

Epistemological perturbations: Using material artifacts to cultivate a knowledge building culture in classrooms

John Ow, Townsville Primary School, 3 Ang Mo Kio Avenue 10, Singapore, john_ow_eu_gene@mac.com

Katerine Bielaczyc, Learning Sciences Laboratory, NIE, 1 Nanyang Walk, Singapore 637616, kateb369@gmail.com

Abstract: The realization of the pedagogic affordances of many CSCL tools require a social infrastructure quite different from that found in traditional classrooms using “instructionist” teaching and learning practices. We are interested in ways to support teachers and students in making the necessary shift in cultural beliefs and classroom practices in order to integrate such CSCL tools --- a change trajectory that we term the “implementation path” (Bielaczyc & Collins, 2006). In the present paper we discuss a research project focused on integrating Knowledge Forum (Scardamalia, 2004) into the science curriculum of nine Primary 3 and 4 classrooms in a Singaporean school. We investigate the use of material artifacts and offline practices in providing a transition mechanism from traditional classrooms toward creating a knowledge building culture. We are particularly interested in how such artifacts and practices lead to “epistemological perturbations” in teacher’s conceptions of teaching and learning.

Schools in Transition

The education system in Singapore is entering a period of change. These changes have their genesis in education policies that seek to develop a nation and its schools for a 21st century economy (www.moe.gov.sg). The goal is to foster in students the skills to learn and adapt in a rapidly changing world. But this requires a radical change in teaching practice, in order to deemphasize the value that knowledge is needed for examination while emphasizing the value of knowledge for solving problems

We believe that learning in a Knowledge Building community supported by Knowledge Forum will support the desired changes in education. Knowledge Forum was first introduced in Singapore in 2001 (Ibrahim & Tan, 2004; Tan, Hung, & So, 2005). Since then, there have been numerous pockets of pedagogic innovation exploring the integration of Knowledge Forum into Singaporean classrooms. However, a scalable model of Knowledge Building communities in classrooms has yet to be developed. Creating such a model is one of the goals of the newly-established Learning Sciences Laboratory in Singapore.

In the present paper we discuss a research project designed to foster learning in a Knowledge Building community as part of the science curriculum of nine Primary 3 and 4 classrooms in a Singaporean school. Unlike other efforts to create knowledge building classrooms with Knowledge Forum (e.g., Bielaczyc, 2001; Caswell & Bielaczyc, 2002; Hewitt, 2002; Ow, Low & Tan, 2004; Reeve & Lamon, 1998), the project did not involve using Knowledge Forum in the first half of the school year. Instead, transition mechanisms were developed in order to scaffold both teachers’ and students’ entry into the CSCL environment through first engaging in an offline collaborative learning environment. The offline learning environment involved material artifacts that were meant to provide tangible “tools-to-think-with” in transitioning to a knowledge building pedagogy that challenged the more traditional Singaporean pedagogy. Hence, we were designing a new implementation path (Bielaczyc & Collins, 2006) for introducing teachers and students to a sophisticated CSCL tool.

The project has just completed its first year of implementation. This paper provides an opportunity to share our work with transition mechanisms, specifically our use of material artifacts and the “epistemic perturbations” in teachers’ conceptions of teaching and learning generated by their introduction. Here we focus on one particular transition mechanism, a material artifact called the “Think Card.”

Supporting Changes in Cultural Beliefs and Classroom Practices

Our project is entitled “Ideas First.” As the name suggests, our approach places work on ideas by the individual and community as its foremost design consideration. The transition mechanisms that we designed for Ideas First are meant to help transition teachers and students from working with “ideas in physical forms” to

working with ideas in the software of Knowledge Forum. Knowledge Forum is a technology-based tool developed by Marlene Scardamalia and Carl Bereiter (1991; 1994; Scardamalia, 2004). Knowledge Forum allows learners to construct a communal multimedia knowledge base. The objective is to engage students in progressive knowledge building, where they continually develop their understanding through problem identification, research, and community discourse. The vision of Knowledge Forum is for students to build collective knowledge with “fidelity to the ways work with ideas is carried out in the real world” (Scardamalia, 2002, p. 6). This vision represents a shift from traditional views of education to “idea-centered education” where problems are found in authentic attempts to understand the world and ideas are viewed as objects of inquiry that can be combined with other knowledge objects, and improved upon (Scardamalia, 2002; Scardamalia, Bereiter & Lamon, 1994).

The Ideas First approach is characterized by four interdependent phases to support students in working with ideas: *idea generation*, *idea connection*, *experimentation*, and *pull-together*. Embedded in the phases are Knowledge Building principles that guide the community’s work with ideas (Scardamalia, 2002). The Think Card was designed as a way to physically reify the ideas and theories generated by children while they work on problems of understanding.

A “Think card” is a 5x7 card that is divided into two halves. The top half of the card is yellow and has the scaffold “My idea is...” The bottom half of the card is green and uses the scaffold “Something I wonder about ...” These scaffolds are intended to help students generate ideas and questions of wonderment which are then shared using the physical classroom walls to create a shared, public space. Students post up their Think Cards on this community space, enabling all children to access the ideas of the class community.

The parallels between notes and views in the Knowledge Forum environment and the “Think cards” and the physical communal space of the Ideas First classroom were intentional design features. Notes in Knowledge Forum and Think Cards are both conceptual artifacts (Bereiter, 2002). These artifacts support learners developing objectified theories and ideas residing in World 3 (Popper, 1972). The objectification of ideas affords learners the opportunity to carry out knowledge work such as generating, comparing, testing, and synthesising ideas. Without the objectification of ideas, these ideas would reside in the mind of individuals impervious to the attention of others in the community. Views in Knowledge Forum and the physical communal space of the classroom walls provide a place in the community for making ideas public. The physical communal space affords the community with opportunities to make connections, improve ideas and even “rise-above” existing ideas.

Teachers saw Think Cards as a means of accessing student ideas in ways that had not occurred in their classes in the past. Through interviews and interactions over the course of the year, teachers described how the Think Cards were a “... more ‘concrete’ way to present ideas and to communicate.” According to the teachers, the Think Cards allowed children “... to ‘voice’ out their ideas” which enabled the teachers to “... see their knowledge as a whole immediately.” Further, teachers noted that, in contrast to the ways they had been teaching science in the past, children were now able to “... see what their friends *were* writing or thinking about.”

Although teachers described the positive value of using the Think Cards, as researchers we also saw that the Think Cards posed a real challenge to the ways teachers viewed teaching and learning. We refer to these disturbances in beliefs about knowledge and learning as “epistemological perturbations.” The teachers in the Ideas First classrooms were used to teaching according to an “instructionist,” or transmission model, in which children are presented with the sanctioned knowledge they are meant to acquire. The ideas that teachers present to students in such classrooms are viewed as the “right” ideas. However, using the Think Cards made visible the diversity among children’s ideas. This idea diversity posed fundamental challenges to teachers’ ontology of “right” and “wrong” knowledge. First, posting the Think Cards on the classroom walls served to recognize a diverse set of students’ ideas as contributions to the community. Thus, the teachers were faced with “wrong ideas” being made available in the public arena. Second, beyond ideas that were “wrong,” the diversity of ideas surfaced many types of “right” ideas beyond the teacher’s sanctioned perspective due to the multiple perspectives and emerging understandings expressed. The existence of emerging understandings or ideas in transition indicates the improvable nature of ideas, in contrast to the notion of ideas as either right or wrong.

Technology-based tools often require a shift in the epistemology and practices of education compared to what students and teachers are used to, making it critical that the implementation paths of technology-based tools be understood and supported more fully (Bielaczyc & Collins, 2006). We feel that the construct of epistemic

perturbations can help deepen our understanding of the types of issues that need to be considered in supporting teachers along such implementation paths. A deeper understanding of the trajectory of implementation also serves to legitimate the struggles that teachers may face. For example, when faced with such disequilibrium, teachers will often move off the change trajectory and revert to traditional teaching practices. In fact, one of the teachers in the Ideas First classrooms spoke of how she handled the wide range of student ideas by working “to reel them back and get them back into the main content.” We believe that analyzing the types of epistemological perturbations that surface can be the starting point for the design of more robust support structures for teachers in transition.

References

- Bielaczyc, K. (2001). Designing social infrastructure: The challenge of building computer-supported learning communities, in the *Proceedings of the EURO-CSCL 2001 Conference*.
- Bielaczyc, K. & Collins, A. (2006). Implementation paths: Supporting the trajectory teachers traverse in implementing technology-based learning environments in classroom practice. *Journal of Educational Technology, 46* (2), 8-14.
- Bereiter, C. *Education and Mind in the Knowledge Age*. New Jersey. Lawrence Erlbaum, 2002.
- Caswell, B. & Bielaczyc, K. (2001). Knowledge Forum: altering the relationship between students and scientific knowledge. *Education, Communication & Information, 1* (3), 281-305.
- Hewitt, J. (2002). From a focus on tasks to a focus on understanding: The cultural transformation of a Toronto classroom. In T. Koschmann, R. Hall & N. Miyake (Eds.), *CSCL2: Carrying forward the conversation* (pp.11-42). Mahwah NJ: Lawrence Erlbaum Associates.
- Ibrahim, A., & Tan, S.C. (2004). Computer-Supported Collaborative Problem Solving and Anchored Instruction in a Mathematics Classroom. *International Journal of Learning Technology, 1* (1), 16-39.
- Ow, E.G.J., Low, A., & Tan, S.C. (2004). Learning to be scientists through social collaborative discourse – A case study in a primary school. Paper presented at the International Association for the Study in Cooperative Education Conference 2004, 21 June to 25 June, Singapore .
- Popper, K. R. (1972). *Objective knowledge: An evolutionary approach*. Oxford: Clarendon Press.
- Reeve, R. & Lamon, M. (1998). Factors to be considered: overlapping communities of inquiry in a knowledge-building classroom. Paper Presented at the *Meeting of the American Educational Research Association*, San Diego, April 1998.
- Scardamalia, M. (2002). Collective cognitive responsibility for the advancement of knowledge. In B. Smith (Ed.) *Liberal education in the knowledge society*. (pp. 67-98). Chicago: Open Court.
- Scardamalia, M. (2004). CSILE/Knowledge Forum®. In *Education and technology: An encyclopedia*. (pp. 183-192) Santa Barbara: ABC-CLIO.
- Scardamalia, M. & Bereiter, C (1991). Higher levels of agency for children in knowledge building: A challenge for the design of new knowledge media. *Journal of the Learning Sciences, 1*(1), 37-68.
- Scardamalia, M. & Bereiter, C (1994). Computer support for knowledge-building communities. *Journal of the Learning Sciences, 3*(3), 265-283.
- Scardamalia, M., Bereiter, C., & Lamon, M. (1994). CSILE: Trying to bring students in world 3. In K. McGilley (Ed.) *Classroom lessons: Integrating cognitive theory and classroom practice* (pp. 201-228). Cambridge MA: MIT Press.
- Tan, S. C., Hung, D., & So, K.L. (2005). Fostering Scientific Inquiry in Schools through Science Research Course and Computer-Supported Collaborative Learning (CSCL). *International Journal of Learning Technology, 1* (3), 273-292.

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