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Transforming Teachers' Construction Of Student Diversity Through Collective Argumentation

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Abstract

Teaching is often viewed as an adult activity focused on promoting student learning through controlling and directing student attention and behaviour within well defined institutional constraints. Collective Argumentation challenges this view by situating teaching within a sociocultural process of promoting student learning through participation in the ways of knowing and doing adopted by localised learning communities. To capture this dynamic process, we tracked across a four-year time frame a group of three teachers in one school who were part of a "design experiment" on Collective Argumentation. We focus here on how categories within their 'talk' about teaching changed as their own pedagogy changed to include the practices of Collective Argumentation. This paper focuses particularly on one teacher whose account of his practices exemplifies the shift characteristic of all three teachers who took up the practices of Collective Argumentation. They adopted a new pedagogical framework that was not focused on controlling and directing student behaviour, but rather on engendering shared practices and enabling students to participate actively as members of a particular classroom community.

Introduction

Sociocultural theory conceives of *change* in understanding as a dialectical movement between everyday experiences and their transformation and re-interpretation within an organised system of cultural concepts that are more general and abstract. Teachers' understanding of the process of *teaching* changes as they gain experience over time, and also as they access different approaches to teaching and different values regarding what is worthwhile learning within contested notions of education and citizenship. For an inexperienced novice teacher the word 'teaching' may simply focus attention on how to control and direct student behaviour to suit the needs of the institution. For an experienced teacher, however, 'teaching' may have a number of other, interrelated meanings related to multiples ways of coming to know and do, and to diverse ways of seeing students. Research literature that has compared novice teachers with their more experienced colleagues, suggests that novices were more challenged in setting appropriate expectations for different students and in tailoring curricular materials to suit the needs of particular groups of students (see Achinstein & Barrett, 2004; Feiman-Nemser, 2001).

From a sociocultural perspective the development of expertise in teaching is an interactive process where everyday routines are transformed by reflective adoption of novel practices that incorporate different notions of worthwhile learning and different models of the learner and citizenship. It is through participating in historically and culturally situated activity spaces that a novice's relationships to others, to activity,

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and to the world may be transformed over time. In other words, the development of expertise in teaching is influenced by relationships, tools, and processes. Analysis of change, therefore must include analysis of the relationships between the agents involved in the activity (expert-novice, teacher-student, teacher-principal, student-student, etc.), the tools that they use to engage with the activity (language, textbooks, planned units of work, tests, etc.) and the processes that they follow to complete the activity (individual, collaborative, communal).

Collective Argumentation offers teachers a sociocultural approach to teaching that promotes productive teaching-learning relationships, tools that may be utilised to promote quality learning, and social processes that facilitate the development of a community of learners (Brown & Renshaw, 2000). Through Collective Argumentation, teachers develop an understanding of teaching that differs from approaches that employ the traditional Initiation-Response-Evaluation (see Mehan, 1979) format of interaction. For example, Collective Argumentation requires the teacher to participate with students in the learning activities of the classroom, to allocate management of the learning activity to groups of students, to facilitate student peer collaboration, and to involve students in discussions that promote learning (Brown & Renshaw, 2000). In other words, teacher engagement with the repertoires of practice associated with Collective Argumentation requires a level of expertise in teaching that goes beyond the utilisation of textbooks and behaviour management routines. For many teachers who have based their repertories of practice on such texts and routines, engagement with Collective Argumentation can re-position them as novices in the teaching-learning context. The re-development of expertise by these teachers requires them to undertake professional development that positions them as learners and to engage in the practices and process of Collective Argumentation. This paper seeks to explore how teachers' framings of teaching and learning change as their own pedagogy changes. In particular, it examines one teacher's account of teaching and learning and what frameworks were used to describe classroom practice as he engaged in professional development that required engagement with the practices of Collective Argumentation.

Collective Argumentation

Collective argumentation involves the teacher and students in ways of coming to know, do and value a subject discipline which reflect the investigative processes and ways of interacting employed by knowledge communities. In simple terms, collective argumentation involves the teacher and students in small group work (2 to 5 students per group) where students are required, initially, to individually "represent" a problem or task by using pictures, diagrams, drawings, graphs, algorithms, numbers, etc. Students are then required to "compare" their representations with those of other group members. This phase of individual representation and comparison provides the potential for differences in understanding of curriculum content to be exposed and examined. Subsequent talk by the students regarding the appraisal and systematisation of representations is guided by the keywords - "explain", "justify", "agree". Finally, moving from the small group to the classroom collective, the thinking within each group is validated for its consistency and appropriateness as it is presented to the whole class for discussion and validation.

Developed in local schools in Queensland, Collective Argumentation is based on principles necessary for coordinating competing knowledge claims: 'generalisability',

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'objectivity', 'consistency', 'consensus' and 'recontextualisation'. 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.

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.

To ensure that teachers are supported when introducing the practices of Collective Argumentation into their classroom pedagogy, a major aim of the professional development offered to interested teachers is to promote the emergence of a professional community of learners. Initially the emergence of this community of learners was facilitated within a school context through teachers, experienced in the practices of Collective Argumentation, conducting workshops involving interested teachers in the practices of Collective Argumentation and then working with those teachers to plan, co-teach, and evaluate units of work. As the number of interested teachers increased beyond individual school boundaries, the maintenance and extension of the community of learners has be facilitated through the establishment of a web site dedicated to supporting teachers in the implementation of Collective Argumentation. Through this web site teachers share planning and curriculum resources, enter into conversations about student learning, and are provided with advice and support by experienced others. It was within the context of this professional community of learners that the study referred to in this paper was conducted.

The Study

Commencing in 2004, the on-going study employs a 'design experiment'(Schoenfeld, 2006) methodology intended to bring about change in the pedagogical practices of twenty, Year 1 to Year 10 classroom teachers. The study requires teachers to be video/audio taped once or twice each year when doing mathematics and/or science with their students. Anecdotal records relating to teacher-student and student-student interactions are made on a regular basis and the teachers and those students who are

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able are asked to keep a reflective journal. At various times throughout the study, teachers are either interviewed or asked to report about the implementation of Collective Argumentation in their classrooms. The interviews employ stimulated recall as a tool for collecting data, that is, teachers individually responded to a set of questions while watching a video of their class doing mathematics and/or science. Teacher reports are elicited during sessions of professional development when teachers gather to talk about the implementation of Collective Argumentation in their classrooms.

As this paper is concerned with investigating how teachers' ways of framing teaching and learning change as their own pedagogy changes, segments of the text of one teacher's interview, conducted in 2004, and the full text of the same teacher's account, delivered in 2007, were examined to explore what frameworks were used to describe classroom practice. A framework may be defined as the perception and interpretation used to organize meaning. A framework can be a way of interpreting that privileges a particular perception while obscuring others and can be deployed without conscious awareness in familiar situations (Achinstein & Barrett, 2004). To facilitate the recognition of frameworks within the texts we employed Bakhtin's concept of voice.

Voice

Bakhtin (1986) developed a theory of voice that emphasized the active, situated, and functional nature of speech as it is employed by various groups (e.g., teachers, psychologists, politicians) within a society. Bakhtin maintained that when communicating with others, people give voice to utterances that are imbued with the perceptions and meanings of past and present contexts of use (Bakhtin, 1981, p. 293). As a unit of analysis, voice, encompasses a broad range of contextual issues relating to a person's perspective, belief system, intention and view of the world (Wertsch, 1991). As a tool for identifying 'frameworks', voice, reflects the ways of organizing meaning that characterize various group behaviors (for example, teachers, psychologists, politicians) that a person has had the opportunity and/or willingness to participate in. As such, 'voice' as used in this paper, encompasses both "what" is being said and the "way" in which it is spoken.

The teacher

The male teacher (Tom) who is the focus of this paper volunteered to participate in the study at the commencement of 2004. At that time, Tom had over 25 years experience in the primary classroom principally with Year 4, 5 and 6 students. Both texts, the interview and the account, referred to his experiences of teaching at one co-education school located in a middle-class suburb of a major city. The school employed an outcomes-based curriculum, mandated the use of textbooks in all classrooms, and used a five-point scale to report student achievement to parents.

The context of data collection

The interview took place towards the end of the first year of Tom's implementation of Collective Argumentation in his classroom, and used stimulated recall as a tool for collecting data. Tom individually responded to a set of 10 questions (see Table 1) whilst watching a video of his Year 4 class (12 male and 13 female) doing Collective Argumentation to learn mathematics. The interview was conducted by the first author of this paper (referred to in the transcripts as Ray) and the interview questions were

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designed to elicit Tom's understandings about how Collective Argumentation positioned the teacher and students in terms of the key message systems that frame teaching and learning - curriculum, pedagogy, and assessment (Hayes, Mills, Christie, & Lingard, 2006).

Table 1: Questions Presented to Teachers

No.	*Question*
01	How important is the teacher's knowledge when doing Collective Argumentation?
02	What are the good points of Collective Argumentation for your own teaching?
03	What are the difficult points of Collective Argumentation for your own teaching?
04	What student behaviour problems has Collective Argumentation provided for you?
05	What three values would you advocate teacher's use when doing Collective Argumentation?
06	How does doing Collective Argumentation help with an outcomes based approach to teaching and learning?
07	What assessment strategies do you use when doing Collective Argumentation?
08	What part of the Collective Argumentation key word format did you find useful?
09	What part of the Collective Argumentation key word format did you not find useful?
10	How could Collective Argumentation be improved?

As can be seen in Table 1, the interview questions were directed at the context in which Tom went about teaching mathematics in his classroom, namely, Collective Argumentation. Selected responses to the above questions (see Table 2) were chosen for presentation in this paper because they typify the perceptions and interpretations used by Tom to frame the act of his teaching.

The second episode of teacher talk, *the account,* took place during a professional development session designed to support teachers in the implementation of Collective Argumentation to teach mathematics and science. The session took place in the 4th year of Tom's implementation of Collective Argumentation in his classroom. During the session, Tom individually responded to an open invitation to teachers to share their experiences of implementing Collective Argumentation. Tom spoke for approximately 10 minutes about his experiences of implementing Collective Argumentation with his Year 6 class (10 male and 15 female) as they engaged with an integrated mathematics/science unit of work. The full transcript of the account (see Table 3) was chosen for presentation in this paper because it captures the changing nature of Tom's learning in the act of his teaching.

Analysis and Discussion

The analysis below focuses on three key categories:- (i) teaching practices per se; (ii) the students and how they are described as they participate in classroom activities; and (iii) the new practice of Collective Argumentation.

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The First Episode of Teacher Talk

Below in Table 2 is the transcript of the first interview. Analysis of the interview is presented according to the three key categories immediately following this transcript

Table 2: Tom's responses to questions about implementing Collective Argumentation

Question	Line	Response
Question 2. What are the good points of Collective Argumentation for your own teaching?	01 02 03 04 05 06 07 08 09 10 11 12 13	For me it (Collective Argumentation) makes me see what they (the students) can really articulate inside their heads, instead of the right answers on a piece of paper. Hmm. And it (Collective Argumentation) can scare you at times too, when their (the students) thinking is so erratic, so different and so radical and lacking in some of the things it ought to have, or you think it ought to have. It (Collective Argumentation) has probably just reinforced that 8 year olds have a whole different range of thinking patterns, some of which are right and some which are whacko, but it is their thinking. You have to give them (the students) a chance to explain that problem back to themselves as much as to you.
Question 3. What are the difficult points of Collective Argumentation for your own teaching?	01 02 03 04 05 06 07 08 09 10 11 12 13 14	For me it is the noise factor, but it wasn't a problem which was insurmountable because I did your (Ray's) stuff. The willingness to spend that amount of time on one problem, whereas on another ordinary day you would do 30 (questions) in one time (lesson), or two pages in their maths text book which is, as you know, one of the things that you must finish by the end of the year. To justify spending so much time, I don't see it as a problem, but….. I enjoy the safety and the comfort of the text book and I know the parents do, but I am really pleased that both my language and my maths text books are finished, so from now until the end of the year I can now do what I want to do and what they (the students) want to do.
Question 4. What student behaviour problems has Collective Argumentation provided for you?	01 02 03 04 05 06 07 08 09 10 11 12	No more (behaviour problems) than I have anyway. That (referring to the students in the video) bunch of kids are very voluble, they are distracted and easily led by about four or five (students). So if anything, it (Collective Argumentation) has helped contain that four or five (students) because now they are in a group of three (students) and there is noise around them, so a comment of their's doesn't get replies from 24 kids, they just get comments from their group and the one (group) next door. So it (Collective Argumentation) probably helps rather than hinders with those kids.
Question 7. What assessment strategies do you use when	01 02 03 04 05	I need to use more check-listing, more anecdotal stuff and I have to open the book on Simone's page and write down stuff about Simone. I'm going to have to use video evidence or taped evidence which I don't do.

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doing Collective Argumentation?	06 07 08 09 10 11	I will have to do more in their journals as evidence, which I did by accident where we glued in the task and glued that in on the page where they did their individual stuff (representation). Then I will have to do something about showing final product, the group stuff (activity).
Question 10. How could Collective Argumentation be improved?	01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17	It (Collective Argumentation) provides a lot of care and support in my class for kids like Anne who struggles to keep up because they don't have to do anymore than a doable piece of work, and then to participate with two others (students) who supported her. It (Collective Argumentation) was great for Anne and she probably blossomed because of it. For the kids who are the clowns they are no longer in charge of the audience, they are just a part of a smaller group and for the kids who are not confident, it (Collective Argumentation) gave them confidence in having the support of two kids to work with. For kids like Karen who like to be in charge, they get to be in charge if the other two kids let her, so she couldn't be disruptive constantly. So it (Collective Argumentation) is a good controlling device.

The Practice of Teaching: The text of Tom's responses to the above interview questions indicates that he views the practice of teaching as being about 'seeing inside students heads' (question 2: line 2) so as to know what is 'right' (question 2: line 3) and what is 'whacko' (question 2: line 11). Teaching, for Tom, seems to be about giving the students a chance to explain to themselves and to the teacher (question 2: lines 12 & 13), controlling noise through using others' strategies (question 3: lines 1 & 2), using class time to complete multiple text-book exercises (question 3: lines 3 & 4), completing the activities contained within set textbooks (question 3: lines 5, 6, & 7), and complying with perceived parental and institutional expectations (question 3: lines 10 & 11; 13 & 14).

The picture of teaching painted by Tom in the above responses is one where practice is framed within a traditional approach to teaching. Within this frame, learning is deemed to occur within the individual, through the production of responses to set tasks, with direction and support being provided by a knowledgeable adult. This traditional framing of teaching and learning is also reflected in the descriptors used by Tom when he talks about students.

The Students: For Tom, students are voluble, distracted and easily led by others who need to be contained (questions 4: line 3 & 6). They need care and support (question 10: lines 1 & 2) through the provision of doable tasks (question 10: line 3) so that they can participate with others by receiving and giving support (questions 10: lines 4 & 5). Students need to complete their textbook exercises so that they can (question 3: lines 13 & 14) do what the teacher wants to do. The more difficult students need to be restricted in terms of the peer audience that they can access (question 10: lines 8 & 9) and the dominant students need the co-operation of others to be disruptive (question

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10: lines 13, 14 & 15). This framing of students as needing to be controlled so that (a) the learning of the less confident can be supported, (b) textbooks can be completed, and so that (c) the teacher and students can pursue more interesting activities is consonant with an approach to teaching and learning that views students as passive recipients of set bodies of knowledge. From this perspective, students' thinking is viewed as 'scary' (question 2: line 4) if it is very different from what is considered to be 'right' or to be 'radically different' from an adult's understanding (question 2: 9, 10 & 11).

Collective Argumentation: Collective Argumentation for Tom is a "good controlling device" (question 7: lines 16 & 17). It appears to be a device that Tom is willing to interpret and implement within a traditional approach to teaching and learning that frames his practice. In other words, the transcript of Tom's responses to the interview questions provides evidence that Tom is incorporating elements of Collective Argumentation (individual representation, group work, student presentations) into the mathematics of the classroom, but is filtering student participation in group activities through the lens of established routines that privilege teacher authority and individual accountability. A common strategy employed by teachers when challenged by change (Linehan & McCarthy, 2001).

However, Collective Argumentation is also challenging Tom to re-interpret his notions of teaching and learning within a framework that privileges (a) the social scaffolding of individual performance, (b) learning activity that goes beyond the self to consider participation in the activity of the group, (c) a developing knowledge base that goes beyond the textbook to focus on breadth and depth of understanding, and that (d) embeds teaching within a mentor/mentee relationship – principles that promote an effective, contemporary view of teaching and learning (Biggs, 1994; Renshaw & Brown, 1997). For example, the need for Tom to re-frame his practice is implied in admissions that he needs to expand his assessment strategies to include more check-lists, anecdotal records that refer to the efforts of individual students, and video/audio records of the products of group activity (question 7: lines 1 to 17). This 're-jigging' of Tom's teaching practice is evident in the following account of practice that Tom delivered in the 4th year of the study. The account (see Table 3) refers to his implementation of a unit of work that required Year 6 students to problem solve as they built working models of machines using Lego robotics.

The Second Episode of Teacher Talk

Table 3: Tom's account of using Collective Argumentation in the classroom

Line	Text of Report – Integrated Unit Using Lego Robotics - Year 6 class
01	I've been promoted, like I said and have gone up to year six, and that is great
02	because I am teaching with Tim Smith, whom I regard as a good mate and he
03	is nearly as old as me.
04	I like the fact that he (Tim) came to our school because now I cease to be the
05	oldest male on staff.
06	So we've (Tom and Tim) got two grade six (classes).
07	Nine or so of mine (students) had me (as their teacher) back in grade four, so
08	they (the students) have had some CA (Collective Argumentation) experience
09	and some of the others in Tim's class have (some experience of Collective
10	Argumentation) so they (the students) have been re-jigged.

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11 We (the two Year 6 classes) do computer and Lego robotics together every
12 Monday afternoon, and I do the Lego part which is, I guess, the more science
13 part, and he (Tim) does the computer stuff.
14 And we have the door between us (the classrooms), so I've got the plasma and
15 he's (Tim's) got the lab.
16 I had started CA (Collective Argumentation) with my kids because of the
17 one's (students) I hadn't had before, and three new girls that I have got from
18 other places (schools), and we had done it (Collective Argumentation) in
19 Maths with one of the examples Ray and I nutted out a few years
20 ago and they (the students in my class) found that good, and just took to it like
21 ducks to water, the new ones (the new students).
22 So then we (Tim and I) did some language stuff and we formulated a class
23 poem (in English) somehow or other, and then I've been using it (Collective
24 Argumentation) in the Lego robotics, but within the afternoon sessions (of
25 school) so that I would set them (the students) a task and they would have to
26 do their own solution, then they would have to do a table (group) solution,
27 because they are in groups of five, not groups of three because we (the school)
28 have only got four sets of models (Lego models), and then they (the students)
29 would have to test them (the Lego models) out and show that yes it did do this.
30 Only yesterday I then took it (Collective Argumentation) a step further where I
31 said to the kids, "Okay you have made your models and you have proved that
32 they work and you are in the process of programming them. What would
33 happen if you changed the size of the wheels?"
34 A fairly simple question, if you put the largest wheels on what would happen
35 to your models?
36 And put them (the students) into their setting groups, which are their groups of
37 three, and they all came up with answers which were all scientifically wrong
38 and I knew straight away that they had got it wrong and I am about to say,
39 "but, but, but" and I thought "no, shut up Tom and go and get a (Lego) model
40 instead".
41 So we (the class) did, we brought a (Lego) model down (to the classroom) and
42 we got the spot mode, and I put it on the table and I said, "okay what would
43 happen?" and they (the students) said, and it (the model) didn't (perform to
44 student misconceptions), so then we had another opportunity to go and say,
45 "well why did, what you thought, why did the opposite happen?"
46 So they (the students) went and did it (the task) individually again and then it
47 (the task) opened up a whole area of friction and other science that we will
48 now have to go and plan for.
49 So I don't know whether it (using Collective Argumentation) was a great idea.
50 It means I have got to go and do a lot more planning.
51 So that was the most recent example (of using Collective Argumentation) and
52 a good one because it focuses on the need for me to plan, and for me to shut
53 up, step back and then be the planner of the learning, because it (Collective
54 Argumentation) worked when I did it.

The Practice of Teaching. The practice of teaching framed in the above account is no longer about 'seeing inside students heads', nor is it about controlling students, completing textbook exercises, nor is it about complying with perceived expectations of school and parents. Tom's account of his implementation of an integrated unit of work is now about working with another teacher (line 2, 12, & 13), doing units of

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work together with other classes of students (line 11), sharing authorship of lesson content (lines 19, 22, & 23), and about collaborating with students (line 41). More strikingly though, teaching for Tom now seems to be about going beyond the set task to open other opportunities for learning (line 30, 46, 47, & 48), posing challenging questions (lines 31, 32, & 33), participating with students to disprove misconceptions (lines 38, 39, 40, 41, 42, 43, 44, & 45), and about planning for learning to take place (lines 50, 52, & 53).

The Students. Students are now viewed by Tom as being 're-jigged' (line 10) in order to engage with Collective Argumentation. No longer are they referred to as being 'voluble', 'distracted', and 'easily led', but now explicit references are made to their being capable of (a) engaging with tasks at the individual and group levels (lines 25 & 26), (b) hypothesising (line 37), (c) communicating and testing predictions (lines 41, 42, 43, 44, & 45), and (d) reconsidering ideas (lines 46 & 47). In other words, the students are seen by Tom as being capable of engaging in the practices of a scientific community.

Collective Argumentation. This shift from viewing students as knowledge recipients to active constructors of meaning is reflected in Tom's re-framing of Collective Argumentation. For Tom, Collective Argumentation has moved beyond being a good device for controlling students, to being a set of pedagogical practices that focus him on the key message systems of teaching and learning – curriculum, pedagogy and assessment. Doing Collective Argumentation now requires (a) that learning sessions be carefully planned (line 51), (b) that the teacher work with the ideas of students, taking the time to 'shut up' and 'step back' (lines 52 & 53) when appropriate, and (c) that assessing student learning be planned into the activity of the classroom (lines 44 & 45). Collective Argumentation is now requiring Tom to generate collaborative relationships with teachers and students and to adapt old classroom routines to the learning needs of students. This generative re-framing of teaching practice provides a sense that Tom considers himself rather than the textbook to be a generator of the learning that is taking place in his classroom (see line 53).

Discussion

Collective Argumentation provides a tool to begin conversations with teachers on how classroom interaction may be used to assist students to come to know and do school mathematics and science. It can assist teachers to consider how, as Ballenger (1997) argues, the traditional learning routines of classrooms may act to impede the development of authentic learning opportunities in which multiple perspectives from students and teachers may come into contact. The two frameworks employed to described Tom's teaching practices, the traditional and the generative, both encompass elements of Collective Argumentation.

Initially, the 'traditional' framing provided a tool through which Tom's understandings of the teaching-learning process and the understandings of teaching and learning upon which Collective Argumentation is based, could grow together into a hybrid form of teaching practice. Within this framing, Tom commenced to share his authority with students by establishing a classroom context that facilitated the emergence and voicing of students' ways of knowing and doing. Students operating in this classroom context were encouraged to occupy a range of roles in the process of coming to know - novice, supporter, conformer, listener, speaker - and these roles had

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a determining influence on the degree to which a student engaged with the activity of the classroom. It was from this framework that Tom was able to develop the means to transform his teaching practices from being traditional to being generative of learning opportunities.

Over time, Tom's framing of teaching and learning as a generative activity provides a sense that teaching is about assisting students to make sense of the ideas being presented to them and about linking students' ideas to the conventions of mathematics and science rather than about teacher and/or textbook evaluations of students' answers. The focus, as demonstrated in Tom's account, is on extending student participation in learning beyond knowing that an idea is right or wrong to exploring how 'cultural tools' such as hypothesising, communicating, testing, and reconsidering may be used as thinking devices and as means to explain and to generate understanding.

In terms of the larger study referred to in this paper, our findings suggest that teachers can employ the pedagogical practices associated with a sociocultural approach to the teaching and learning of mathematics and science as long as they are supported within their school communities and provided with on-going assistance (Brown & Renshaw, 2006). It has been our observation that, for some teachers, the framing of teaching and learning in terms of perceived accountability requirements to standardized testing regimes, rarely permits the use of Collective Argumentation in the classroom in a manner that promotes the development of teaching practices that go beyond the traditional. It is hoped that some of these teachers will follow Tom's example and use Collective Argumentation as a tool to move from traditional to generative teaching practices. However for the majority of the 20 teachers now engaged in the broader study, Collective Argumentation has provided a means to frame teaching and learning in ways that assist them to negotiate the complex interaction between authentic student learning and the institutional requirements of schooling. How teachers may be assisted to further address this interaction is the focus of our future research.

However, the analysis of interview responses and of the teacher account provided in this paper conveys a sense that the characteristics of Collective Argumentation that are appealing to teachers and students are those that situate teaching and learning within collaborative relationships. Collective Argumentation focuses the teacher and students on collaborating with each other when coming to know and do mathematics and science in the classroom. A clear hierarchy of authority exists in many classrooms, with the teacher assigned the institutional status both of "knower" and "leader", and students expected to enact the more compliant roles of "novice" and "follower". Collective Argumentation challenges this classroom hierarchy by proposing more symmetrical, participatory and collaborative forms of interaction between teachers and students.

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