

Emergence of a Pre-Service Community of Practice

Merrilyn Goos

The University of Queensland
<m.goos@uq.edu.au>

Anne Bennison

The University of Queensland
<a.bennison@uq.edu.au>

This paper reports on our research with pre-service secondary mathematics teachers in building a community of practice featuring face to face and online interaction. We analyse bulletin board discussions involving our 2003 student cohort in terms of Wenger's (1998) three defining features of a community of practice: mutual engagement, joint enterprise, and a shared repertoire of resources. The emergent design of the community has contributed to its sustainability in allowing pre-service teachers to define their own professional goals and values.

In reviewing current research perspectives on mathematics teacher education, Lerman (2001) proposed that sociocultural theories could offer useful conceptual tools for studying teachers' learning as a collective process of enculturation into the practices of a professional community. The study described here develops the concept of *community of practice* in a pre-service teacher education context. The aim of the study is to analyse processes through which such a community is established and maintained when interaction is online as well as face to face. In this paper we identify features of an emerging community by analysing bulletin board discussions amongst our 2003 cohort of pre-service secondary mathematics teachers.

Learning in Communities of Practice

Wenger (1998) describes three defining characteristics of communities of practice as mutual engagement of participants, negotiation of a joint enterprise, and development of a shared repertoire of resources for creating meaning. Engagement need not require homogeneity, since productive relationships may arise from diversity and involve complementary rather than identical contributions. Yet participants are connected by their negotiation of an enterprise linked to the larger social system in which their community is nested. Such communities have a common cultural and historical heritage, and it is through the sharing and re-construction of this repertoire of resources that individuals come to define their identities in relationship to the community. Because communities of practice evolve over time they also have mechanisms for maintenance and inclusion of new members.

Although communities of practice are generally constituted through face to face interaction, technologies such as the Internet can provide an alternative medium for participation. Within mathematics education, there have been attempts to design online communities to encourage the collaborative construction of knowledge and to challenge prospective teachers' beliefs about learning, teaching, and the nature of mathematics (e.g., Schuck & Foley, 1999). Enabling pre-service students to continue their participation in a technology-mediated community during practicum sessions may also assist them to critically reflect on the dilemmas of practice and persist with innovative teaching approaches promoted by the university program (Brett, Woodruff, & Nason, 1997).

Two difficulties identified in research into online communities concern the tension between designed and emergent communities, and the question of sustainability. For example, Derry, Lee, Kim, and Seymour (2001) identified various forms of resistance to an

online community designed for a cohort of secondary teacher education students. In imposing a structure on the operation of the community, the researchers incorrectly assumed that students and instructional staff shared their research goals. They concluded that any attempt to design a community should respect the context and follow from a careful analysis of local conditions and the needs of members. Even when student participation in online discussions is encouraged rather than mandated, teacher educators face difficult decisions about whether and how to intervene to ask questions, offer suggestions, or correct misconceptions (Schuck, 2003). Barab (2001) writes of the inherent tension in managing the interplay between the designed and the emergent in building online (or face to face) communities of in-service and pre-service mathematics and science teachers. He maintains that it is preferable to create a framework and then facilitate the growth of the community by adopting an emergent design so that participants build the space, rather than imposing a design completely formulated in advance. The sustainability of a community of practice is related to the designed/emergent duality in that an emergent community is more likely to meet the needs of its members because they have played a part in its development and thus identify with its goals and values. These were the issues we investigated in the study reported here. Our research questions are:

1. What evidence is there in bulletin board discussions of the emergence of a community of practice of pre-service mathematics teachers?
2. What factors might have contributed to the emergence of such a community?

Research Design and Methods

Participants

Three successive cohorts of prospective secondary mathematics teachers are participating in the study from 2002-2004. (This paper draws on data from the 23 students in the 2003 cohort). Students are enrolled in a pre-service Bachelor of Education (BEd) program available to undergraduates as a four year dual degree or to graduates as a single degree taken in four semesters over eighteen months. Students take our mathematics curriculum studies course as a single class group during the Professional Year, corresponding to the fourth year of the Dual Degree and the first two semesters of the Graduate Entry program. This course aims to create a learning environment consistent with recent curriculum reforms (e.g., National Council of Teachers of Mathematics, 2000) and socioculturally oriented research in mathematics education (e.g., Goos, in press) in emphasising mathematical thinking and collaborative inquiry. Twice during the Professional Year all students complete a seven week block of practice teaching. The class meets twice weekly for three hour workshops during the remaining 17 weeks of the year. Dual Degree students are eligible for graduation at the end of the Professional Year while Graduate Entry students must complete additional courses (not related to mathematics education) over Summer Semester and the first semester of the following year. This final Graduate Entry semester begins with a ten week internship spent teaching in schools.

Data Sources and Analysis Methods

Interaction between students and lecturers is both face to face and online. We established a mathematics community website via Yahoo Groups, with membership of the group restricted to successive cohorts of students participating in the study. The website offers access to bulletin board, calendar, email, and file-sharing facilities. One advantage

of such a community over Web-based course tools used for flexible learning in university programs lies in its continued accessibility to members after graduation. Also, unlike university course discussion forums, our mathematics community website allows members to use email for sending messages to the entire group as an alternative to posting messages to the bulletin board. (In the remainder of this paper when we discuss bulletin board use we are referring to all messages sent to the Yahoo Group's email list or posted directly to the website bulletin board.)

Messages sent via email or posted to the bulletin board are automatically archived on the website and thus available for analysis. Bearing in mind the lessons from previous research on designed versus emergent online communities, we decided to impose minimal structure on bulletin board communication. (This contrasts with the approach taken by most other courses in the Bachelor of Education, which require students to make a specified number of posts to a WebCT bulletin board as part of the course assessment program.) We told students the bulletin board would be an important form of communication for the course and we reinforced this from the start of classes, for example, by providing information about forthcoming workshops, inviting students to continue discussions about mathematics teaching begun during class, and forwarding messages about mathematics teaching approaches we found on other email discussion lists. Students were free to use the mathematics curriculum bulletin board for any other purposes they chose.

At the end of the course we conducted a group interview with the students to obtain feedback on their use of the mathematics community website, and invited them to add further comments later via the bulletin board. We wanted to know their reasons for using the website, what elements of the site they found most useful, and how often they read the email/bulletin board messages. The latter question was important to gauge the extent of any vicarious participation not evident in the list of archived messages. We additionally asked students to comment on benefits or disadvantages in using the bulletin board compared with face-to-face communication in class. During this discussion students also contrasted the ways in which they used the mathematics community website with their participation in electronic discussion forums associated with their other university courses.

Although mathematics curriculum classes ended on 31 October 2003, members of this cohort are continuing to post messages to the bulletin board, even at the time of writing. The quantitative analysis of bulletin board messages covers the period between 17 February 2003 (the start of the 2003 Professional Year) and 26 January 2004 (the start of the final semester of the BEd for Graduate Entry students). Qualitative data from later messages, and also from the group interview, are included in the analysis where appropriate to support our arguments concerning the emergence of a community of practice.

An initial count of messages was conducted to determine the distribution of messages over time, who had posted them, and whether these posts were initiating a new topic or responding to a previous message. Messages were then categorised in a two-way analysis according to the phase of the course during which they were posted and the message content. Three course phases were identified: *coursework*, when students were on campus attending mathematics curriculum classes (17 weeks); *practicum*, comprising two periods of supervised field experience in schools (14 weeks); and *Summer Semester*, when Graduate Entry students completed three educational theory courses in intensive mode (8 weeks). Analysis of message content revealed five categories: *administrative*, *professional*, *advice*, *information*, and *social*. Administrative messages were related to the organisation

of the course, while professional messages were concerned with theoretical or practical issues arising from readings, class discussions or practicum experiences. Participants sought or offered advice on a range of topics, such as handling teaching situations or preparing for employment interviews, and they exchanged information about teaching resources and job vacancies. The purposes of social messages included organising class social gatherings and celebrating personal achievements.

Evidence of the Emergence of a Community of Practice

Drawing on Wenger's (1998) framework, we analyse evidence that a community of practice emerged amongst the 2003 pre-service cohort in terms of the degree of mutual engagement between participants, the manner in which students negotiated the joint enterprise of learning to teach mathematics, and the shared repertoire of resources they developed for maintaining their community during and after completing the course.

Mutual Engagement

A total of 474 messages was posted in the period 17 February 2003 to 26 January 2004. Of these, 123 were sent by ourselves, 327 by students in the 2003 cohort, and 20 by students in the 2002 cohort. Four were automatically generated when files were uploaded.

Table 1

Number of Messages Posted by Lecturers and Students in Different Phases of the Course

Participants	Course Phase		
	Coursework	Practicum	Summer Semester
Lecturers	45	36	42
2003 students	52	87	188
2002 students	14	6	0
Other ^a	1	0	3
Total	112	129	233

^aRefers to messages automatically generated when files were uploaded to the website.

Each of the 23 students who enrolled in the course for 2003 posted at least one message. Twelve students posted between 1 and 10 messages, seven posted between 11 and 20 messages, and two posted between 21 and 30 messages. The highest users were the two students who sent 42 and 86 messages respectively. Contributions were clearly unequal; yet in the group interview all students insisted they checked their email regularly and read all messages, even if they did not always respond. Another indication of the extent of mutual engagement can be gained by comparing the distribution of messages initiating a new topic with those that respond to a previous message. Amongst the 2003 cohort, 123 posts were classified as "initiating" messages and 204 as "responding", suggesting that there was genuine interaction between participants.

We were also struck by students' increasing engagement over the duration of the course, and beyond into Summer Semester. Table 1 shows that the frequency of messages posted by lecturers changed little in the three phases identified earlier, while students' contributions increased in number. The onset of Summer Semester for Graduate Entry students, and the simultaneous search for employment by Dual Degree graduates, triggered

intense discussion amongst the students. That this discussion lasted well beyond the conclusion of the mathematics curriculum course implies that students found value in maintaining the sense of community engendered by their engagement.

Joint Enterprise

The way in which students and lecturers negotiated different aspects of the joint enterprise of learning to teach mathematics can be investigated by examining how the content of bulletin messages changed over time. Figure 1 plots the number of messages by content and demonstrates that the enterprise was defined differently during the coursework, practicum, and Summer Semester phases of the BEd program.

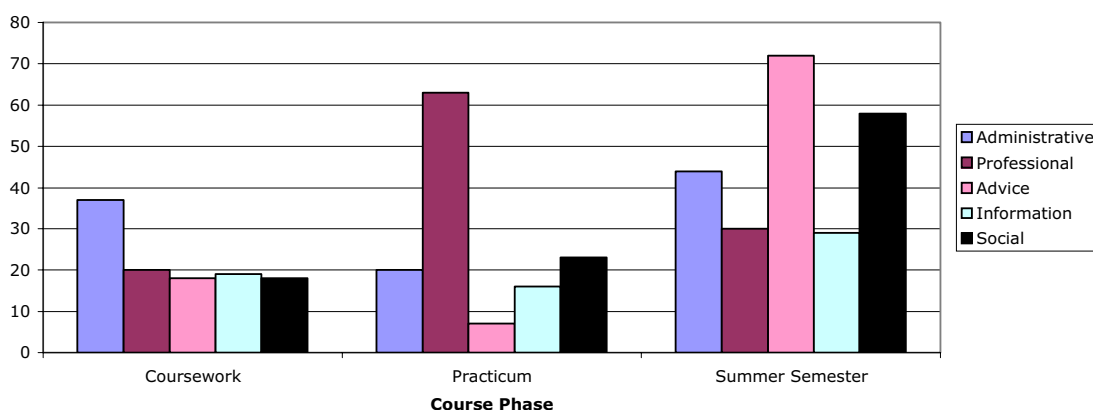


Figure 1. Message content in different phases of the course

While students were attending classes on campus, messages were most often administrative and reflected development of what Wenger (1998) describes as relations of mutual accountability among participants. These relations include:

... what matters and what does not, what is important and why it is important, what to do and not to do, what to pay attention to and what to ignore, what to talk about and what to leave unsaid, what to justify and what to take for granted, what to display and what to withhold, when actions and artefacts are good enough and when they need improvement or refinement (p. 81).

Of the 37 administrative messages, 23 were posted by us and 14 by students. They often referred to course assessment requirements, for example, the scheduling and content of seminar presentations and peer teaching sessions.

During the two practicum sessions the discussion turned to professional issues, and most of the 63 messages of this type were posted by students (51, compared with 12 from lecturers). Increasing connections with the wider professional community became evident as the students negotiated their new identities as mathematics teachers. For example, one student recounted her experience of providing graphics calculator-related professional development to other teachers in her practicum school. (All names are pseudonyms.)

From: "Suzie" <student email address>

Date: Thu, 29 May 2003 10:24 PM

Subject: my school

Hi all,

I just wanted to share a nice little warm fuzzy experience i had a few days ago. My school uses the g.calc in senior maths B & C but only for text book exercises which require them to do so ... In the

junior school they are unheard of. When I came up with the idea of demonstrating box and whisker plots with 'my' yr 10 class the teachers were intrigued if not a bit wary – so i met them half way and decided to just do a class activity with the g.calc projector thing. After much searching, we found the devices to project the screen onto the wall (still in packaging, never seen the light of day). I experimented with it for a while and before long i was taking a workshop for maths/science teachers on how to use it!

Anyways, my school is great and everyone is really nice, including the kids! I'm almost feeling like a 'real' teacher!

Summer Semester began only one week after the Professional Year ended and, with it, the mathematics curriculum course. However, students found a new purpose for the bulletin board in helping each other cope with the three intensive courses of study on the sociology of education they now had to complete. They navigated this unfamiliar theoretical territory by devising inventive practices that helped them to reconcile their dislike of the courses and the way they were taught with the overarching enterprise of learning to teach. One student's query (below) was pivotal in that it prompted the group to divide the required readings amongst members and post chapter summaries to the bulletin board so all could benefit. His salutation, "Hi Maths squad 2003", also signifies his sense of identification with this community of prospective mathematics teachers.

From: "Chinh" <student email address>

Date: Tue Nov 4, 2003 8:25 am

Subject: RE: [course code]

Hi Maths squad 2003!

I just realise that we have to read 5 chapters to prepare for the first tutorial (next Monday). I have read chapter 1 & 2 of JC (only 29 pages). But chapter 1 of CC is "amazing". Because all I can remember is "consumer" and "consumerism" and the conclusion makes sense to me. If you have read the chapter 1 of CC could you tell us what they are saying in the middle of the chapter, please. Also I would like some advice on how to read and make the most out of sociology text books, your advice will be much appreciated. Thank you and welcome to summer semester (Oh, boyz!!!!)

During this phase, 188 of the 233 messages were posted by the students as they appropriated the bulletin board to their own purposes. Here the joint enterprise was marked by seeking and giving advice, organising social events to maintain community cohesion, and negotiating relations of mutual accountability around the courses' administrative and assessment requirements.

Shared Repertoire

The Yahoo website itself was an important element of the repertoire of resources this community of practice used to make meaning of the enterprise of learning to teach mathematics. Two examples illustrate how students used the bulletin board to maintain the community and its shared history and to integrate newcomers through "generational encounters" (Wenger, 1998, p. 99). In late January 2004 as the Summer Semester was about to end, one student (Adam) posted a message announcing that "after chatting to a few people I have created a new Yahoo group for us to use (...) mainly so that we don't overawe Merrilyn and Anne's new class with our abilities :)". He then gave details of the name of the new group and how to join. Later he explained to us that he and his peers wanted to continue their online discussions during the forthcoming internship, but in a different space so as not to overwhelm members of the incoming 2004 cohort with large numbers of email messages from people who were strangers to them. Interestingly, however, the 2003 cohort also continued to post messages to the original mathematics community bulletin board and this has brought them into (virtual) contact with students in the new 2004 cohort. Adam has now invited these new students to join the "old timers"

Yahoo group so they can participate in discussions about their predecessors' internship experiences as novice mathematics teachers.

After the internship, Graduate Entry students finish their final semester by completing two further educational theory courses and they do not meet for classes again in their curriculum groups. Nevertheless, members of the 2003 cohort, including Dual Degree graduates who have started teaching, used the bulletin board to organise their own mathematics-specific internship debriefing session, and they invited newcomers to attend.

From: "Chinh" <student email address>

Date: Sun Mar 7, 2004 12:26 pm

Subject: Re: Debrief

Hello everyone!

I just wonder if we can have a debrief after the internship among us sometimes, cos I would love to hear more stories and experience from everyone which I think listen to a story is more interesting than reading one (in this case).

PS: all Merrilyn and Anne's students are also welcome

Factors Contributing to the Emergence of the Community

Our analysis indicates that students increasingly took the initiative in engaging with each other, defining their own academic and professional goals and values, and constructing a repertoire of resources for maintaining and extending the community. From our group interview with the students we can identify two significant factors that contributed to the emergence of the community. First, students noted that participation was voluntary and not assessable. This led to a different usage pattern compared with other university course websites where their contributions were mandatory and graded for assessment. Referring to the latter, one student stated that "I posted my minimum allocation and didn't read much of what others had to say". Another explained why:

Mandating the use of discussion lists and then basing grades upon this has led to a false sense of collegiality. Unfortunately, discussion has been stifled by the need to produce X 'original' postings in order to achieve Y percent. [The Yahoo mathematics website] on the other hand is totally voluntary. This shifts the focus away from simply meeting criteria to pass a subject, and towards developing a sense of community.

Second, students pointed out that having face to face as well as online interaction in a small class was crucial in creating familiarity and trust so that the bulletin board became "an outlet for discussion of ideas/problems, and a relief valve for stress". This compared unfavourably with their experience of WebCT discussion forums in other BEd courses, where up to 200 students might be posting messages on a wide range of topics not necessarily related to mathematics teaching. In fact, one student commented that using WebCT reminded her she was a *student*, whereas using the Yahoo mathematics community website and bulletin board made her feel like a *professional*. Associated with this was the convenience of having messages automatically delivered to their email inboxes (unlike WebCT, where students are obliged to log on to the website).

Implications and Future Directions

We attempted to manage the tension between design and emergence in establishing communities of practice (Barab, 2001) by creating a community framework in the form of the mathematics education course website and bulletin board, and allowing our pre-service students to build the space that would meet their needs. Along the way we have faced some interesting dilemmas. Like Schuck (2003), at times we found it difficult to decide whether

and how to intervene in a discussion when students were exploring alternative interpretations of a problem or classroom experience. Also, while we regard students' establishment of an alternative Yahoo group as convincing evidence of the growth of the community, we were naturally curious about the discussions that might be occurring there. Recently, the students invited us to join their new group, and we anticipate that our continuing engagement with this cohort after they graduate will provide rich data on the sustainability of communities of practice that span the transition from pre-service to initial professional experience for secondary mathematics teachers.

References

- Barab, S. (2001). *The Internet Learning Forum: Building online communities of practice*. Paper presented at the annual meeting of the American Educational Research Association, Seattle, WA.
- Brett, C., Woodruff, E., & Nason, R. (1997). *Communities of inquiry among pre-service teachers investigating mathematics*. Paper presented at the Annual Meeting of the American Educational Research Association, Chicago, IL. (ERIC Document Reproduction Service No. ED 408 255)
- Derry, S., Lee, J., Kim, J., & Seymour, J. (2001). *From ambitious vision to partially satisfying reality: Community and collaboration in teacher education*. Paper presented at the annual meeting of the American Educational Research Association, Seattle, WA.
- Goos, M. (in press). Learning mathematics in a classroom community of inquiry. *Journal for Research in Mathematics Education*.
- Lerman, S. (2001). A review of research perspectives on mathematics teacher education. In F. Lin & T. J. Cooney (Eds.), *Making sense of mathematics teacher education* (pp. 33-52). Dordrecht: Kluwer.
- National Council of Teachers of Mathematics (2000). *Principles and standards for school mathematics*. Reston, VA: National Council of Teachers of Mathematics.
- Schuck, S. (2003). The use of electronic question and answer forums in mathematics teacher education. *Mathematics Education Research Journal*, 15, 19-30.
- Schuck, S., & Foley, G. (1999). Viewing mathematics in new ways: Can electronic learning communities assist? *Mathematics Teacher Education and Development*, 1, 22-37.
- Wenger, E. (1998). *Communities of practice: Learning, meaning, and identity*. Cambridge, MA: Cambridge University Press.