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CRITICAL PERSPECTIVES ON COMMUNITIES OF MATHEMATICAL INQUIRY

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While the notion of Communities of Inquiry (CoI) has its origins in philosophy, there has been widespread interest in mathematics classrooms as Communities of Mathematical Inquiry (CoMI). This paper outlines the structure and content of Research Forum 2: Critical Perspectives on Communities of Mathematical Inquiry, gives a brief review of research in the area, and highlights some key issues.

ABOUT THIS FORUM

The goal of this Research Forum is to present critical perspectives on Communities of Mathematical Inquiry (CoMI) and to engage participants in a (possibly continuing) international research community of inquiry addressing the questions that will be raised in the forum.

This forum will include five brief presentations based on the presenters’ papers in this volume. The first session will set the scene in terms of the theoretical frameworks to be adopted, a summary of the field, and the main issues and findings. In the second session, presentations will relate to the underlying assumptions that shape teaching as a cultural activity, or what Stigler and Hiebert (1999) refer to as the cultural scripts in different countries, and the affordances and hindrances that these imply for classroom functioning as communities of mathematical inquiry.

Both sessions will allow substantial time for discussion, focused on the questions:

- What are the benefits, if any, of applying CoMI in a classroom?
- What current practices constitute versions of CoMI in your country?
- How might CoMI be developed in a classroom?
- Which are the affordances and hindrances for CoMI in a classroom?
- How can international collaborative research support the development of CoMI?
- How might this “group” establish a collaborative research program?

However, as the aim is to create a community of inquiry, participants will be encouraged to frame their own questions for discussion.

A continuing discussion group will be formed for those participants who wish to participate in an extended community of inquiry with a view to possibly carrying out collaborative research in the area.

Space restrictions dictate that this paper can only provide a very brief introduction to Communities of Mathematical Inquiry, research in the area, and some key issues.

COMMUNITIES OF MATHEMtical inquiry

The notion of Communities of Inquiry (CoI) originated with the work of the philosopher C. S. Peirce (1839–1914), who argued that we “come to know the world via a communal and pluralistic community of inquirers engaged in a scientific method of inquiry” (Pardales & Girod, 2006, p. 301). In the classroom context, the notion of Communities of Inquiry has underpinned the Philosophy for Children movement (for example, Lipman, Sharp & Oscanyan, 1980; Splitter & Sharp, 1995).

Key features of classrooms functioning as communities of philosophical inquiry are the development of skills and dispositions associated with good thinking, reasoning and dialogue; the use of subject matter that is conceptually complex and intriguing, but accessible; and a classroom environment characterised by a sense of common purpose, mutual trust and risk-taking.

Inherent in Communities of Inquiry is the belief that social interaction is a requisite for learning and that students and teachers can engage together in scientific discourse where progress is made through building on one another’s ideas which are publicly displayed and evaluated (see Lipman, Sharp & Oscanyan, 1980; Wells & Mejia-Aruz, 2006; and also Greeno, 1992; Bereiter, 1994, who refer to progressive or scientific discourse rather than Communities of Inquiry). Thus, in a community of inquiry, participants are engaged in confronting problematic situations and participating in dialogue and argumentation (in the sense of Krummheuer, 1995).

Within the PME and the wider mathematics education community, there has been widespread interest in mathematics classrooms functioning as communities of inquiry (or inquiry classrooms). Research into Communities of Mathematical Inquiry (CoMI) has addressed all of the three aspects of CoI, although it is often impossible to divorce one aspect from another as they are so closely intertwined. Much of the research, has focused on progressive discourse, collective argumentation and the socio-mathematical norms associated with these (for example, Cobb, Wood & Yackel, 1991; Yackel, 2001; Yackel & Cobb, 1996; Williams & Ryan, 2001; Brown & Renshaw, 2004; Groves & Doig, 2004; Groves & Fujii, 2008). This research spans the development of skills of thinking, reasoning and dialogue and the development of a classroom climate that encourages students to see themselves as mathematical thinkers, and models the teacher as being in authority rather than as the authority (Splitter & Sharp, 1995).

Other research foci include: the importance of appropriate and conceptually rich tasks and questions that provoke mathematically rich activity (c.f. the Japanese hatsumon), the need for conceptual press, and the need to interweave the concrete and the abstract (for example, Kazemi, 1998; Groves & Doig, 2002; Groves, Doig & Splitter, 2000); the assumptions underlying mathematical thinking and the process of inquiry in CoMI and the teacher and student actions that indicate these (Goos, 2004); and the role of CoMI in teacher education and teacher professional development (for example, Jaworski, 2004; Williams, Corbin, & McNamara, 2002).
CULTURE AND IDENTITY

In the tradition of Hans Freudenthal and the *Realistic Mathematics Education* (RME) movement in the Netherlands, the late Leen Streefland attempted to establish CoMIs in primary classrooms by giving students responsibility for their learning, using realistic problems, addressing students as “researchers”, and using their solutions as the source of mathematics for the lesson (in much the same vein as seen in the Japanese structured problem-solving lesson – see for example, Fujii, 2009). Streefland also believed in creating a classroom climate of mutual trust where all students could participate in constructing mathematical meaning (c.f. Splitter & Sharp, 1995). According to Elbers (2003), students in Streefland’s classes began to view themselves in different roles and speak about themselves in different ways. They talked about their new identities and responsibilities as members of a community of inquiry. They criticized each other when somebody fell back into the habits of conventional lessons. (p. 81)

The term *normative identity* is used by Cobb, Gresalfi and Hodge (2009) to refer to the interactively constituted classroom obligations with which students need to identify in order to be regarded as a successful “doer” of mathematics, and use *personal identity* to refer to the extent to which a student identifies with or merely complies with, or even rejects, these obligations – that is, the extent to which students turn “obligations-to-others” into “obligations-to-oneself” (p. 47). They also distinguish between *conceptual agency* – involving choosing methods and developing meanings for themselves – and *disciplinary agency* – using established methods. They argue that these distinctions provide a useful tool of analysis and apply it to contrast the mathematical learning in two classrooms. In the “design experiment class”, the students, who had developed sophisticated reasoning and argumentation skills, also considered themselves to be succeeding mathematically due to their ability to make substantial contributions to classroom discussions.

These two descriptions not only resonate with CoI, but also describe the way in which Japanese mathematics classrooms operate, at least at the elementary school level, where the goal of learning is not for individual benefit but for whole-class progress (Fujii, 2009). Lewis (1998) characterises Japanese elementary schools by “the three C’s: connection, character, and content” (p. 32), with teachers seeing as their first priority helping children develop a strong emotional connection to school, while fostering friendship, co-operation and responsibility, and giving children time to convince themselves of the concepts contained in the “frugal, shared curriculum” (p. 35). Learning is seen as a co-operative activity, with success being “judged by whether one sets and meets rigorous personal goals and does one’s best for the group” (p. 36). Inagaki, Hatano and Moritas (1998) see classroom as a community of learners rather than individuals, with even the silent students learning. Thus, in Japan, notions such as *distributed authority* are supported by deep-seated cultural factors, which may account for the difficulties often associated in Western countries with creating CoMIs beyond research projects specifically targeting such practices.
PROGRESSING MATHEMATICS WHILE PROGRESSING DISCOURSE

In earlier work, Cobb and his colleagues (for example, Yackel & Cobb, 1996; Yackel, 2001) focus on the socio-mathematical norms associated with learning to communicate in ways that progress mathematical understanding (see also Kazemi, 1998). Sherin (2002), however, highlights the difficulties teachers have in moving from a traditional classroom to what she calls a discourse community by drawing attention to the “balancing act” required of teachers to use students’ ideas as the basis of discussion while progressing the mathematical content.

Sawyer (2004) contrasts the strongly framed vertical discourses usually associated with teacher-directed mathematics teaching with the more loosely structured, context based horizontal discourses that are more closely related to everyday life. She observes that the former is usually regarded as being more conservative, but also more visible in terms of its pedagogy, than the latter, with “invisible” pedagogies often being seen as more progressive, but disadvantaging groups who are unaware of the rules of participation. In her explanatory case study, she describes the way in which a first grade teacher enacts a “radical pedagogy” which focuses on

 collective access to valued forms of knowledge … as students work together to learn the rules of these discourses … [and which has the] potential to enable very young students from diverse backgrounds to tackle the complex interrelationships of vertical and horizontal discourses in real life problems, while ensuring that mathematics remains at their heart. (Sawyer, 2004, pp. 457; 462)

It is no accident that this class and their teacher were involved in Philosophy for Children, and that it was the “culture” from the philosophy lessons that was explicitly continued in mathematics lessons.

CONCLUSION

Research into Communities of Mathematical Inquiry has increasingly looked at inquiry as a collective activity which is supported and constrained by cultural assumptions and practices at the local school and broader community levels. As Stigler and Hiebert (1999) point out, our efforts at improving teaching often ignore the fact that teaching is a cultural activity and overlook the insights we can gain into our own cultural scripts through comparative research.

One purpose of this Research Forum is to bring together an international community of researchers with a common interest in furthering research into Communities of Mathematical Inquiry, with a particular focus on the ways in which cultural factors impact on such practice. While cultural beliefs that underpin teaching in Japan and the West have frequently been highlighted (for example, Stigler & Hiebert, 1999; Groves & Fujii, 2008), there are many nuances that still need to be explored in order to paint a more complete picture of Communities of Mathematical Inquiry across countries and cultures. It is our hope that this Research Forum will stimulate an ongoing program of collaborative research.
References


