that is more sensitive to kb nature of students' discourse.

## Endnotes

- (1) The following persons participated in this research as Knowledge Forum® Japan Research Group: Shigenori Inagaki, Masaji Fujimoto, Isao Murayama, Hayashi Nakayama, Makiko Takenaka, Miki Sakamoto, Etsuji Yamaguchi, and Tomokazu Yamamoto.

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