

# Tracking A Student's Changing Social Positions Within A Primary Mathematics Classroom

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## Abstract

*Changing educational demands related to new basic skills, new organisational structures, and a culturally diverse student population have created challenges for teachers and students to engage in more effective pedagogical relationships. A key sociocultural notion underpinning these relationships is community. Increasingly school classrooms are being referred to as Communities of Learners, Communities of Inquiry, and Communities of Practice. Essential to any notion of community is identity. Multiple types of participation and changing forms of membership are fundamental properties of classroom communities and their activities. However, the formation of a new self within a diverse, but inclusive classroom takes time and is difficult to research. This paper describes a year-long case study conducted within a broader Ph.D. research programme. The study describes the journey of a student operating in a collaborative upper-primary mathematics classroom as she moves from a social position of dependence on others to a position where she displays a confidence and a willingness to access ideas and solution processes contained within the cultural resources of the classroom. Student journal writings are analysed in accordance with conditions identified as being conducive to establishing classroom learning communities and implications are drawn regarding the organisation of classrooms that facilitate a shared culture of learning mathematics.*

The idea of viewing teaching and learning as occurring in classrooms which provide students with access to the practices, skills and ways of interacting adopted by mature communities of practice is gaining currency in educational literature (see, Renshaw 1998). The notion 'community of practice' has been described as "a set of relations among persons, activity, and world, over time" and as being "an intrinsic condition for the existence of knowledge . . ." (Lave & Wenger, 1991, p. 98). As an analytical tool, 'community of practice' has been used in varying degrees to describe the situated nature of learning (Lave & Wenger, 1991; Roth & Bowen, 1995), the location of knowing within the shared resources and practices of a community (Lave & Wenger, 1991; Mercer, 1995; Roth, 1995; Elbers & Streefland, 1997), and the shifting location of participants as they move within a complex form of practice (Lave & Wenger, 1991; Brown & Renshaw, 1997; Goos, Renshaw, & Galbraith, 1994).

Classroom communities of practice may be described in terms of the resources and practices its members share to complete common tasks (Roth, 1995). Shared practice includes 'talking about' (e.g., stories, community lore) and 'talking within' the community (e.g., representing, comparing, explaining, justifying, agreeing, validating). Shared resources include facts, artifacts, conventions and heuristics pertinent to a community and display material, social and conceptual dimensions (Roth, 1995). The notion of classroom practice and resources can be expanded to encompass the physical and social spaces in which students operate (Brown & Renshaw 1997; Brown 1998), commitments which privilege

certain ways of thinking and acting within the community (Renshaw & Brown, 1997a, 1997b), and pedagogical scaffolds that enable students to participate in the process of classroom talk (Brown & Renshaw, 1995).

In line with this expanded understanding of classroom practice and resources, Roth (1995) has identified conditions integral to supporting learning within a classroom community of practice. According to Roth (1995) students learn when (a) they and/or their ideas are able to move about and meet in areas of high participant density, (b) practices or resources are highly desirable from a student perspective, and/or (c) practices or resources are well promoted by the teacher or other students. In order to identify the indicators that students themselves recognised as shared resources and practices, Roth (1995) employed a detailed analysis of videotaped interactions and ethnographic observations of students studying a unit on civil engineering within a Year 4/5 classroom, that is, student 'talk within' a classroom community. The data presented by Roth (1995) illustrated considerable differences in the distribution of resources and practices throughout the classroom. For example, students readily adopted an idea or practice that originated within the classroom, whereas the adoption of resources and practices that originated outside the classroom was less common. Roth (1995) concluded that it is more difficult to transform a community in terms of its practices than in terms of its resources, and that resources and practices were more readily adopted by students when learning opportunities were provided in a classroom climate that encouraged students to build on each other's ideas than in a classroom climate that focused on the origins and attributions of ideas.

A year-long study conducted by this author as part of a Ph. D. research programme (Brown, 2001) has also made extensive use of videotaped interactions and ethnographic observations to identify indicators of forms of 'talk within' a Year 7 mathematics classroom and how it may support communal forms of memory, reflection and learning. A major interest of this study was to explore the notion of 'talking about' a community of practice and how 'talk about' may contribute to students learning 'to talk' as legitimate participants within a classroom community of practice.

Lave and Wenger (1991, p. 109) maintain that 'talking about' a community of practice can give insights into the shared practices and resources of a community once the process of 'talking about' becomes "a practice of its own". One source of 'talking about' a classroom community which fulfils this requirement is structured student journal writings. Journal writing in mathematics has been associated with an increased exposure of students' views about mathematics and its learning (Borasi & Rose, 1989). If maintained over an extended period of time, journal writings may take on the qualities of autobiographies which can provide insights into students' beliefs about mathematics, levels of confidence students experience when doing mathematics, and insights into students' awareness of changes and influences for change in their understandings of the mathematics teaching/learning process (Southwell, Brady, Harrison, & Lavaring, 1996).

Structured journal writing, where students reflect upon and respond to open-ended questions posed by the teacher, goes beyond the intention of a student saying what he/she means and can be said to be a "manifestation of the resources for saying available within the culture" and locates the task of interpreting student journal writings within a student-teacher dialogue (Waywood, 1996, p.604). This dialogicality requires a shift in focus from writer to text, where the texts of the structured student journals - the product of the students' writing about their community - offer insights into the changing social positions adopted by students as they negotiate social relationships and emerging identities. This paper examines the structured journal writings of one student operating in a Collective Argumentation Year 7 mathematics classroom. One question was of specific interest to the analysis. Namely, what did the writings of this student say about the nature of her relationships with her peers and

with mathematics as she went about knowing and doing mathematics in this Collective Argumentation classroom?

### *Collective Argumentation*

Developed in local schools in Queensland, Collective Argumentation is based partially on the pioneering work of Miller (1987). Miller defined three interactive principles necessary for coordinating student involvement in the learning process. First, the '*generalisability*' principle requires that students attempt to communicate their individual thinking about a task. Students may do this by drawing a diagram, creating a flow-chart, or re-writing the task in their own words. Second, the '*objectivity*' principle requires that ideas relevant to a task can only be rejected through reference to past experience or logical reasoning. Students may do this by noting similarities and differences between students' ideas and through explaining their ideas to a small group of peers. Third, ideas about a task which are contradictory to each other or that belong to mutually exclusive points of view must be resolved through group argument - the '*consistency*' principle. Students achieve this by justifying why some ideas about a task are more appropriate than others and through providing reasons as to why certain ideas should be accepted or rejected by the group.

Brown and Renshaw (2000) extended Miller's principles from the small group to the whole-class context by including a principle of '*consensus*' and a principle of '*recontextualisation*'. Consensus requires that all members of the group understand the group's approach to completing the task and that they can articulate elements of the group's approach in their own words. If a member of the group does not understand, there is an obligation on that student to seek clarification, and a reciprocal obligation on the other group members to assist. Finally, the '*recontextualisation*' principle involves students in presenting the group's ideas about the task to the class for discussion and validation. Communicating to class members outside the group, challenges students to rephrase ideas in terms familiar to the class, to defend their thinking, and, where necessary, to reassess the validity of their thinking. Collective Argumentation, therefore, creates diverse communicative spaces in the classroom where students have regular opportunities to **represent, compare, explain, justify, agree** about and **validate** their ideas.

## **Method**

### *The context of the study*

The Year 7 classroom referred to is situated in a metropolitan primary school located near the centre of Brisbane. The class comprised 15 female and 11 male students who came from middle and working class sections of the local community. This paper focuses on the writings of one female student, Cath. This student's journal writings were chosen as a focus for the study as Cath described herself as a high-ability mathematics student who frequently achieved good results, but liked mathematics only sometimes. Cath had attended the school since Year 1 and was not considered by any member of her class as liking mathematics more than them.

### *Journal Writing Procedure*

Early in First Semester each student in the class was provided with a list of questions (See Figure 1) which they pasted onto the inside front cover of their journal notebooks. The questions were adapted from a structured learning-log model advocated by the Department of Education, Queensland (1996). At the completion of each Collective Argumentation session students were provided with a 15 to 20 minute period in which to respond to the

session in their journals. Writing time was provided either immediately following each session or at the commencement of the next class session.

### Mathematics Journal Reflection Sheet

Date: \_\_\_\_\_

- (01) Today's mathematics session was about?
- (02) Today I worked with?
- (03) What did you do in today's math session?
- (04) Why did you do it that way?
- (05) What did you learn in today's math session?
- (06) What did/didn't you enjoy in today's math session?
- (07) What difficulties did you have in today's math session?
- (08) What didn't you understand from today's math session?
- (09) How did you feel about today's math session?
- (10) How do you feel you worked during today's math session?

**Figure 1:** Mathematics journal questions.

The students individually recorded their responses in their journal notebooks. Students typically devoted one page to one Collective Argumentation session and determined for themselves which questions to respond to and how much space to devote to each question response. The journals were kept by the students and submitted to the teacher approximately once a month. It was emphasised to the students that the journals were not for assessment purposes and no verbal or written personal feedback was provided. However, general issues raised by students in their journals were sometimes made the topic of a class discussion. Although encouraged to respond to each question the quality and content of responses were determined by the students. Informed written consent was sought and received for the journals to be used for research purposes.

All 10 questions of the journal were open in nature with the first 4 questions relating to student perceptions about the nature of the activity engaged in (content, partners, personal activity, and motivation). Questions 5, 7 and 8 relate to student perceptions about their learning/understanding and the difficulties encountered during the session. Affective perceptions of the session are sought through Questions 6, 9 and 10. It must be noted that the journal questions address each student as an individual and no bias is evident in the questions relating to the teacher's preferred student practices. For the purpose of this study, Cath's responses to journal question 4: "Why did you do it (the math) that way?" were focused on. Cath's responses to this journal question were chosen for analysis because the question requires her to account for why she did or did not participate in the individual, co-operative, and collaborative processes being promoted in the classroom. Over the course of

the year, Cath worked mainly with Tracey and Diana - working partnerships where relationships could often be broadened to include Lisa and May.

### Results and Analysis

Table 1 records the 39 responses made by Cath over the course of First Semester to the journal question: "Why did you do it (the math) that way?"

**Table 1:** Cath's first semester statements in response to the question "Why did you do it that way?"

(Statement No.) Date/Month	(Journal Question No.) Statement
(01) 11/03	(4) Mr Brown told us to.
(02) 12/03	(4) Because that's the best idea Diana and I had.
(03) 13/03	(4) It was the way the group decided on.
(04) 17/03	(4) It was the way the group decided on.
(05) 19/03	(4) Because that's the way the group decided.
(06) 20/03	(4) The group decided on that way.
(07) 21/03	(4) It was the way the group decided.
(08) 25/03	(4) It was the only way we could think of.
(09) 26/03	(4) The group decided on that problem.
(10) 08/04	(4) It was the only right way we could think of.
(11) 09/04	(4) It was an easy way of looking at the problem.
(12) 10/04	(4) It was the appropriate solution for the problem.
(13) 14/04	(4) It's an easy way to remember and it's an easy solution to the problem.
(14) 15/04	(4) It was an easy, appropriate solution.
(15) 16/04	(4) It was the way the group decided on.
(16) 21/04	(4) It was an easy, quick way to get through the questions.

(17) 28/04	(4) It was an appropriate solution.
(18) 29/04	(4) It was a good solution, it worked and it was easy.
(19) 30/04	(4) Easiest solution.
(20) 01/05	(4) It was the most common solution in our group.
(21) 06/05	(4) We didn't do it that way to start off with, until Mr. Brown told me where I went wrong and so I did it that way because Mr. Brown told me to.
(22) 07/05	(4) It was the only way I could think of.
(23) 08/05	(4) It was the only way we could find that worked.
(24) 20/05	(4) I suppose I copied off Katie's group because it was the only one that made sense to me.
(25) 21/05	(4) Because you told Joel to do it that way.
(26) 22/05	(4) It was the way Lisa and I agreed on.
(27) 26/05	(4) It was a good way, it just didn't work.
(28) 27/05	(4) It was the right way and the only one we could think of.
(29) 28/05	(4) Diana, Lisa, and I all thought of that one.

**Table 1 Cont'd:** Cath's first semester statements continued.

<b>(Statement No.) Date/Month</b>	<b>(Journal Question No.) Statement</b>
(30) 29/05	(4) It was an easy set out problem, with a few multiplication sums, division, adding, minimising, and converting.
(31) 02/06	(4) I think it was a good idea and it was a quick and easy way of doing it.
(32) 03/06	(4) I think it was a good way and Diana and I agreed on it.
(33) 05/06	(4) It was a good way and Diana and I agreed on it.
(34) 10/06	(4) We thought it was right.

(35) 11/06	(4) It was easy, quick, and right.
(36) 16/06	(4) I think it was a good way. We didn't get the exact answer but we weren't long off.
(37) 17/06	(4) I think it's right. I tried to explain it well and say what I thought as best I could.
(38) 18/06	(4) It was easy, the timelines worked, they were quick and showed everything and explained it well.
(39) 20/06	(4) It was an easy, quick way of doing it.

As recorded in Table 1, Cath's initial reason for engaging in the social processes being promoted in this classroom was because the teacher told her to (Statement No. 1). This statement is possibly an echo of participation in past mathematics classrooms where learning may have been perceived as the correct performance of a task and where the teacher may have been viewed as the direct transmitter of knowledge and skill to students. Perhaps the statement reflects Cath's definition of the situation as being one in which collective argumentation is to be used to promote conformity in the class and to improve the overall general performance of the class as a system. Whatever Cath's reason for writing this statement, conformity to the perceived wishes of the teacher is soon replaced by statements that imply a consensus with the thinking that is occurring in her group (Statement Nos. 2-10, for example, "It was the way the group decided on"). However, the question "Why did you do it that way?" asks for an account and it is interesting to notice the changing character of Cath's accounts of why she participated in the social processes of the classroom as she progresses through First Semester.

During the first month of engaging in Collective Argumentation, Cath's focus in her statements is on the problem solving process - it is the group that decides (Statements 03, 04, 05, 06, 07, and 09). During the second month of engaging in Collective Argumentation, Cath's emphasis on 'process' falls away and her statements begin to focus on the problem solution - easy, appropriate, good way/s (Statements 11, 12, 13, 14, 16, 17, 18, and 19). This focus on the problem solution remains throughout the remainder of the semester. However, as the semester progresses the focus on the problem solution is complemented with a recognition by Cath of the contributions by work-partners and others to sense making in the problem solving process - for example, "Diana and I agreed" and "I suppose I copied off Katie's group because it was the only one that made sense to me" (Statements 23, 24, 26, 28, 29). It is interesting to note that, during this time, Cath acknowledges her teacher's input - an input where 'being told' no longer refers to a teacher direction or transmission, but to expertise (Statement 21: "We didn't do it that way to start off with, until Mr Brown told me where I went wrong . . .") and indirect guidance (Statement 25: "Because you told Joel to do it that way").

Towards the end of First Semester, Cath's statements begin to evidence a stance towards doing mathematics that is more assured and more personal (for example, Statements 31 and 32: "I think it was a good idea/way . . ."). From being "told what to do", either directly or indirectly by the teacher, and from "copying" off another group, Cath begins to assume a social position within the classroom where she starts to think for herself and to assess the quality of her own and her group's thinking (see for example Statement 36: "I think it was a good way. We didn't get the exact answer but we weren't long off"; and Statement 37: "I think it's right. I tried to explain it well and say what I thought as best I could").

Taken as a whole, Cath's First Semester responses to the question "Why did you do it that way?" imply a changing form of membership within the classroom community. From initially assuming a position in the collective work of the class that seems quite dependent on teacher directions and to lack confidence, Cath subsequently moves towards a position where her engagement in the social processes of the classroom is contingent on ideas coming from a range of others (her group, other groups, and the teacher). Dependence on ideas coming from others would be expected in a Collective Argumentation classroom where the "sharing" and "building on others' ideas" were important ways for participants to draw support from the community. Cath's statements (Nos. 21, 24, & 25), acknowledging her perceived authorship of ideas, imply such a dependence. However, even though acknowledgement of the authorship of ideas is an important practice in most communities, Cath's use of the words "I suppose I copied . . ." (No. 24), "you (the teacher) told me . . ." (No. 21), and "you told Joel . . ." (No. 25), suggests that participating in the processes of building on others' ideas and acknowledging when you do so is difficult for Cath.

Comparing, listening to, and building on other's ideas are important elements in discerning similarities and differences in problem solutions, and by doing so students raise the status of ideas and solutions to that of objects of reflection (Yackel & Cobb, 1996). In this way, communicative actions such as explanations and arguments may become explicit objects of classroom discourse as students take seriously the challenge to go beyond making sense of an explanation for themselves, to making judgments about how other students may make sense of it (Yackel & Cobb, 1996). Evidence that Cath is taking on the challenge of assessing ideas and solution processes as she moves towards assuming a more self-assured position within the community is provided towards the end of Semester 1 when she writes "It was easy, the timelines worked, they were quick and showed everything and explained it well" (No. 38).

However, Cath's shift from participating in explanation to making the explanation an object of discourse, that may be assessed on its efficiency, comprehensiveness, and effectiveness, is better illustrated through an examination of Cath's Second Semester statements. Table 2 records the 36 responses made by Cath over the course of Second Semester to the question "Why did you do it that way?"

**Table 2:** Cath's second semester statements in response to the question "Why did you do it that way?"

<b>(Statement No.)</b>  <b>Date/Month</b>	<b>(Journal Question No.)</b>  <b>Statement</b>
(01) 08/07	(4) Our answer was right. We thought by the way it was written out, it was easy to understand and some parts were self-explanatory.
(02) 09/07	(4) It was mathematical, easy for others to understand and wasn't very hard to explain.
(03) 10/07	(4) It was a good way, all three of us had that idea, it worked and was easy to understand and explain.
(04) 11/07	(4) It was an efficient way of doing the problem, it was right and we all had that idea.

(05) 14/07	(4) We thought it would work.
(06) 15/07	(4) It was a great way, we took some shortcuts to make it shorter but made sure everyone understood.
(07) 17/07	(4) It was efficient, it worked and we all agreed on the idea.
(08) 21/07	(4) It was the easiest way to understand and was mathematical.
(09) 22/07	(4) It was the only way that we could think of.
(10) 23/07	(4) It worked and we all had that idea.
(11) 25/07	(4) It worked, it made sense and it was a good problem.
(12) 28/07	(4) It worked, we've been working with that kind of thing and we all agreed on it.
(13) 29/07	(4) It was the only way we could think of that made sense.
(14) 31/07	(4) We thought it was right and it looked good and was a good problem.
(15) 15/08	(4) You told us to try a different solution with adding on squares. We thought this was a good idea so we built onto it. It was good and it worked.
(16) 18/08	(4) It worked. We all agreed on it and it was good because it consisted of all our ideas.
(17) 18/08	(4) It worked. Nobody else had that idea and it was clever.
(18) 21/08	(4) We thought it was a good idea. We did misread the question, but we were only one step away from the answer.
(19) 25/08	(4) It was interesting, mathematical, self-explanatory, and right.
(20) 26/08	(4) It worked, we hadn't done it that way before and it was different.
(21) 27/08	(4) Katie and I thought it was a good idea, it reflected on a good idea from yesterday.
(22) 28/08	(4) Nobody else had thought of it. It was a good idea and it was different.
(23) 01/09	(4) It was a different, interesting, easy way to do it.
(24) 02/09	(4) I thought it was a good way.
(25) 03/09	(4) It reflected on a few days ago and it worked. The only problem was

	we measured the length of the rectangle wrong.
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**Table 2 Cont'd:** Cath's second semester responses continued.

(Statement No.) Date/Month	(Journal Question No.) Statement
(26) 04/09	(4) I thought it was a good way and it was easy to understand.
(27) 08/09	(4) I think it was right. It was the only way I thought of.
(28) 09/09	(4) It was hard using trial and error, but in the long run it was good. It worked for us and we made a good discovery.
(29) 10/09	(4) It was again proving our rule works and reflecting on it. We discovered more things and it was quite easy to understand.
(30) 11/09	(4) It proved our rule, it was quick. If you understood yesterday's (work) it was easy to understand.
(31) 06/10	(4) It was an appropriate way to approach the problem and it was straight forward.
(32) 09/10	(4) It was different to everyone else and it explained it in a simple way.
(33) 23/10	(4) It was experimenting using trial and error and it was a new way.
(34) 27/10	(4) It was an appropriate way to approach the problem.
(35) 29/10	(4) It worked and was a good way of going about the problem.
(36) 05/11	(4) It worked and was an easy way to look at the problem.

*Using communicative practices as cultural tools*

As recorded in Table 2, the first 5 statements written by Cath in response to the question "Why did you do it that way?" display qualities concerned with developing perspectives that are useful for assisting others to interpret and to make sense of the complexity of school mathematics. Statements such as No. 01 "We thought by the way it (the group's representation) was written out, it was easy to understand and some parts were self-explanatory", and No. 02 "It was mathematical, easy for others to understand and wasn't very hard to explain", emphasise a shared understanding developing in this classroom, namely, that group solutions are to be presented as objects for others' reflection.

As Cath's and her group's understanding of what constitutes an acceptable explanation evolves, Cath's statements go beyond suggesting judgments about what counts as an acceptable explanation or argument to suggesting qualities of intellectual autonomy. Within Cath's statements, certain utterances about her group's presentations of problem solutions to the class begin to make consistent appearances. For example, when commenting, over the course of the semester, on her group's solutions to particular problems, Cath states that (a) "it was a good/easy way of going about/looking at/understanding the problem" (Statement Nos. 1-3), (b) "we took some short cuts . . ." (Statement No. 6), (c) "it was efficient . . ." (Statement Nos. 4 & 7), (d) "it looked good" (Statement No. 14), (e) "it was clever" (Statement No. 17), (f) "it was interesting . . ." (Statement Nos. 19, 23), and (g) "it was different" (Statement Nos. 20, 22, 23, 32). These statements suggest that, during Second Semester, Cath and her group were actively involved in the process of shaping, refining, and polishing their mathematical presentations to the class, and that elements of mathematical aesthetics such as efficiency, simplicity, and clarity were becoming important components of the culture of mathematical thinking developing in this group.

According to Silver and Metzger (1989), aesthetic judgments relating to the 'efficiency' ("we took some short cuts"), 'simplicity' ("it was an easy set out problem"), and 'clarity'

("it was the easiest way to understand") of problem solutions are associated with the flexible representation systems that expert mathematicians (mathematics professors, graduate students in mathematics, etc.) have available to them. Cath's Second Semester statements, therefore, indicate that learning and doing mathematics in this group is about more than an enculturation into this classroom's ways of knowing and doing mathematics and that a more general enculturation into the practices of a broader community of mathematicians may be taking place.

#### *Participating in the social-historical-cultural context of an emerging classroom community*

Just as Cath's shift from personal ("It was the only way I could think of") to social understandings ("It was the only way we could find. . .") appears sociocultural in nature, so too does her move from participating in the social context of the her group to participating in the cultural-historical context of an emerging classroom. For example, Cath's statements (a) "We thought this was a good idea so we built onto it" (No. 15), (b) "It consisted of all our ideas" (No. 16), (c) "It reflected a good idea from yesterday" (No. 21), (d) "It reflected on a few days ago" (No. 25), and (e) "If you understood yesterday's it is easy to understand" (No. 30), suggest the development of a sociocultural approach to learning mathematics. Cath's Second Semester statements provide insights into the nature of this sociocultural approach.

According to Cath's statements (see Table 2), the sociocultural approach being developed towards knowing and doing mathematics in her group is an approach where the shared experiences of the class over time, commitments which privilege certain ways of thinking and acting (for example, to work towards a common understanding), the co-construction of knowledge in partnerships and relationships with others, and endeavours to engage in higher levels of understanding ensure that the mathematics that is emerging in this group is an effective bridge for some students to eventually participate in the conversations of broader communities of mathematicians. Within Cath's statements, elements of such conversations are already being heard - conversations through which using trial and error may lead to the making of a "good discovery" (No. 28), proving and reflecting may lead to discovering "more things" (No. 29), and experimentation may lead to the development of a "new way" (No. 33) of understanding mathematics.

However, what really highlights Cath's emerging participation in the cultural-historical context of this learning community is the stance, reflected in her statements, that her group adopts

to doing mathematics in this classroom. Doing mathematics, for Cath's group, is no longer simply about agreeing on an efficient, comprehensive, and convincing approach to solving a problem. Doing mathematics for Cath's group is now about (a) finding connections between what the group did yesterday and what the group is doing today (Statements 12, 25, and 30), (b) finding new, different, novel, and clever solutions to problems (Statements 17, 20, 22, 23, 28, 32, and 33), and about (c) finding evidence to prove the effectiveness of such solutions (Statements 29 and 30). In other words, Cath's group, as reflected in her statements, is becoming involved in the activities of broader mathematical communities - activities where the work members do is considered to be their own ("We did it"), mathematical (Statements 2, 8, and 19), elegant (Statements 14 and 35), and to provide a great sense of accomplishment (Statements 6, 11, 14, 15, 17, 22, 23, 32, and 33).

As such, Cath's statements describe a student who has moved from a social position of dependence on others to a position where she displays a confidence and a willingness to assess ideas and solution processes - a more self-assured position within the social fabric of the classroom. In total, Cath's statements suggest the development of a local community of practice where 'argument' and 'explanation' are based within a framework of difference and alternatives, and where the move by students towards more mature forms of participation is evidenced through their journal writings - writings which suggest that working spaces within the classroom are being transformed from an aggregate of individuals into a participatory learning community.

### **Conclusion**

Multiple types of participation and changing forms of membership are fundamental properties of communities of practice and their activities (Lave & Wenger, 1991). This paper has provided insights into the notion that students' representations/ ideas/ points of view within a collaborative classroom can come to be viewed by the students themselves as shared social resources with the potential to promote understanding and an awareness of the 'self' as acting in partnership within a community of practice.

The emergence of these shared social practices and resources did not happen by chance. The collective practices and resources in this class have been scaffolded by the teacher over a period of time as he introduced and supported the students in using Collective Argumentation. The physical classroom setting which facilitated the emergence of these shared practices and resources was organised around the negotiated decisions of the students and teacher. No student in this classroom belonged to a scientific/mathematical community where roles, status, respect, and degree of autonomy are determined in part by members' commitments to communal ways of thinking, saying, writing, and doing. The students in this classroom operated in a space that was a subcomponent of an institutionalised education system that, in many ways, specified what roles, status, respect, and degree of autonomy the members of this classroom were accorded. However, the students and teacher in this classroom were successful in negotiating and establishing shared practices which encouraged participants to step outside the culture of the conventional classroom, yet remain within the institutional culture of the school. The negotiation and establishment of these practices involved the students and teacher in multiple types of participation where the production and validation of ideas, explanations, and arguments were viewed within a communal framework that highlighted notions of 'difference', 'critical query', 'reflection', and 'aesthetics'.

The practices of this classroom were constituted through means that operated in and interrelated with the social-historical-cultural context of an emerging classroom community of practice. It was observed through an analysis of Cath's journal entries that, within this context, Cath constructed distinct social positions that show different relationships to the

classroom community. The initial writings of Cath reveal a social position where involvement in mathematics was viewed as being mainly an individual event directed by the teacher. Later writings, however, reveal the adoption of a social position where involvement in mathematics is viewed as a socially situated transaction where others share an understanding of the nature and purpose of the transaction, and an awareness that the social processes of the classroom may be used as 'tools' to promote individual learning and development within the community.

The above characterisation of social positions constructed by Cath within this emerging classroom community of practice illustrates that as students participate in the co-operative, collaborative, and communal processes of a classroom, they construct certain social positions and take on attributes associated with those positions. This is not to say that such positions within a classroom community are fixed and universal. One could imagine a variety of positions that students could construct when imagining new relationships and 'new' selves within an emerging community of practice. However, what the above characterisation does affirm is that students involved in the formation of a community of practice will represent to themselves and to the teacher, to whom their texts were addressed, what they take this community of practice to be about and how they will insert themselves into it.

What the community of practice is about will be represented differently by different students. A community of practice classroom is not quite the same space for all students. It appears to be a social space in which difference, diversity, and inclusiveness may interact to create a classroom culture in which students may construct different social positions at different times within the life of the community. Examining student journal entries appears to be an efficacious way for researchers to gain insights into the nature of the social positions that students may construct as they journey towards or away from more mature ways of participating in the practices of a community.

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