Towards Design-Based Knowledge-Building Practices in Teaching

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Abstract: This paper explores knowledge building in a community identified by Bielaczyc and Collins (2006) as a hotbed community—a community in which knowledge creation has taken on a life of its own. The practices of six elementary schoolteachers are analyzed to inform the development of teachers' knowledge-building practices and to better understand how teachers develop and sustain innovative knowledge-building practices.

Overview

Helping teachers learn and develop as professionals is of great consequence to the teaching profession (Darling-Hammond & Bransford, 2005). To address this challenge, a line of research reported below focuses on a shift from "individual" to "communal" processes (Shulman & Shulman, 2004; Hammerness, Darling-Hammond, Bransford, Berliner, Cochran-Smith, McDonald, et al., 2005). As argued by Darling-Hammond and McLaughlin (1995), conventional ideas of in-service training or knowledge diffusion need to be replaced by opportunities for knowledge sharing; teachers need to be provided with opportunities to share what they know, discuss what they do not understand and relate new concepts and strategies to their own unique teaching contexts. Accordingly, many designs in relation to community-based teaching-learning have been proposed in response to this change of perspective (e.g., see Grossman, Wineburg, & Woolworth, 2001; Hammerness et al, 2005; Palincsar, Magnusson, Marano, Ford, & Brown, 1998).

More recently, however, scholars have further identified the need to transform teacher-learning communities into knowledge-creating or knowledge-building communities (Bielaczyc & Collins, 2006; Chan & van Aalst, 2006; Hargreaves, 1999; Scardamalia, & Bereiter, 1999; Zhang, Hong, Teo, Scardamalia, & Morley, 2008). These communities do not function merely as "learning" communities with the goal of replicating best practice or applying ideas from the educational research community. Instead, a knowledge-building community works to advance knowledge by helping to advance both theory and practice, with the goal of going "beyond best practice." They function more like a research, business, or scientific knowledge-creating organization than traditional teacher communities where the notion of "beyond best practice" is underrepresented, especially in comparison to research communities and knowledge-intensive industries where knowledge building and innovation are expected.

In the present study, we explore the dynamics of a teacher community committed to continually improving their practices so that they are able to advance beyond "best practice." The teachers in this community are engaged in collective knowledge building, in their interactions with each other, as part of a larger professional development community, and in their work with their students. Knowledge building is a social process focused on the production and continual improvement of ideas of value to a community (Scardamalia & Bereiter, 2003), and defined by a set of 12 knowledge-building principles which represent design challenges, ideals, and improvable objects in their own right (see Scardamalia, 2002, for detailed description). For example, the principle of "community knowledge, collective responsibility" emphasizes that contributions to shared, top-level goals of the community be rewarded as much as individual achievements and that community members produce ideas of value to others and share responsibility for the overall community knowledge advances (Scardamalia, 2002). The set of principles enables a theoretically-guided or principle-based design approach to teaching practice (Hong, Scardamalia, Messina, & Teo, 2008; Zhang, Hong, Teo, Scardamalia, & Morley, 2008), as contrasted with conventional classroom work defined by pre-specified procedures, clear scripts and rules, or componential tasks (see, e.g., Dick & Carey, 1990; Gagne, Wagers & Briggs, 1992, Mager, 1975; Merrill, 1983) or any highly-structured teaching activities that represent fixed rather than improvable classroom procedures (Hong & Sullivan, accepted). The purpose of this exploratory study is to uncover the nature and document the process of how these teachers worked together as a community and engaged in sustained knowledge advancement.

Method

Participants were six teachers from the Institute of Child Studies (ICS), University of Toronto. ICS is a laboratory school and it enrolls students from Nursery (Pre-K) to Grade 6, with each classroom having approximately 22 students. Knowledge building pedagogy was first used at ICS in late 1996. There have been quite a few changes of staff over the years, but each of the six teachers has had several years of experience with knowledge building pedagogy. Data were mainly gathered from the teachers' reflective journals (also known

as "Calendar of Inquiry", COI) recorded in a Knowledge Forum database between September, 2002 and April, 2004. Knowledge Forum is a computer-supported knowledge building environment, which provides knowledge building supports both in the creation of ideas and in the ways these ideas are displayed and linked (Scardamalia, 2004). In the present study, Knowledge Forum was employed to provide the teachers an online, public space for collective problem-solving, and a means to their professional development. The teachers used Knowledge Forum to share their teaching reflection with their colleagues by posting their reflective journals (in the form of notes).

In addition, the teachers also met face-to-face for about two hours on a weekly basis to further discuss their problem of understanding, knowledge advances, and technological issues, in relation to their knowledge building practice in class. The teachers' reflective journals thus not only served as an end for their self-reflection but also as a means for synthesizing their collective, reflective wisdom derived from the meeting. The average number of words produced in each teacher's journal is 174,808 (SD=29,134.67).

As the main interest of the present study is to understand the nature and process of how these teachers together engage in knowledge-building practice, we intend to propose a theory of these teachers' collective knowledge building practices. So a qualitative analysis approach based on grounded theory (Strauss & Corbin, 1990) was employed to analyze these journals. Specifically, the three coding stages based on grounded theory (Strauss & Corbin, 1990) were employed: open, axial and selective coding.

Data Analysis

Open Coding

The analytic procedure referred to in grounded theory as "the constant comparative method of analysis" was adopted for open coding (Strauss & Corbin, 1990). The first author was the major coder. Twenty-four codes that emerged from free coding of data were categorized into five major categories, along with their properties and dimensions, as identified in Table 1. In grounded theory, each category represents an observed phenomenon. Properties are attributes or characteristics pertaining to each phenomenon while dimensions are a location of properties along a continuum. For example, phenomena in the "Design" category can be based on the control property (how much control the teacher has of the situation) and where they are on a continuum from a conservative "meeting expectations" to an adventurous chance/emergent dimension.

Table 1: Open coding of the teachers' collective knowledge-building practices

Categories	Properties	Dimension (Continuum)	
Design (principle-based)	Control	Planned/Expected	Emergent/Chance
	Sequence	Past (design implementation)	Future (re-design)
Problem Identification	Nature	Recurrent	Progressive
	Relevance	Teaching relevant (i.e., pedagogical and curricular)	Less teaching relevant (e.g., technical issues)
	Source	Self-generated	Other-generated
Reflection	Orientation	Practice-oriented	Theory-oriented
	Means	Intra-personal reflection	Group or collective reflection
Theory Evaluation	Relevance	Knowledge building principles oriented	Non knowledge building principles oriented
	Context	Local theory: specific to class context	Universal theory: general to most class context
Deeper Understanding	Source	Personal experience	Vicarious or shared experience
	Means	Trial and error	Reflective
	Object	Practical knowledge	Theoretical knowledge

Axial Coding

To further analyze our data, axial coding is adopted to put the coded data (see Table 1) back together in new ways by making connections between categories. Figure 1 represents the coding scheme used to interpret the data. A major purpose of employing grounded theory is to explore causal relationships, by integrating major phenomena identified from data into a basic causal framework. As suggested in Figure 1, it is posited that the central phenomenon is problemization (Problem); the causal conditions are design related activities (Design); the Intervening Conditions are teachers' reflective practices (Reflection and Theory Evaluation); and the consequences are teachers' improved knowledge and gradually more refined experiences (Deeper Understanding).

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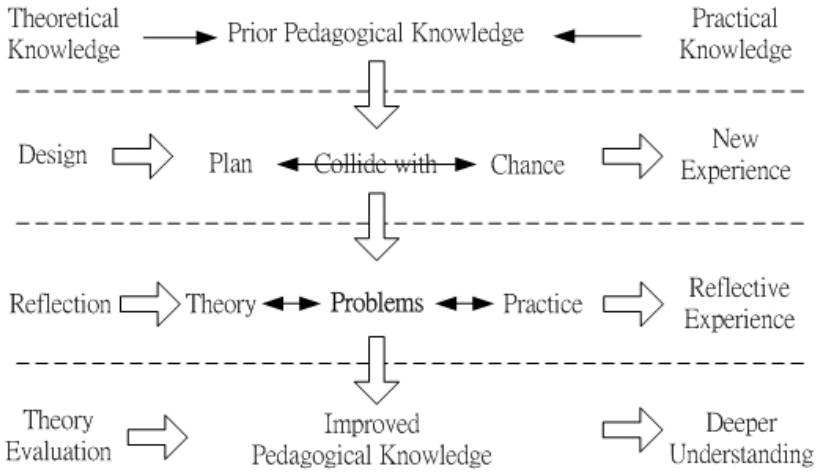

Figure 1. Teachers' collective knowledge-building practices

Selective Coding

Our third-level, selective coding, involved building a story to connect categories. The unfolding story suggests that teachers commonly start their journal writing by posing a problem encountered in class teaching due to the collision between their design and emergent situations. A large portion of their narrative then describes their class teaching experiences related to the problem that emerged, followed by further individual and group reflection on the problems and insights gained. In the following analysis, we further elaborate relationships between problem-reflection, and attempts to characterize the causal relationships and cycles of activity that underlie their design process. Excerpted examples are also included to corroborate the findings.

Central phenomenon.

The central or major phenomenon was identified to be progressive problem-solving surrounding three main kinds of problems: pedagogical, curricular and technical. Problem-solving was progressive, in the sense that teachers continually addressed new problems and/or reconstructed previously addressed problems at continually higher levels rather than allowing the same problem to appear repeatedly. For example, in attempting to help young children develop a stronger sense of community, the Grade 2 teacher tried to look at the same problem in several different ways, while at the same time inviting colleague for collective reflection and problem-solving:

> I am wondering how to get the children to put the information they are learning onto the view. I have encouraged them to think about what we have been doing, discussing and adding to our blackboard chart and to add all this to the Community view [a Knowledge Forum "view" is a collective problem-solving and design space], but they have not been following through on my suggestions. Any ideas? I'm trying to maintain a balance between giving the children some guidance and not making them feel as if I am telling them what to put on the view. On the other hand, I would like the notes to reflect their growing understanding of community.

Causal conditions.

As suggested above, these teachers work with a set of knowledge-building principles, but these principles do not serve as prescriptions, but rather as design parameters. Teachers use these principles flexibly and engage continuously in design, balancing chance circumstances and the constraints within which they work as they open up new possibilities for knowledge building practice and theory. For example, in order to support the knowledge building principle of "idea diversity," the Grade 1 teacher commented:

> This year, I would like to have the children tackle KF in a different way…after sharing their ideas, all captured on paper by the teacher, they will decide what collaborative note they want to post on KF. This way their ideas are more generally heard and the process of knowledge building becomes more transparent...I hope.

Intervening Conditions.

The data suggest that the starting point for progressive problem-solving has more to do with the design challenge the teacher is facing than to efforts directed specifically at implementing a particular theory or

practice. For example, one teacher engaged in a 3-year effort to improve his practice, with the principle "community knowledge, collective responsibility" as the stated goal (see Zhang, Scardamalia, Reeve, & Messina, in press). In the process he substantially altered his practices, with corresponding improvement in student outcomes. Throughout there was continual movement between theory and practice, with challenges in implementation resulting in refinements to both practice and principle. The means of reflection (both individual and collective) is related to the context in which the teachers work. They all move between theory and practice to some extent, as the following reflection on a question regarding young kids' metacognitive capacity suggests. The Nursery Grade teacher reflected in her journal:

> One of the MA students in my room was talking to me about assessment and asked can the kids do "self-assessment?". This seems directly related to the questions I've been having about knowledge building at this age. Are the kids conscious enough about the learning process (their own or others') to monitor (assess) as they go?

Consequences.

The data also suggest that teachers innovate by transforming their personal teaching experiences (i.e. more crude experience of initial design, or trial and error, and more refined reflective experience, see Dewey, 1938) into deeper understanding and integrated knowledge of theory and practice. For example, after conducting a three-year, design-based research in his own class, the Grade 4 teacher wrote:

> In analyzing the data from the past 3 years, it seems true (contrary to my original hypothesis), that there has been progress each year in the significant change from pre-test to post-test, significantly more activity each year, and even the portfolio notes themselves seem to suggest that the students have been demonstrating epistemic agency [i.e., a knowledge building principle]. Building from last's years success (a year with students working organically in any study group they were interested in) with less structure, I think this year, I will continue to test the boundaries by consciously trying to not influence the direction of the study. Students will be asked to write Problems of Understanding notes tomorrow. We will look at them on Friday and try to come up with a class mission statement to ensure that the community is working toward the collection of a common understanding made up of various studies. Exciting times ahead!

Discussion

What is unique about knowledge building practices in teaching? How does it differ from other teaching practices? We first consider more common perspectives, for example "teaching as craft" (Bereiter, 2002). Such craft practice is largely guided by one's personal experience (Leinhardt, 1990) and tends to capitalize on specific teaching experiences in order to generate useful rules of thumb for problem-solving. Such practical knowledge can be associated with what Polanyi (1967) described as 'tacit' personal knowledge. Another is replication of best practices, often accomplished by eliminating problems that emerge to cause unexpected difficulties so that the "best practice" can be adopted without variation. Another practice might be termed "theory-to-practice." in which the goal is to capitalize on existing theories for solving problems in relation to teaching practice. However, this is also a problem-elimination approach, to the extent that it emphasizes the general applicability of theory (universality) and overlooks the unique role of practical knowledge in refining theory (cf. Sawyer, 2004).

Knowledge building practice, in contrast, involves a more dynamic and integrated approach in which teachers reflectively move between principle-based pedagogical ideas and practical strategies with the goal of advancing both. It capitalizes both on the strength of design and that of adventurous teaching (Cohen, 1989; Sawyer, 2004), allowing new problems to emerge or recurrent problems to be re-defined and transformed for progressively more advanced problem-solving, with unplanned, new learning designs collaboratively improvised through classroom interaction (Zhang et al., 2008). This represents an important form of teacher professional development aimed at cultivating more reflective and innovative teachers.

In summary, while teaching has been viewed as a craft (Bereiter, 2002) and the idea of education as a progressive science is new to most teachers and to the discipline as a whole (Bereiter, 2002; Cohen, 1989), the teachers in this study engaged continuously in progressive problem solving (Bereiter & Scardamalia, 2003), with practice and theory reciprocally linked, and new designs serving to advance both their practices and student achievement. The current study suggests that it is important to foster a teaching culture with theory-practice interaction through teachers' collective reflective experience (Dewey, 1938), and to make innovation in teaching practice a common knowledge-building experience among teachers.

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