Children Thinking Mathematically Beyond Authoritative Identities

Agnes Macmillan
The University of Newcastle

This paper seeks to explore the dimensions and characteristics of pre-school practice in which young children are able to develop mathematically. Transcripts of pre-school children's discourse during engagement in daily routines and activities form the data for an analysis of their quantitative and logical thinking. The relationship between the quality and nature of the discourse, the activities and experiences of the children and the sociological dynamics of the environment are also examined. In such an environment personal volitional and motivational dispositions are able to function, and individual interpretations are valued. Within this context, the question of the extent to which a sense of autonomy leads to cognitive growth is raised.

Impressive developments have occurred in the use of a wide range of methods which allow and encourage children to express what is perceived and understood about mathematical ideas and concepts, and enable them to make salient connections between the mathematical processes (Clements & Del Campo, 1987; Cobb, 1985; Ellerton, 1987; Pengelly, 1990; Steffe & Cobb, 1988). However, children's research has shown that it is very easy for children to construct inappropriate mathematical assumptions, and adopt inappropriate strategies, and that these are often formed as a result of experiences in which the intended meaning has been inaccessible to the child (Abelson, 1979; Bandura, 1986; Lewis, 1990; Nespor, 1987; Nisbett & Ross, 1980; Rokeach, 1968). Many studies have revealed the anomalies of the more traditional approaches of teaching mathematics, and their powerfully deleterious effects on understanding (Clements, 1990; Erlwanger, 1975; Newman, 1977; Steffe & Wood, 1990).
A major concern and subject of recent research in mathematics education has been the role of affect in the learning of mathematics. Mandler's (1975, 1984) major studies on emotion, and its cognitive, psychological and physiological effects, have been given considerable attention in the mathematics education literature (McLeod, 1991; McLeod & Adams, 1989; Pajares, 1992). Confidence, perseverance and curiosity are thought to be the standards which develop a mathematical disposition (McLeod, 1989). A study by Fennema and Peterson (1985) investigated these autonomous learning behaviours and they took the view that when children come to school they are, for the most part, autonomous, self-motivated and self-regulatory learners.

Within the sociological dimensions of a school classroom, the issue of autonomy for the teacher and for the children is a complex and difficult one. The teacher and children are constantly faced with dilemmas of competing concerns and conflicting interests. There is a need for them to act responsibly towards each other, and for them to maintain a mutual interdependence. Concurrently, individual volitional and motivational orientations may be in conflict with community goals, beliefs and interests (Tonnies, cited in Everingham, 1994, pp. 23-26). According to Everingham (1994), the manner in which these extra-discursive elements of morality are resolved by the teacher has a powerful impact on the other members of the classroom community:

Obligations are not decided once and for all but are continuously contested in a field of power relations, by the particular people involved, who interpret the particular circumstance of each and every situation (p. 29).

Habermas has discussed two forms of rationality: a communicative moral attitude which is based on a need for common understanding, and a strategic moral attitude which is based on coercion and manipulation, aiming for subjective control. The former is an emancipatory morality which strives for equality and individuation through negotiation.
Everingham's (1994) work called into question the critical theorists' assumption that "an autonomous subject ... will simply emerge developmentally," and took the view that autonomy must be "actively produced" (p. 115).

Davies (1993) has made a fascinating study of the relationship between knowledge, identity development, and the factors which inhibit idiosyncratic interpretations of experience: she referred to the as factors which "disrupt obvious patterns of desire" in the classroom (p. 42). According to Davies, before children go to school, they are confident and sure about the "apparently infinite revisability" (p. 40) of their knowledge and their parents' knowledge, but at school "deference to the teacher's knowledge becomes almost inevitable, along with a high degree of uncertainty about independent perceptions and reasonings" (p. 42). Students "come to regard the authority of the teacher and text as an obviousness, rather than as anything that can or should be called into question" (p. 44). Davies believes that knowledge of "how to get it right" is crucial in establishing an identity.

Lave and Wenger (1991) propose an interpretive analytical approach of a learning environment which incorporates theories of learning such as the constructivist approach, but also considers the need for a comprehensive understanding of the whole person in terms of their relationship with the activity in which they are engaged, and a range of socio-cultural factors which permeate the environment. This post-structuralist analytical approach forms the basis of the analysis on which this paper is based.

This is a report of tentative findings of results from the analysis of material which forms the initial part of a current and more substantial investigation. The focus of the main study will be on the effects on children's mathematical thinking of the transition from a child-generated learning environment of a pre-school, to a teacher-generated instructional environment of school. The 'Apprenticeship Model' of Lave and Wenger
(1991), who investigated six different apprenticeship practices from various parts of the world, is a very similar model to the one upon which preschool practice is based: there is emphasis on being an active participant, where learning is through a gradual process of osmosis, and where the emphasis is on expressive language and modelled behaviours. The move to the first year of school is likely to introduce the children to their first experiences of a formal learning environment, based on a Piagetian cognitive conflict model (Piaget, 1975). In such an environment, conceptual development is likely to be promoted through an outcome-based instructional program, and the learner is mainly a passive receptor of information.

The following episode is representative of the kind of child-generated discourse which was occurring during a six-week observation period at a local preschool.

The Zoo Animal Construction Episode

(Bob, John, Tim, Robert, Sean and Martin are building a large square structure with wooden blocks)

1. SEAN: Sometimes you see Bob and Christine kissing.
2. JOHN: Yeah. (Everyone except Bob laughs.) Hey, Bob, you're not playing here. Play the 'Yes/No' game.
3. BOB: Yes (meaning that he would play with them).
4. SEAN: Have a look at these tails.
5. TIM: Tails are different, aren't they?
6. SEAN: Pretend Bob's the snapper, trying to get these animals. You're not building with us (to Bob).
7. BOB: Yes, I am.
8. SEAN: Have a look what's happened. They've grown (the onions growing in jars of water.) Look, these onions have grown.
9. ROBERT: (in corner with animals) Daddy, Mummy.
10. SEAN: How do you know?... Robert's living over there.

11. BOB: (To Robert, as he makes his own construction) Watch mine as you're walking past. (Sean dumps a pile of 1/4 blocks near his building.)
12. TIM: Is that enough?
13. JOHN: Can you please pass me one?
14. SEAN: Pass the parcel. (They pass the blocks. Michael arrives. They have made a two-tiered brick wall and then added another tier.)
15. SEAN: We don't need any more. Hey Robert, look at ours.
16  JOHN: I don't know how to do this bit.
17  SEAN: (To Tim) Are you building with us? Have a look at the 
   outlaw's building. Have a look, Robert. (Tim is putting a roof on.)
18  SEAN: Robert is living with us. Robert doesn't like these. (He 
   shows John what's left in the tub. John goes to the teacher to 
   ask for some more small blocks.)
19  MRS C: I'll get them out when I've finished talking to Peter's 
   mum.
20  JOHN: They're all sorts of colours. The colours they're supposed 
   to be in real life.
21  ROBERT: I've flown to the 
   other side of the world. Do you want to come over with me? 
   (John plays with him. Sean has taken a puzzle off the shelf while he 
   waits.)
22  TIM: Why are you doing a puzzle?
23  SEAN: Because I want to.
24  TIM: Ours is really big isn't it, Sean?
25  ROBERT: They really guard you. (The lions are placed side by side 
   on two pillars on top of the construction.)
26  TIM: All the animals guard you. (They've put a row of cylinders 
   on top and then try to get an animal out from a tiny space at the 
   bottom.)
27  BOB: Can you mind this for Michael?
28  TIM: Ours is better.
29  SEAN: Yeah, ours is better. We had a secret door.
30  JOHN: Robert, I think we should keep that one up so these won't 
   fall down. (It crashes)
   Doesn't matter, it's only the sides. Put that back. (It crashes again. 
   They're all down.)
31  MRS C: Wow. What happened then?
32  SEAN: Let's make another one.
33  TIM: Crocodiles (Playing, digging in the debris of fallenblocks).
34  SEAN: I got these.
35  ROBERT: I got these.
36  TIM: I found these. (All the children have pairs of animals.)
37  BOB: How about you have these and I work with you?
38  SEAN: No, you can't work with us.
39  MRS R: I'll get the other animals for you.
40  SEAN: I'm going to have heaps.
41  JOHN: I'm going to have heaps. Not in such a hurry. We'll get our 
   animals.
42  ROBERT: (With the wooden ones animals) Who wants some of mine?
43  SEAN: We need some other kangaroos. These are all of mine.
44  TIM: These are all of mine.
45  ROBERT: I've got a big gorilla. The big ones are better than the 
   little ones. I haven't got 
   much little ones. (John takes his crocodile.) I'm going to tell on 
   you.
46  JOHN: I'll only give it to you if you say 'please'.
47  TIM: Look at this funny elephant.
48 JOHN: Please can I have the woolly mammoth? (Tim gives it to him.)
49 MICHAEL: Can I play?
50 ROBERT: It's not our building. It's Bob's.

51 SEAN: I'm using the camels. Yeah. I'm using all of these.
52 ROBERT: I've got boobies (referring to the gorillas).
53 SEAN: (To Tim) You don't have to have them. Look at all the animals we got.
54 TIM: Yes I do.
55 SEAN: They're on our team. They're going to get charged. A monkey, a monkey.
56 TIM: Don't, Geoff. (He's going over the debris.)
57 SEAN: You've got a red gorilla.
58 ROBERT: I don't care.
59 SEAN: Yeah, yeow, yeow. A little one. A little baby one. (Martin has his wooden lion eating a little plastic one.) Let's build our building. I'm just getting little ones. (To Geoff) Get! Get! We're setting ours up. (Geoff and Martin play nearby. Sean and John squabble over the camels.)
60 JOHN: I'm having it.
61 SEAN: Hey, you're on our team. You can be on everyone's team, except Martin and Geoff's (to them). Let's build a building now.
62 JOHN: Let's build a building now.
63 MARTIN: Here's a baby one.
64 SEAN: Martin can only have the baby ones. Pretend you put some blocks on. Don't eat them. I'm on Robert's team. Robert, I'm on your team. Hey, what about some bears. What about these? (He plays around the fish tank.)
65 TIM: (quietly) Let's build a building.
66 JOHN: That's my big one. (They still play with animals. The animals are eating each other.)
67 JOHN: You can make a little base. I'm making a little base for it. OK? (Sean, Geoff and Tim have gone to another activity.)
68 SEAN: I'm building a very high wall for this. (Peter starts a construction in another corner. Martin is watching.)
69 ROBERT: (To John) Do you know where our house is? Do you know where my house is?
70 JOHN: No.
71 ROBERT: Course you know where my house is.
72 JOHN: You live in a little road.
73 ROBERT: It's on the other side of the road, up further. If you invite me to your birthday party you can show me.
74 JOHN: I might remember. I wasn't allowed to have a party.
75 ROBERT: You know Clare? She's turning six! And she's only five! (Screws up his face, intrigued with the idea.) And she's only in Kinder. (Martin comes over to them). We won't play with Martin.
76 SEAN: We'll invite all them in the same class.
77 JOHN: I didn't see you (when Robert talks about being in the playground one time and
John wouldn't play with him. He builds another structure using the shelf corner as two
sides, putting slats diagonally on top.) Just put these where you can. (Starts putting themon.)
78 ROBERT: I'll have all the big animals. They can be on our team.
(Puts some on the box on the shelf at eye level. Has made a pattern.)
79 ROBERT: All guards. Now all look out. Except for the big monkey.
John's linking in the base. Just pretend you saw heaps of them coming (makes jungle noises.
Geoff and Peter have come back and take the remaining plastic animals.) You can have
it. You have one there on our team. Put more animals on guard.
80 ROBERT: This big one goes here. These two little ones go here... The daddy gorilla?
(Balances them on top. Has added animals in symmetrical positions,
except for two.)
81 MRS C: Boys, put the toys away because it'll soon be time to do
something here. (Chad brings the coconut over. He's carrying it.)
82 JOHN: Everyday, you have a choice. Everyday. (In the corner with Robert and the animals.
83 GEOFF: (To visitor) I used to have a ball like this (holds a big ball).
84 JOHN: Make a statue. These are real ones. (The boys haven't
packed up and are putting animals on the lunch bag box. Peter has made another small structure.)
85 JOHN: Look how beautiful we are (re the animals).
86 ROBERT: The girls've got make up. Where do you get make up from?
I mean, how do you get it on? (A child behind the screen tells him.)
87 ROBERT: All the black ones, the black ones. (He calls to John as he gets some gorillas.)
88 JOHN: Sean, come and have a look at our building. Sean, come and
have a look at our building. Come and have a look at the base (Sean ignores him).
89 ROBERT: John.
90 SEAN: I'm playing.
91 TIM: What're you doing now?
92 SEAN: I'm playing.
93 TIM: So we don't have to pack up?
94 ROBERT: No not till play time.
95 SEAN: We don't need a base.
96 MRS C: Children, it's time to come to the mat please. I want you,
John, to be in charge of the animals, that's your special job.

Mathematical Concepts as Powerful Socio-Cognitive Images
The Negotiation of Meaning Through Discourse

An analysis of the discourse of the above episode has suggested that the children were thinking in mathematical ways as they engaged in a fairly typical pre-school activity. The categories used for the cognitive aspects of the discourse are from Bishop's (1988) Six Universal Mathematical Activities, which were developed from an extensive study of cultures around the world. These are counting, locating, measuring, designing, playing, and explaining. "Playing" has not been incorporated into the analysis, because the environment from which most of the discourse has arisen was during child-generated "play" sessions.

Logical thought or reasoning is strongly associated with mathematical pursuits, it requires consistency of thought, interpretation and identification of information and the synthesising the information in order to form a conclusion (English, 1990). Bishop's (1988) definition of explaining includes ways of representing relationships between phenomena, and for this reason, evidence of logical thought or reasoning will be included in the category of "explaining". The additional categories of problem solving and problem posing have been included in this analysis, as these processes are strongly associated with mathematical thinking in an educational or quasi-educational context.

Counting. The children used quantifiers in "fuzzy" ways. They used expressions like "Is that enough?", "I'm going to have heaps", "We need some other kangaroos", "Yeah, I'm using all of these", and "We'll invite them all in the same class." Going beyond the mathematical terms of "enough," "heaps," "some other" and "all," to the meaning and significance of the talk, it is clear that being able to quantify objects in their environment is important to the children, not only because it enables them to express and clarify their own perceptions and understandings of their experiences, but it enables them to receive and deliver knowledge about
the thinking and interpretations of other people. Objects and experiences are being classified in quantifiable terms in a way which projects a powerful social dimension. Robert's instruction to "put more animals on guard" highlights the idea that "more", "heaps" and "all" denote power. When the supply of blocks dwindled, John confidently approached the teacher for more. These children are exhibiting an understanding that numerical quantity is necessary in regulating objects and people in their environment.

The distinguishing features of the objects became the subject of the children's observations: "Tails are different, aren't they?", "Have a look what's happened. They've grown. Look, these onions have grown", "Look at this funny elephant", "These are real ones", "All the black ones. All the black ones", and "They're all sorts of colours, the colours they're supposed to be in real life."

Locating. References were made to the position of objects or people: "I've flown to the other side of the world. Do you want to come over with me?", "Yeah, we had a secret door", "Crocodiles! I got these! I got these! I found these!"; and when positioning the toy animals and themselves, "Do you know where my house is?" and its response, "It's on the other side of the road, up further". Expressions such as "The big one goes here. These two little ones go here" located objects in positions of power, in the front and on top of the structure, and on guard. Robert's physical positioning of himself was certainly important to Sean as he wanted the matter clarified and established on two separate occasions: "Robert is living over there" (Robert was playing some distance away from him at the time) and "Ross is living with us" (as he came closer again). John appreciated the concept of the animals positioned regally on the pillars of the structure when he said, "Look how beautiful we are!".

The lions and gorillas as guards were
symbols of power. An important part of the
design centred around creating an appropriately majestic addition to
the structure on which
to position these animals. Pillars were arranged symmetrically, with an
animal carefully
placed on each one, the lions guarding each side of an opening. The
image which was
created prompted two children to express their appreciation of the
result: "They really
guard you ... all the animals guard you."

Measuring. Not only did Robert (45) classify the objects
according to size, but he
denoted a powerful association to them: "The big ones are better
than the little ones." He
classified himself as being powerful because he had "a big
gorilla," and reinforced this
with the notion that this powerful image would not be denigrated by
letting it be known
that he did have some little ones as well. This image is echoed a
little later by the same
child: "I'll have all the big animals. They can be on our team."
The children also selected
lions and gorillas, animals with powerful associations for them, as the
guards of their
structure. In contrast, John expressed considerable excitement and
appreciation of the
attractiveness of the little animals (59). The rejected "friend",
Martin, was only allowed to
"have the baby ones." This child was happy also to make a "little
base" for his animal.
Later this child makes a powerful association of time as he wonders
about the delights of
being able to make a choice of activity at pre©school (82).

Designing. Most of the discourse in this episode has been
generated from the
experience of designing a structure for the zoo animals, so the
planning of the physical
structure and creating an imaginative structure for the play has
produced much of the
quantifying and locating talk. There is also a strong relationship
between the regulative
discourse concerning the materials used in the construction and its
design. However, there
were a few examples of discourse relating specifically to the design of
the structure. There were some design©related problems: "I
don't know how to do this bit"; and another
concerning accessories to the design, "Hey, what about some bears?
What about these?".
There were some suggestions, such as "Make a statue", "Let's build a building", "Robert, I think we should keep that one up so these won't fall down", and after it fell down, "Doesn't matter, it's only the sides. Put that back (one of the supporting blocks)", "Let's make another one."

Explaining. In one sense all the discourse which is related to the construction is an explanation of an event, an idea, or a requirement concerning the construction: for example, "I'm building a very high wall for this", "I'm making a little base for it, OK?". Apart from the considerable amount of discourse on that subject, Robert explained to John the position of his house, "on the other side of the road, up further", and he also explained his fascination with the notion that Clare is turning six when she is still only five and in Kindergarten!

There must have been a considerable degree of reasoning occurring throughout the creation of the construction. All the decisions which were required to build the structure, to make it stable, functional and aesthetically pleasing must have been based on the reasoning process. Logical reasoning was required to predict and interpret information about block sizes, weights and locations, and to make evaluations about events and developments. Deductive reasoning would have been involved in order to explore and establish causes of events.

These children seem to be experts at such an enterprise, in the sense that most of the decision-making was automatic; in the event of a problem arising, the need for some kind of new organisation of the materials was expressed. As few problems arose concerning the structure itself, until it collapsed, there were few examples evident from the discourse, apart from the instance when John reasoned that certain blocks would need to be kept in order to maintain the stability of the structure (30).
Problem posing. When Robert observed that some children were putting on make-up, he inquired, "Where do you get make-up from? I mean, how do you get it on?" There was problem posing concerning the construction, when John needed some assistance, "I don't know how to do this bit".

Problem solving. The solution of problems relating to the physical aspects of the construction were expressed: "You don't have to have them", "How about you have these and I work with you." Robert worked on the problem of being able to go to John's house to play, by asking John if he knew where his own house was. When his idea failed to bring about the expected invitation, Robert suggested, "If you invite me to your party you can show me."

The Negotiation of Power Relations Through Discourse

The control mechanisms which seem to be most dominant in this episode are those which regulate and classify individual children in their relations with the people and objects in their immediate environment. The relationship between the development of mathematical concepts and the regulation of the objects involved in the activity has been discussed, so it is mainly the discourse which focuses on social relationships which will be addressed in this section.

The form which the regulation and classification takes could be negative (eg. through exclusion, resistance, transgression) or positive (eg. through cooperation, acceptance of responsibility, or modelling the behaviours or patterns of discourse of others). Because the positive forms of regulatory behaviours are those being portrayed as desirable by the adults in the practice, the discourse which mirrors that of these adults will be discussed subsequently, when the transparency of the practice and its capacity to permit a growing sense of identity as an autonomous participant to emerge, is examined.

Social power through regulation. On two occasions Bob
was excluded from the
"team" (2, 6), but he nevertheless refused to succumb to an isolated position and set about building a construction of his own in very close proximity to the "main" structure. He was clear about protecting what was valuable to him as he requested to Robert, "Watch mine as you're walking past." When John took one of Robert's crocodiles, he indirectly asserted his own power to regulate John's behaviour by threatening to go and tell the teacher (45). When Michael asked if he could play, Robert again showed a lack of strength by denying his ownership of the structure and transferred responsibility to Bob (49, 50). Although less than brave when it comes to regulating his own behaviour, the following excerpt shows that Robert is delighted to have an opportunity to practise being regulative on those around him:

All guards. Now look out. Except for the big monkey. John's linking the base. Just pretend you saw heaps of them coming. (He makes jungle noises. Meanwhile Geoff and Peter come back and take the remaining plastic animals.) You can have it. You have one thereon our team. Put more animals on guard.

Sean's attempt to regulate Tim by suggesting to him that "You don't have to have them," failed when Tim responded "Yes I do." Sean also attempted to regulate Martin: "Pretend you put some blocks on. Don't eat them." John used his memory as a means for regulating Robert's friendly advances, thereby excluding knowledge of the location of Robert's home, and his own behaviour in the playground, from their association (67©70). John conceded that he "might remember"

to invite Robert to his birthday. This child knows about the power of non-disclosure.

Social power through classification. It was very important to Sean to know the nature of team membership. He wanted to know whether Tim was building with them (17), and to be reassured that he was on Robert's team (55). He was delighted that the monkeys were on their team: "They're on our team. They're going to get charged. A
monkey. A monkey." Later, Martin was only allowed to have "the baby ones" and was only allowed to pretend to put the blocks on. John's comment that he "wasn't allowed to have a party" also suggests that he could have regarded himself as different, in the sense that he could choose whether to participate or not in socially desirable and predictable behaviour and practices.

In Sean's remark that "sometimes you see Bob and Christine kissing", there is an implication that Bob is being classified as behaving in a way which is contrary to their own aspirations, by associating himself with a girl in such an intimate way. Nevertheless, that the girls remain objects of curiosity, if not genuine interest, is reflected in Robert's observations: "The girls've got make©up. Where do you get make©up from? I mean, how do you put it on?"

Autonomy as the Basis of Reciprocal Respect and Recognition

During the episode of the construction, the children sought recognition for something they had understood or created from each other. The tails on the animals struck a chord of interest or recognition with Sean (4), which led Tim to respond with an understanding of his own: "Tails are different, aren't they?" Sean called to Robert, "Have a look at the outlaw's building. Have a look, Robert." Tim noticed that Sean had stopped building and asked him "Why are you doing a puzzle?" Sean's reply, "Because I want to," was less than informative. One of the rejected members of the group, Bob, asked one of the less powerful but more accommodating members of the group to mind Michael's construction for him. Understanding of the social reality was evident here. When Tim wanted his construction recognised as being better, Sean responded with "Yeah, ours is better. We had a secret door." Later, John expressed a desire for Sean to come and look at their building and base (88). It seems to have been more a matter of voicing his own pleasure with his creation, than actually wanting recognition from someone else, as John went on concentrating on the next addition or elaboration when Sean ignored his request. In a similar vein, Sean's "I'm playing ... I'm playing" seemed more a
matter of self-affirmation and an expression of pleasure in what he was doing, than a need for external recognition.

The Teacher as an Authoritative Identity

The teacher is the person who is responsible for the dissemination of knowledge within a structure which has been particularly established for that purpose. In most schools, the teacher has authority over the knowledge only to the extent to which government-imposed curricular structures permit selection in terms of sequencing and timing of their contents, and in terms of teaching approaches and strategies. Pre-school teaching personnel generally have much greater choice and flexibility of content and approaches from which to construct their programs.

Apart from a very small number of government pre-schools which are sub-systems of primary schools, most pre-schools are regarded as being primarily concerned with child care, and as such, they function with financial autonomy and are not attached to a State education system. Their affiliations are as much with government departments of health and community welfare as they are with education. In this respect, pre-school teaching personnel function more autonomously at every level, than systemic teachers. Pre-school teaching personnel are not publicly accountable for the educational content of their programs to the degree which school teachers are accountable. Pre-schools are perceived publicly as having child-supervision, or, at best child-care functions, and as being socialisation agencies, as much as educative agencies.

Although the children are not expected to receive explicit educational instruction, they are expected to be permitted to play and be exposed to interesting and stimulating experiences which may or may not be primarily designed for an educative function. Most parents of pre-school children would expect that although the children do not participate in an instructional program they are nevertheless being prepared for the "real" learning which is going to happen upon entering school.
The analysis of the contributions to the discourse of the teaching staff, which usually included the teacher (who was also the director) and two teaching assistants, has a dual dimensional focus. One dimension concerns the authority of the teacher and the manner in which the knowledge is disseminated and disciplinary factors are controlled, and the other dimension concerns the manner in which participants come to understand what it means to be able to have access to a legitimate claim on, or identity with, the practice.

The Teacher as Regulator of Knowledge and Discipline

From a cursory glance through The Zoo Construction Episode it would seem that teacher discourse is conspicuous by its infrequency and brevity. The six communications of the teacher in the transcript were in fact the only ones made by the teacher to this group of children during the morning session. Mrs Collins was talking to Peter's mother for some time, and although she was situated towards the centre of the room and was able to observe the children, it was more a matter of her being visible and available to the children if they wanted her, than for her to maintain close observation and monitoring of their actions. The two teacher assistants were with the children as they participated in other activities most of the time, although one of them spent some time making written observations of the construction group. Apparently this was a routine procedure.

The children in this class are encouraged to value and appreciate the teacher's need for autonomy. When John requested more small blocks from the teacher, she let him know that although she had accepted and understood his requirement, she wanted him to appreciate that what she was doing was also important to her and to another child's parent. It was the pleasant, friendly tone of her voice which showed her acceptance of his need, and it was the information which explained why it was important for him to wait which was to lead to his acceptance of her need. When the construction fell
down with a great crash, the teacher's response, "Wow!", dissipated any possible disappointment of the children; it was an acceptance of the predictability of such an event and it attracted their attention to the dramatic impact of the crash. Then her question, "What happened then?" directed their attention to a possible cause of the collapse and away from the prospect of rebuilding the structure.

Later, some of the other children in the class gathered around Mrs Collins as she took a bag from her cupboard and took out a coconut. She quietly asked the children around her, "How do you think we'll open it? I think maybe the milk's dried up." The children were taking turns holding it and looking at it when a child called out "It's morning tea time!" Mrs Collins smiled at all the adults in the room and asked in a friendly tone, "Who said?" She knew the child was really just playing at being "teacher." and still smiling, she said to the children, "All go on playing." It was very soon after this that she asked the children on the construction, "Boys, put the toys away because it'll soon be time to do something here." Mrs Collins then started helping the assistant teachers to clear the tables for morning tea. Most of the other children were gathered around her on the mat, wondering about her questions, "Do you know what a coconut looks like? What colour is it?" She reminded the group still playing, that it was time to come to the mat. Her statement, "I want you, John, to be in charge of the animals, that's your special job!", clearly delegated responsibility to John. John was a child who found it difficult to initiate or accept responsibility; the teacher recognised this, but couched the task in terms of its importance as an act of elevation of his own sense of self-worth, as well as an act of communal service.

The Teacher as Creator of a Socio-Cognitive Climate

The teacher models her philosophies of teaching practice and theories of learning through her actions and communications with the people in the practice, and through the
design, structuring and organisation of activities and experiences. Here the concern focuses on whether this preschool culture would seem to be promoting for the children, the ontogenesis of autonomy, and an emergent identity as a legitimate participant in the practice.

A climate of acceptance. An important aspect of an environment in which acceptance is pervasive is that it is non-reactive, and as such, practically eliminates the likelihood of regressive thoughts or aggressive behaviour. The teacher's acceptance of the disturbance made by the collapse of the construction (31) was a powerful example of her willingness to accommodate, and her capacity to understand the situation from the children's perspectives. The other example of an accepting response from Mrs Collins was when the child adopted her teacher role and asked the children to pack up for morning tea.

A climate of co-operation. When Mrs Collins was taking longer than usual to talk with Peter's mother, one of the teacher assistants went to get the extra materials for the children. The professional people in this classroom seemed to be quietly but perfectly tuned to each other's needs and actions, and were models of co-operation not only in their association with the children, but towards each other.

Although the children resisted accepting Bob and Michael into their "team," and were keen to draw attention to the fact that their construction was better than others', in terms of sharing the materials and classroom space, there was co-operativeness among the children. The fact that no teacher intervention of any kind was required throughout the hour-long session of this episode, bears testimony to the respect held by the children for each other's needs and interests. The "pre-school rule" to share was often quoted by the children and was generally adhered to by them.

A climate in which there is clarity of access. The children had open and clear access to exploration of their ideas, to resources, to each other, and
to the adults. It was common practice for all the adults to be available, as far as possible, for whatever purpose was required by the children. At the same time, the children were expected to assume responsibility for posing their own problems and solving them. They were encouraged to reason and find their own paths of resolution and restitution with both cognitive and social problems. This meant that there was a strong likelihood of the children learning to accept responsibility and to be responsible. Adult accessibility and availability was meant more as a last rather than first resort for need fulfilment. Even though this clarity of access was pervasive in this environment, for most of the children's time, it was peripheral to the really engaging and important business of playing. It was important for the children to know that there was clear and ready access to help if they needed it, but the drive to maintain the satisfaction derived from being the director and regulator of one's own experiences took precedence over almost everything else.

A climate in which there is clarity of meaning. In this environment the children were free to explore, experiment and test their own ideas, confident in the knowledge that their offerings of new discoveries of understanding would be earnestly, respectfully and joyfully accepted. Their self-initiated and chosen paths toward understanding were valued. The child who said, "Everyday, you have a choice. Everyday." was reflecting a poignant reality of life in this classroom.

That the children's explorations were regarded with respect was evident at pack-up time when the children were usually asked whether they would like to leave the construction to use later. Although there was an absence of teacher statements which might have indicated her interest in the proceedings, it was a common procedure for her to discover the nature of the development of their ideas by unobtrusively making written re

Towards of Model of Autonomous Learning

Shared participation is that stage on which the old and the
new, the known and the unknown, the established and the hopeful, act out their differences and discover their commonalities, manifest their fear of one another, and come to terms with their need for one another. Each threatens the fulfilment of the other's destiny, just as it is essential to it (Lave & Wenger, 1991, p.116).

Legitimate Peripheral Participation (LPP), or Situation Learning, is the formal name given to Lave and Wenger's (1991) Apprenticeship Model for the interpretive analysis of a practice. It is from this model that the principal dimensions of this emerging model of autonomous learning have been drawn. In so far as it is possible to discuss a detailed and complex model of analysis without reducing it to simplistic terms, explanations of its fundamental premises will be attempted.

Legitimacy. Legitimate Peripheral Participation perceives learning as an integral and inseparable aspect of engagement in social practice, and it explores the complexity of the situatedness of activity (or experience). Its broad theoretical perspective focuses on the relational character of knowledge, the negotiated character of meaning and the concerned, engaged, dilemma-driven nature of activity for people. Each of its components should be considered as "defining the others" and "cannot be considered in isolation" (p. 35). Their combinations create "a landscape" - shapes, degrees, textures - of community membership" (p. 35). Legitimacy of participation characterises ways of belonging, of a participant being able to make a legitimate claim on a practice.

Peripherality. The notion of peripherality is related to social location, and is seen as a positive term whose opposite is unrelatedness and irrelevance to ongoing activity. It is meant as a "way of gaining access to sources of understanding through growing involvement" (p.37). It is a dynamic concept involving relations of power of the social structure. Legitimate peripherality is thought to play a pivotal role for the participant in
"providing access to a nexus of relations otherwise not perceived as connected" (p. 36).

Participation. The participation component of LPP incorporates a view of learning in which it is a feature of the practice as well as being individually constituted. Learning occurs just from being a co-participant, through, for example, interaction, observation, modelling and imitating. It is partly in this respect that the diversity of what is internalised and interpreted from a common experience occurs, and when participants learn many things which have not been anticipated or expected by those who plan and structure the environment.

Participation concerns learning what to do, or to develop a participation schema which would include the ability to anticipate, to master the timing of actions, and the ability to improvise. Emphasis is placed on the importance of the participant engaging in experiences which are integral to a developing capacity to perform in ways which are modelled in the practice by its authority figures. LPP is about a way of being in the social world more than a way of coming to know about it. Considerable importance is placed on the relationship between understanding and experience and the constant negotiation and renegotiation of meaning.

Identity. Motivation is linked to the development of identity; newcomers to a practice are though to have fewer demands placed on them in terms of effort, responsibility and time constraints. They should be provided with a broad access to the practice and to a developing sense of belonging. The focus need to be on maintaining a sense of being a co-participant, rather than being a subject who has to be changed to suit the environment. Learning and a sense of identity are seen as being inseparable. A newcomer needs to be able to understand the community and all that goes with it in order to establish their own identity in its future. Shared participation is a dynamic and reciprocal relationship.
Negotiation of meaning, access to understanding and the formation of an identity are the constructs through which interaction and power relations function. The analysis of the discourse of a particular practice will reveal the nature of the interaction and power relations.

Autonomy. The construct of autonomy is implied rather than directly explored within this model of situated learning. But other sociological dissertations have provided part of the framework for this aspect of the emerging model of autonomous learning. Davies (1993) employed a similar post-structuralist critique to explore the relationship between autonomy and a sense of identity and Everingham (1994) concentrated on its moral aspects. In the mathematics education literature, Kamii (1985) examined Piaget's aim of autonomy as an educational objective.

The volitional aspect of autonomy is its most fundamental regulative function (Corno, 1993). It is linked to motivation in that it is a regulator of wants, needs, self-concept and procedural beliefs (Bandura, 1977; Covington, 1984). Autonomy becomes heteronomy when internal motivational functions become disfunctional, or are dominated or usurped by external regulators (Macmillan, 1991; Nicholl, 1976, 1983, 1984; Stipek, 1993). The cognitive aspects of motivation concern the need for challenge and intellectual engagement (Malone & Lepper, 1987). The emotional reactions which influence confidence and perseverance are also powerful (Graham, 1984; Malone & Lepper, 1987; Weiner, 1986).

The design, structure and organisation of the activities. This aspect of the emerging model of autonomous learning has been drawn from the mathematics education literature (Brown, 1982; Mellin-Olsen, 1987), and the cognitive psychology literature (Case, 1980; Gold, 1987) and the early childhood literature (Kirsch, 1974). Video-tape recordings of the children will provide the evidence for this part of the investigation, and so only indirect reference has been made here the relationship between
the design,
structure and organisation of activities or experiences and other aspects of the practice.
This is not meant to diminish its importance, but rather an exploration of this relationship
with the children's development of mathematical concepts will be explored in a later paper.

In Conclusion - An Allegorical Question

Let us imagine a variation of the story of Goldilocks in which we bestow on her a legitimate claim to enter and explore the house of strangers. In this story, however, the house is a preschool, baby bear represents Goldilocks's peers, mother bear her immediate adult authority figures, and father bear the governmental system which regulates preschool guidelines. Mother bear and baby bear are already in the house when Goldilocks arrives, and she doesn't ever see father bear during her time at the preschool. Because she is encouraged to investigate the aspects of the environment which interest her, she takes her time, feels free to interpret her experiences and to make choices which suit her needs and disposition. It takes her quite a long time, and a lot of exploring, observing, listening and reasoning, to become accustomed to mother bear and baby bear, but gradually she becomes more confident and comfortable with them. It seems to Goldilocks that she just begins to feel relaxed about being in this strange place when she has to go to another strange house, a big school, where there is another group of strangers.

This time father bear is home all the time and he has plenty to say about what happens in the house. Mother bear has many more children to look after, and has to make them do lots of very hard work. Not only is the work hard, but there seems to be too much of it, it has to be done in a particular way, and one has to stop when everybody else does. Also, one hardly ever gets to choose to do the things one wants to do. In this new environment Goldilocks finds it difficult to understand what all the new things are about, and mother bear is usually so busy with all the other children that she hardly ever has time to listen to her or to help her. Mother bear asks a lot of
questions and Goldilocks begins to worry about whether she is telling her the right answers. Goldilocks is afraid that others will notice any mistakes she makes.

All this raises a fundamental question: do we impose too much of an indigestable mathematics agenda on children too soon and too fast?

References


