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COMMUNITIES OF MATHEMATICAL INQUIRY:
A PRIMARY PEDAGOGY IN PERIL

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This paper outlines some examples from an Australian education system, and its classrooms, that provide evidence of practices that are considered as antithetical to establishing and maintaining Communities of Mathematical Inquiry (CoMI). Although some possible solutions are posed, implementation is left open for readers to consider, as contexts vary widely from jurisdiction to jurisdiction.

INTRODUCTION

Belonging to, or being part of, a community is highly valued in today’s society, if the rise of so-called “social software”, like Facebook, is to be taken as evidence. However, this paper argues that “community” as a facet of education or learning, is being threatened and may well become extinct in a large number of the world’s schools. More disturbingly, the spread of the “un-community” is not confined to school education.

For example, in a recent article, Rochford (2008) decries the alienation of university students from the university community, and that “the higher education system in Australia is based on presumptions of human interaction that are antithetical to the traditional idea of a university community” (p. 41). Further she quotes Hager (2005) who suggests that students have become passive receivers of education, not part of a learning community. This is at the tertiary education level, but what is happening in the compulsory years of schooling, and more particularly the primary years?

In any discussion about community in mathematics learning, ideas that consistently emerge are those resonant with the notions suggested by Lipman and his colleagues (Lipman, Sharp, & Oscanyan, 1980) and Splitter (Splitter & Sharp, 1995) for Philosophy for Children. For example, Splitter and Sharp list the following marks of a philosophical discussion: reasoning and inquiry; concept formation, and meaning making (pp. 127-130). All of these marks form the reason that it is from this philosophical perspective that the present paper views effective mathematics pedagogy.

The first point that must be made is that many educators consider that Communities of Inquiry (CoI), and related ideas, such as Communities of Mathematical Inquiry (CoMI), are productive forms of pedagogy, and particularly so by members of the mathematics education research communities (Groves & Doig, 2004; Groves, Doig, & Splitter, 2000). Anthony and Walshaw (2008) claim that “the classroom community is the cornerstone for developing a sense of belonging in mathematics classrooms” a view supported by Pegg and his colleagues (2007) among others.
Practitioners too may hold these opinions, as shown by Doig, Groves and Splitter's (2001) report of the project Mathematics classrooms functioning as communities of inquiry: Models of primary practice. In this project, video-data of mathematics lessons were collected from ten Year 3 and 4 primary classrooms in Victorian government schools, and a lesson from each of the Year 3 and 4 classrooms at the Japanese School of Melbourne. Primary teachers, primary school principals, and mathematics educators who participated in a series of focus groups were unanimously supportive of CoMI as representing effective mathematics pedagogy. Further, that the Japanese primary mathematics lessons represented examples of CoMI. The effectiveness of the pedagogy in the so-called Confucian Heritage Cultures (CHC) (see, for example, Watkins & Biggs, 1996) is supported by evidence from numerous international comparative research studies. Thus, it is argued, that CoMI is an effective pedagogy for mathematics teachers to employ.

If this is the case, why then claim that CoMI is a pedagogy in peril? The answer is, that, if we accept that Asian primary lesson patterns are good examples of CoMI, these represent only a part of school practice, albeit a large part in terms of student numbers. In other jurisdictions, it can be argued that CoMI is not supported as a pedagogy, but is threatened, or replaced, by pedagogies antithetical to CoMI. Threats from two quarters are considered in this paper. The first is from the education system, and the second is from classroom support materials. The examples are taken from current documents and Internet support materials for teachers in Victoria, Australia.

EFFECTS OF THE EDUCATION SYSTEM

In Victoria the Department of Education and Early Childhood Development (DEECD) is responsible for curriculum, curriculum support, and also supporting classroom pedagogy. To this end, DEECD maintains a large and complex web-site that allows children, parents and teachers to access every aspect of school education under DEECD's purview. Part of this enterprise entails suggesting what are considered effective pedagogies. In our case, while the suggested pedagogy is not mandatory, it is the most prevalent to be found in classrooms. The pedagogy, it is suggested, should be differentiated to maximize children's learning - in other words, differentiated to attend to individual children's needs, a laudable objective.

However, given a class of twenty or more children, individualized instructional practices are impractical for many teachers, and so a modified pedagogy is employed. This is a class management strategy that has a whole class period at the beginning of a lesson (orientation), followed by small group work (teaching), and finishing with a whole class "share time" (plenary). This arrangement is popularly known as the "hamburger model". Each of the parts of this hamburger, unfortunately, as recommended, or in practice, do have different foci. For example, the orientating first.
part may deal with yesterday’s lesson on length, the small group work may have
several foci, and the plenary at the end may be a sharing of all the disparate parts.

An example lesson observed in the previously mentioned *Mathematics classrooms
functioning as communities of inquiry: Models of primary practice* had three groups
in the group work part: one group was using sale catalogues to try and purchase
$1000 000 of property, a second group of two children was asking classmates to
guess the total value of a mixed collection of coins in a jar, and the children in the
third group were tossing coins to observe sequences of heads and tails tossed. At the
end of the lesson in the plenary, the class teacher had children from each group report
their “findings”. Obviously, each group had some difficulty in understanding other
groups’ findings. When asked about this, the class teacher pointed out that each day
the groups would change activity and by the end of the week, when everyone had
tried all activities, there would be a whole class discussion. It is easily seen that this
arrangement is antithetical to forming a CoMI.

Thus, starting with a laudable suggestion, the end result is antithetical to effective
pedagogy: the devil, as is said, is in the detail.

There is a further issue with the notion of classes working in small groups. The
figures below show the physical and dialogical arrangements of a hamburger-style
lesson. In the figures T represents the teacher, S the students, and the arrows show the
main direction of information flow.

![Diagram](image)

**Figure 1:** The orientation part of the lesson.

Figure 1 shows the orientation part of the lesson. The instruction and questions flow
from teacher to students. It is typically a rehearsal of known work, and is usually in a
simple question and answer format. Clearly this is not intended to be part of a CoMI
and it would be churlish to deny the usefulness for many children of this part of the
pedagogical model.

Figure 2 shows the group work part of the lesson. Note that the bottom group is the
focus or teaching group. This group receives special attention due to their
mathematical needs, while the other (two) groups work independently of the teacher.
The teacher independent groups may not be studying the same topic as each other, as
clearly shown in the sample lesson from the *Mathematics classrooms functioning as
communities of inquiry: Models of primary practice* project described above.
Figure 2: The group work part of the lesson.

Figure 3 shows one of the children describing their experiences and learning to the teacher and the remainder of the class. Each child would be expected to take this role in turn. The class and the teacher would also ask questions, and at times the plenary could become dialogue, but observation suggests this rarely happens.

Figure 3: The plenary part of the lesson.

It is clear that the hamburger model of pedagogy is antithetical to CoMI due to its structural elements. It would appear that the dilemma for CoMI is how to address individual student needs while enabling a form of dialogue and community.

IN THE PRIMARY CLASSROOM

Support at the primary classroom level of the most obvious examples of CoMI—antithetical practices are to be found in text books. In Victoria the common practice of text-book writers and publishers is to take the curriculum content, which is expressed in terms of achievement outcomes (objectives), and fragment this further in the following manner. Each major topic in mathematics (for example, number, geometry, measurement) is subdivided into smaller topics that can be taught in a single school term. In Australia there are four ten-week terms in a school year.
(although some terms may vary slightly from this general pattern in some years). In this way, each major topic is "visited" every term, and is usually seen as an example of (Bruner's) spiral curriculum. Next, the term sub-topics are re-divided into smaller parts that can be taught in single lessons. But these are presented in the text-book on non-consecutive pages, for example, pages 14, 26, 41, 55, 68, 80, ... A consequence of this process is that these myriad parts of the curriculum are interleaved, and no coherent or sustained learning can take place. To complete the disarray, each page of the text-book may have two or three different aspects of these parts per page! For example, a measurement page may have tasks that require measuring the length of real objects in centimetres, working out how many centimetres there are in a metre (!) and writing a given number of centimetres as whole metres. While this example is based on Dean and Nightingale (2003) the format of their book is not unique but is rather ubiquitous.

The Victorian primary teacher is supported then by text-books, and other materials, that accept that an "atomized" curriculum is both efficient and effective. And yet, research into the practices of effective teachers of mathematics does not support the use of such "atoms", but rather suggests that effective teachers more often implement, *inter alia*, sequences of lessons rather than single one-off activities, and make explicit connections between ideas (Doig, 2003). Further, CHC classrooms demonstrate that a sustained focus is enabling of a CoMI and thus it can be claimed that the use of a text-book of the nature above is antithetical to a CoMI.

CONCLUSION

In the preceding paragraphs we have described examples of pedagogical practices and their supporting materials that are, intentionally or not, antithetical to CoMI as a basis for effective mathematics classroom practice. This is despite evidence from CHC classrooms that CoMI is an effective pedagogy. The question that remains is how to change the present situation in the face of current practice.

Clearly, pilot classrooms need to be established that can demonstrate the effectiveness of CoMI as a pedagogical practice. Such classrooms would need to be open to visits from other teachers, parents, and other interested parties. Data of CoMI effectiveness for learning that is patent and understandable to the intended audience needs to be collected and widely disseminated. Convincing an education system to trial approaches that they see as antithetical to their own prescribed, or suggested, models would be a large and lengthy task. Perhaps mathematics education researchers, such as members of the PME community, can form research networks, with individuals contributing their findings to form a critical mass. Perils may yet be prevented.

References

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