AGENCY/NUMERACY: A POSTSTRUCTURALIST ANALYSIS OF THE RELATIONSHIP BETWEEN CLASSROOM MATHEMATICS AND NUMERACY IN NEW TIMES

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*The key issue canvassed in this paper is whether or not current teaching practices in mathematics are likely to foster or inhibit numerate behaviours in students. I understand numerate behaviours to comprise both intellectual (mathematical) and self (social) knowledges (Willis, 1998) which are interwoven and interdependent. Numerate behaviours are fostered where student initiation and construction of mathematical ideas is genuinely valued such that they are authorised or enabled to speak and write their developing constructions with respect. A poststructuralist analysis of classroom practice in three (3) primary mathematics classrooms shows that although students are actively engaged in the construction of knowledge, **what** they learn of mathematics and of themselves as numerate individuals may not be conducive to the construction of a sense of agency so necessary for lifelong learners of the new millenium.*

INTRODUCTION

The field of mathematics education is currently saturated with debate and research on the possibilities and limitations of students' active involvement in learning mathematics (Boaler, 1998; Hiebert et al., 1996; Yackel & Cobb, 1996). In Australia, *A National Statement on Mathematics for Australian Schools* (1990) states "It is now widely accepted that learning is best thought of as an active and productive process on the part of the learner" (p. 16) where "teachers assume a considerable responsibility for creating the best possible conditions for learning for all students" (p. 18). However, it is my belief that much more work needs to be done to understand better the "active and productive" learning process and the teacher's role in establishing and maintaining a learning environment that fosters not only the construction of powerful mathematical knowledges but a sense of empowerment or agency in learners as well.

With recent definitions of numeracy (Willis, 1998) stressing both the intellectual and social aspects of learning and applying mathematics, it is imperative that educators and researchers establish clear and unambiguous understandings of what mathematical and social knowledges will best equip students for the new millenium. Although many educators, including the three (3) whose classrooms I videoed for this research, have willingly embraced "constructivist" and "problem solving" approaches to teaching mathematics, it is not clear that these approaches necessarily foster numeracy as "the *competence* and *disposition* to use mathematics to meet the general demands of life at home, in paid work, and for participation in community and civic life" (Willis, 1998, p. 71, my emphasis). In this paper I argue that although active and collaborative aspects of learning are encouraged, in many ways the students' experiences of mathematics are little different from those encountered in "transmission" classrooms. I use the poststructuralist concepts of power/knowledge and subjectivity to show how classroom activities and practices continue to deprive students of choice and the possibility of taking themselves up as numerate agents.

AGENCY

Poststructuralist concepts can be used to show that agency for learners is not an unproblematic issue. "Constructivist" and "problem-solving" approaches are premised on humanistic understandings of the individual agent which is contrary to poststructuralist notions of subjectivity (where the individual is subjected to, and in turn influences, power/knowledge relations in discourses). The humanist individual is seen to have a unified,

rational and coherent identity; s/he interacts with an external social world and internalises norms and values. S/he takes rational control; those not making appropriate rational choices are seen to be in some way deficient. Extrapolated to the mathematics classroom, the competent and responsible humanist agent learns the mathematics that s/he is later able to apply in the external world of work and leisure.

Poststructuralist understandings of subjectivity and power/knowledge relationships in discourses would have it that agency is not so easily won. Indeed, agency can in no way be considered an attribute of an individual, a disposition, but is rather a matter of constituted subjectivity, and how one has been, and is being, positioned within discourse(s). The concept of subjectivity allows no external/internal divide between the individual and society (or the classroom context) nor the active/passive binary regarding learning; to live is to learn and power/knowledge relations abide in all interactions constituting subjectivities either to liberatory and empowering ends or to lack of engagement and indifference. Teaching mathematics can be regarded as a discourse, where classroom activities and practices (such as completing worksheets, streaming) are implicated in constituting subjectivities for agency, or not. Using a poststructuralist framing, (developing) agency in a mathematics classroom would appear to be premised on:

(a) The recognition and affirmation of the learner's prior (and present) constituted(ing) and intellectual knowledges; and

(b) The construction of the learner as one with the right to speak and be heard; and as one who has the right and ability to go beyond given meanings and forge something new.

I will elaborate on each of these in the methodology section below as these comprise the analytic framework of my research; the concepts of subjectivity, as in (a) above, and power/knowledge, as in (b).

METHODOLOGY

At the end of 1997 I videoed the mathematics lessons of several primary and early childhood teachers who were recognised as competent and innovative in this field. All teachers videoed were committed to having students actively engaged in learning, as is reflected in the video extracts. I have chosen three (3) lessons for analysis: one from a Year 1 class playing number games; a Year 3 lesson on shapes and a Year 5 cooking lesson. I intend to show that although these teaching interactions engaged all children in the active construction of knowledge, that is they were *engaging* as in (a) above, they were not necessarily *enabling*, as in (b).

It is not easy to measure engagement; indeed one can merely infer. Engagement is a qualitative entity, a process, and it has to do with constituted subjectivity, "who" a person is and how well classroom activities jell with or reproduce previously constituted knowledges and understandings. Within the discourse of mathematics, engagement is influenced by how the learner sees that the content (mathematics) that is to be learned and the processes of learning "fit" with preconstituted needs and desires. For example, it could be that many students will engage with whatever the teacher presents because they have been constituted to "know" mathematics as a powerful ticket to future employment opportunities; others will engage only minimally because they may perceive that what is to be learned is irrelevant to their lives or that the processes of learning are alienating (for example some cultures/individuals may find the competitiveness of many activities off-putting).

Enablement has to do with agency or the extent to which a particular individual is authorised to establish him/herself as a competent, "numerate" being within the power/knowledge

nexus in any context. Using poststructuralist concepts, agency is not an unproblematic issue. It does not necessarily follow from merely knowing a lot of mathematics nor is it a personal attribute or disposition. Rather agency is constituted through engagement in enabling interactions. In the classroom, enabling interactions are those where the learner can speak his/her developing understandings and conjectures and be heard with respect as learner and initiate into a community of inquiry. Beyond the classroom, agency as numerate subject is again constituted (or not) according to one's ability to speak and use the mathematical knowledges considered powerful in a particular context. For example, for life and work in the twenty-first century, enablement/agency beyond the classroom would seem to be premised on the construction of, and the ability to use, higher level thinking skills such as conjecturing, patterning and making connections between mathematical ideas rather than the reproduction of facts, skills and procedures more relevant to a past era (National Council of Teachers of Mathematics, 1991).

THE DATA

In the Year 1 classroom, the children were in groups playing mathematical games. One group was throwing small bean bags at a chart headed with tens and ones, each child endeavouring to make the largest number. After each turn, the children would write the number they had made on a chart. A second group was involved in an activity throwing a die and putting beads onto a "ten" frame. When there were ten on the frame, the idea was to put these ten onto a pipe cleaner, and start again. The overall aim was to see who could get the most pipe cleaners filled with beads. Another group was playing a concentration game; turning over cards two at a time to try to make a pair. The cards had pictures on them, not mathematical signs or symbols. The last group I videoed in this room was playing an "odds and evens" game; adding the faces of the dice and, if the answer were "odd" advancing in one direction, if "even" the other. The idea was to get to the edge of the board first.

The Year 3 children were also sitting in groups when I entered the room. The teacher began the lesson by discussing the difference between 3-D and 2-D shapes, getting one child to draw a shape on the blackboard. The children all appeared to be listening intently and watching what was happening. The first group encountered was making 3-D shapes with constructo-straws; copying from pictures of shapes on a wall chart. After they were finished, they were to write down the number of faces, edges and vertices for each shape. A second group was (rather confusedly) looking for pictures of 3-D shapes in a magazine. Completing a worksheet was the task set for another small group where the children had to colour various shapes certain colours; for example, they were asked to colour the three-sided polygon blue. Some children were constructing shapes from nets using scissors to cut them out and sticky tape to stick them together.

The cooking lesson in Year 5 went on for an hour and a half. Before beginning the recipe, the teacher went through the rules for group work in detail and assigned roles for managers, collectors and recorders. The children sat in groups, and one person went to the front of the room to collect an ingredient only after the teacher had indicated that this was now an appropriate thing to do. The groups were rather large, with children standing around desks put together to form a rectangle, so vision and physical involvement were sometimes difficult. However, I noted occasions where the children were taking care to ensure that all group members were given an opportunity to measure ingredients and stir the shortbread.

ANALYSIS OF THE DATA

In each of the classrooms I visited it is clear that the students are actively involved in learning. Indeed, as previously mentioned a poststructuralist reading of practice does not allow the active/passive binary; to live is to be constituted through discourses of one sort

or another, all discourses positioning learners in ways that enable and empower or limit the ability to act in powerful ways. My reading of what I observed in these classrooms is that although all the activities were *engaging* in that the students appeared to find the activities relevant and enjoyable, ultimately they may not have been *enabling* in that students were not authorised to take themselves up as agentic numerate individuals in/for new times.

The classrooms I looked at in this research were all from the one school which draws students from a relatively high socio-economic area. There were some Japanese students in the school who were learning English as a second language; the remaining students were largely Anglo-Australian. There were no Aboriginal or Islander students as would commonly be the case in most schools in this geographical area of North Queensland. Using the poststructuralist concept of subjectivity as an analytic tool, it is perhaps not surprising to find that the great majority of children in these classes were actively engaged in set activities. The classroom mores and uses of language would largely reflect those experienced at home, making the classroom community a welcoming, or at least comfortable, place for most of the students to be. Also, through involvement in home-based discourses, these students would most likely have been constituted to know mathematics as an important and powerful subject deserving their full effort and attention. However, if we take seriously new definitions of numeracy, it may be that engagement in mathematical activities as depicted in these classrooms is not sufficient to ensure either the intellectual or social competencies required for numerate participation in society and work in the future. To better substantiate this suggestion I will use the poststructuralist concept of power/knowledge to show how students continue to experience mathematics as disconnected facts and procedures and themselves as reproducers of the teacher's superior knowledge. Thus *what* they are learning, the intellectual or mathematical knowledge, and *how* they learn it, merely reproduce traditional views of the nature of mathematics and teacher/student roles.

From the data it is clear that in all the classes videoed the children are engaged in activities that might readily be recognised as "mathematical". In the Year 1 classroom the children throwing bean bags at a "tens and ones" chart are learning how to write and read numbers to 100; another group is practising making groups of ten; yet another is consolidating visualisation skills in a memory game and a final group is playing a game that relies on the children's knowledge of prime and composite numbers. The year 3 class is learning to make and name 3-D shapes and describing the various attributes. One group is completing a worksheet which, in this case, is more a consolidation or assessment, rather than a teaching/ learning, activity. The Year 5 class was learning to recognise and use metric measures in making shortbread.

While it is impossible to list accurately all the intellectual knowledge developed, reinforced or assessed in these lessons, it is possible to highlight important knowledges that are conspicuous by their absence. In the classrooms I visited there was no space nor time for exploration of patterns and relationships in mathematics and no fostering of conjecture and communication of student initiated mathematical ideas. Although the teachers believed themselves to be fostering the students' construction of mathematical knowledge, the mathematics I saw in my visits comprises what I see as "service" mathematics where children learn facts and skills: what 350g looks like, how to write numbers, names of shapes. Although important, an emphasis on such low-level mathematical knowledge, to the exclusion of the previously mentioned content, reproduces a view of mathematics as comprising disparate facts and skills and right/wrong answers. Just as importantly it excludes students from a knowledge of the richness and regularity of mathematics, of mathematics as an activity in which one can engage on one's own terms to powerful ends.

While teachers hold on tightly to a view of mathematics as isolated skills, procedures and formulae to be "given" to students, they will not be encouraged to attempt more investigatory or inquiry approaches to teaching which may be more empowering or enabling for students. In a poststructuralist sense, enablement or agency for students is constituted in discourse. Thus mathematics, as a discourse, could be taught in more investigative ways that construct the student as a valued member of a community of inquiry with the right to initiate and explore new ideas and meanings. This would require a fracturing of the power/knowledge nexus as it currently operates in classrooms to explicitly recognise both the intellectual knowledges and subjectivities that students bring with them, and which are then (re)constituted in mathematics' classrooms. In the classrooms I visited, although the children were engaged in and enjoying the mathematical activities, there was no evidence of students involving themselves in numerate behaviour in the sense of having the agency to initiate and communicate mathematical ideas. All the activities they undertook were planned by the teacher, and had clear parameters set as to "correct" performance. For example, the "games" the Year 1 students were playing were initiated and tightly controlled by the teacher, such that any variation was seen as an aberration. One student who was throwing a die and putting beads on the "ten" frame merely disposed of extra beads when there were more than ten. Group members remonstrated and showed the correct procedure for playing the "game". In the Year 3 class I did not observe (although if may have been done later) students and teacher coming together to talk about what they had learned about 3-D shapes. Although they had established some facts about these shapes, the learning environment was not one that fostered conjecture and exploration of the similarities and differences in properties of the various shapes.

CONCLUSION

Humanistic discourses stress the importance of confidence and a positive disposition if students are to be able to establish themselves as numerate individuals in the world of work and leisure. It is as if these are personal attributes that one could easily nurture if only one applies oneself assiduously enough to the mathematics. A poststructuralist understanding of the individual constituted through discourse places the onus squarely on the uses of language and practices of school mathematics to construct students who know themselves as competent and capable numerate persons.

However, there are no methods of teaching nor theories of learning that hold all the answers - in the end there are just interactions between teachers and students that are more or less abling for individual learners. Numeracy is not a gift but a social practice always in process; it is contextual and always constituted by, and constitutive of, learners. Thus as educators we can never be sure that our students who have constructed mathematical knowledge in school will consider themselves, and be considered by others in authority in a particular context, as numerate. I am thinking here of women and Aboriginal and Torres Strait Islanders, for example, who, although they do well at the mathematics, may not even consider careers requiring high levels of mathematics as they see themselves as not really belonging in this field. On the other hand, it may be that a constituted positive subjectivity or sense of agency in school mathematics could be highly correlated to future success in disparate fields even though one may not have fully grasped all the set mathematical content?

It has to be accepted, of course, that in mathematics, unlike other discourses, a curious situation exists whereby one can find oneself in a relatively powerful position with regard to employment and further education prospects simply by having amassed lots of mathematical knowledge and passed the exams. As Paechter (1998, p. 65) states:

> Mathematics provides a fantasy of power and control which, although at least on one level chimerical, is part of a discourse in which those seen as having 'mastery' of it are given a real (in the sense of exercisable) power, arising from its possession, rather than from the knowledge directly.

However, this power comes at a cost. In order to compete successfully in the discourse of school mathematics one must abandon or place on hold one's already constituted and embodied personhood which "while pleasurable because of the illusion of mastery that it brings, is also painful, a denial of the self" (Walkerdine, in Paechter, 1998, p. 66). As can be seen from this research, even so-called "constructivist" and "problem-solving" methods of teaching mathematics can rob learners of a sense of agency as they are unable to meaningfully access relationships of power/knowledge in the classroom.

In this paper I have used the poststructuralist concepts of subjectivity and power/knowledge as analytic tools to look beyond the surface of active involvement in teaching-mathematics-as-usual. I have suggested that if educators truly value numeracy as a social practice, much needs to be done to turn around the crippling effects of teacher and textual authority on student learning, especially, and perhaps most damagingly, where the rhetoric of personal sense-making and "problem solving" endures. In assisting teachers to think more carefully about what they do, and the effects of their uses of language and classroom practices on students, a poststructuralist analysis aims to cause an easing of the iron grip of tradition; it hopes to facilitate an opening up of classroom interactions and activities to student initiated voices and meanings in communal processes of inquiry and exploration.

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