

“Doing Maths”: Children Talk About Their Classroom Experiences

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From their everyday experiences of life in classrooms, children develop understandings of what is meant by “doing maths”. This paper draws on the findings of an ongoing longitudinal study following the mathematical learning careers of ten children from the beginning of their third year at primary school as seven-year-olds to the end of their eleventh year as sixteen-year-olds. Over this time, “doing maths” has changed remarkably little for these students. Using the children’s accounts of doing maths, the paper probes the connections among mathematical content, teaching, and learning, and considers the implications of their stories for teaching practice.

Setting the Research Scene

Researcher: So what things do you usually do in maths time?
Georgina: Get out our maths books and do our maths. (Early Year 4)

Over the past 20 years there has been a concerted effort on the part of curriculum designers and mathematics education researchers to describe and change the culture of teaching mathematics (e.g. Boaler, 1997; Davis, 1996; Yackel & Cobb, 1996). Transmission pedagogies in which the teacher positions her/himself in front of the class to explain new mathematical ideas followed by the children sitting at their desks completing written tasks from textbooks or worksheets, have been criticised for their failure to engage and motivate children, and their failure to invoke children’s powerful mathematical thinking, reasoning and working (e.g., Yackel, 2000).

Eight-year-old Georgina’s response to my question (above) was typical of the children who were participating in a longitudinal study of children’s attitudes to mathematics. The study began in 1998 as the children were about to start their third year of primary schooling and followed their evolving relationships with mathematics and growing mathematical identities until the end of their fifth school year. The study asked, “How, beginning from a young age, a significant proportion of children experience a loss of interest in mathematics with a concomitant decline in their achievement?”, a phenomenon revealed by research in many countries (Garden, 1997). The study focused on ten 7-year-old children, randomly selected from ten different schools in the Wellington region of New Zealand. It was hoped that a sample of young children of similar age from a range of school environments might provide a more complex understanding of how children experience mathematical learning and what features of their learning environments might be linked to the disaffection and alienation noted in large-scale quantitative studies such as TIMMS.

An ethnographic case study approach was used in order to construct an intimate picture of the children’s lived experiences of learning mathematics, particularly through the words of child participants, their families and their teachers (Walls, 2001; Walls, 2003). In early 2007, it was decided to extend the study. These ten students, now 16 years old, were contacted again and asked to continue their case-narratives. In addition to the earlier research question, I was interested to find out: (1) whether the children’s engagement in mathematics classrooms had changed over time (2) how the children’s experiences had

shaped their feelings about mathematics as a subject, and (3) whether these experiences had an impact on their feelings about and continuing participation in mathematics.

The study draws on the theory of *symbolic interactionism*, which suggests that we make meaning about the world from the everyday rituals and routines we experience. Blumer (1969), a key proponent of this theory, described symbolic interactionism as being founded on a number of *root images*, the most important of which is *social interaction*. He contended that “societies” or “cultures” exist only in action, and must therefore be viewed *in action*. By *action* he meant “the multitudinous activities that individuals perform in their life as they encounter one another and as they deal with the succession of situations confronting them” (p. 6). To reveal out how the children in the study might make meaning through everyday social interaction, data were gathered through a wide range of methods including classroom observations, interviews with the children, teachers and parents, informal discussion with classmates, questionnaire sheets, and examination of mathematics exercise books. Pictures began to emerge of how learning mathematics was typically experienced by these children.

“This is me Doing Maths”: Gathering Young Children’s Experiences

During their first interviews in early Year 3, the children were provided with a blank page headed “*This is a picture of me during maths time*”. They were encouraged to draw themselves in any way that best showed what they usually did during this part of the school day. The drawings of these 7-year-olds revealed much about what they perceived as “doing maths” (Figures 1 to 10). Eight of the children drew themselves seated at a desk or table, pencil in hand and their maths book or worksheet in front of them. Liam was the only child to draw himself actively engaged with others. He depicted himself with his friends, naming each one as he drew, constructing a tower of wooden blocks (Figure 10). Dominic drew himself at a table with other children, all working individually in their maths books (Figure 6). Toby drew other (childless) desks with worksheets to indicate classmates, but showed himself to be working alone (Figure 3). Mitchell was the only child who was not able to distinguish “maths” from the other activities he was expected to do at school. He drew himself skipping, the activity in which he had been engaged a short time before the interview, and drawing, the activity he said he most liked (Figure 9). Jared’s drawing is notable for its action and movement (Figure 1).

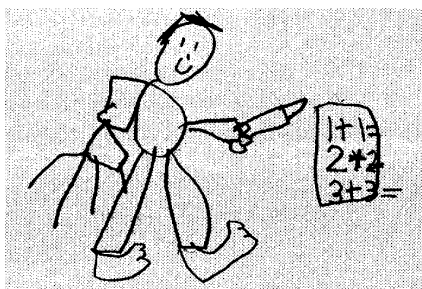


Figure 1. Jared (Early Year 3).

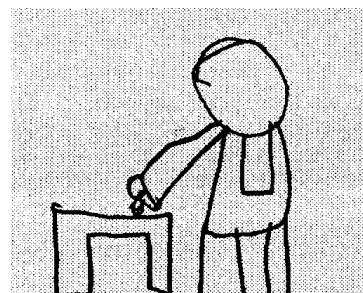


Figure 2. Peter (Early Year 3).

The children were asked to explain their drawings.

- Toby: This is the table and that on there is the worksheet. (Early Year 3) (Figure 3).
 Researcher: And what’s that you have just drawn? (Figure 4).
 Rochelle: It’s my desk.

Researcher: So what's this here?

Rochelle: Book.

Researcher: Is that your maths book? (*Rochelle nods*) (Early Year 3)

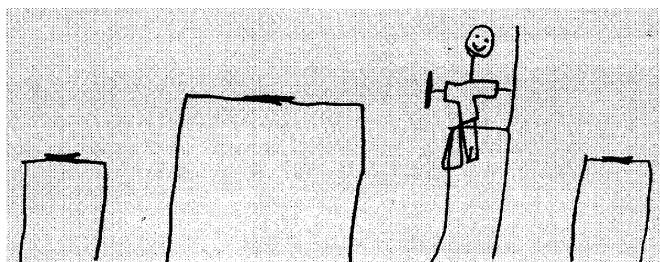


Figure 3. Toby (Early Year 3).

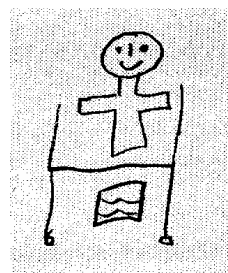


Figure 4. Rochelle (Early Year 3).

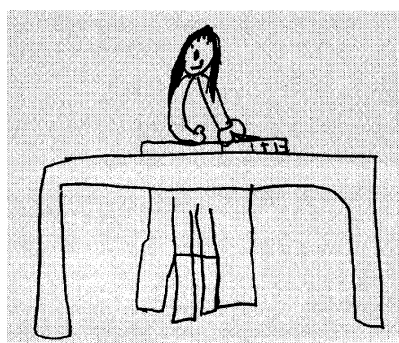


Figure 5. Georgina (Early Year 3).

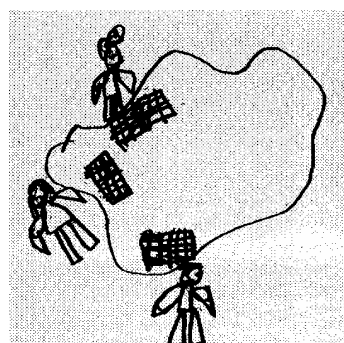


Figure 6. Dominic (Early Year 3).

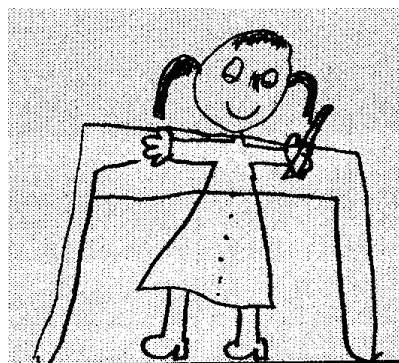


Figure 7. Fleur (Early Year 3).

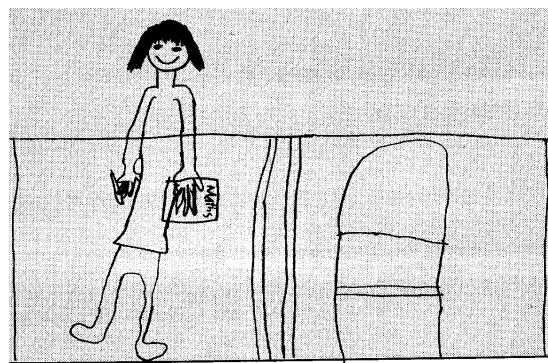


Figure 8. Jessica (Early Year 3).

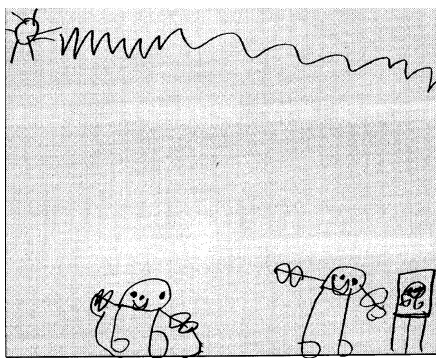


Figure 9. Mitchell (Early Year 3).

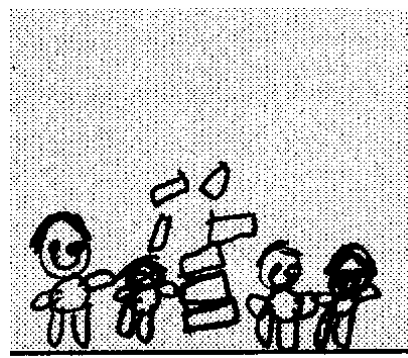


Figure 10. Liam (Early Year 3).

At the beginning of Year 4, the children were again asked to draw themselves during mathematics time (Figures 11 – 20). By this time, Mitchell was able to talk about what happened at mathematics time and how to identify mathematics as a distinct subject as the following conversation shows:

Researcher: How could you show me that you're doing maths on your picture?

Mitchell: I've got a desk.

Researcher: And what's that?

Mitchell: My maths book.

Researcher: And it's got a tick on it, has it?

Mitchell: No, it's a 'seven' [See Figure 11] (Early Year 4)



Figure 11. Mitchell (Early Year 4).

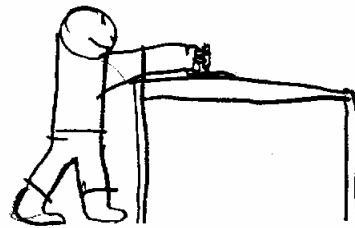


Figure 12. Peter (Early Year 4).



Figure 13. Dominic (Early Year 4).



Figure 14. Liam (Early Year 4).



Figure 15. Fleur (Early Year 4).

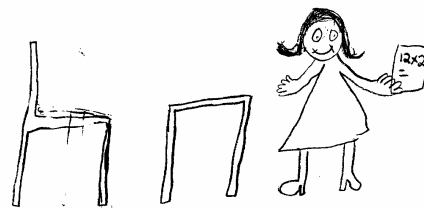


Figure 16. Rochelle (Early Year 4).

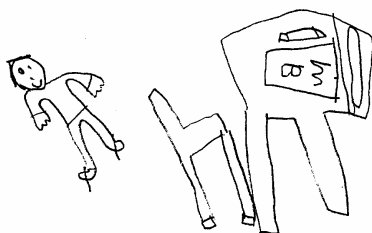


Figure 17. Jared (Early Year 4).



Figure 18. Toby (Early Year 4).

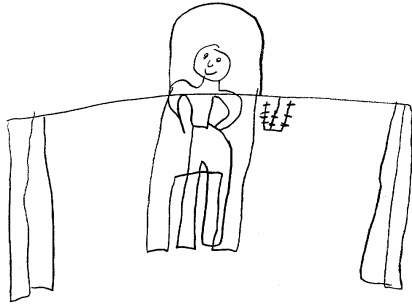


Figure 19. Georgina (Early Year 4).

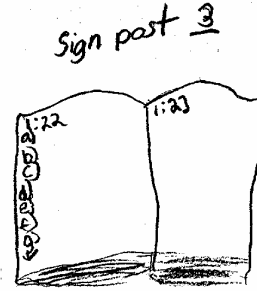


Figure 20. Jessica (Early Year 4).

Although nine of the ten children drew themselves engaged in a writing task, Georgina drew herself with a three-bar abacus, (Figure 19). Earlier in the interview she explained that using the abacus was one of the few mathematics activities she had really enjoyed. The fact that she drew this instead of what usually happened at mathematics time was the result of comments made during the drawing process:

- Researcher: Here's a place for drawing a picture of yourself during maths time. So what would you usually do?
- Georgina: Shall I draw a table?
- Researcher: Yes. (*After Georgina has drawn herself with a big smile*) You're looking pretty happy. (*She has earlier rated herself at only 1.5 out of 10 on the self-rating scale for how happy she feels at maths time*)
- Georgina: I'll put the abacus.
- Researcher: So what things do you usually do in maths time?
- Georgina: Get out our maths books and do our maths. (Early Year 4)

Jessica was not keen to draw herself so she drew her mathematics exercise book (Figure 20).

- Jessica: Do I have to do it of me? Can I just do it of my maths book?
- Researcher: It's hard drawing you is it? (*Jessica nods*) How would you want to draw yourself if you could? How would you imagine yourself, what would you be doing with the maths book?
- Jessica: Um, well, what I could do is I could do us standing looking at the maths book and then you could see a little bit of the writing.
- Researcher: Sounds great. Away you go.
- Jessica: Then it would be the one we work out of. (*Draws the her maths exercise book opened at a page of exercises*)
- Researcher: What's the book called?
- Jessica: We usually put the label, Signpost 1, Signpost 2.
- Researcher: Which one would you usually use?
- Jessica: Signpost 3. (*Writes this label above her exercise book.*) (Early Year 4)

Liam's Year 3 and Year 4 pictures differ markedly. Classroom observations revealed why. In Year 3, his teacher conducted an activity-based programme using *Beginning School Mathematics*. Discussion and direct experience with concrete materials were the norm in this classroom, with children recording as necessary on worksheets or paper, while the teacher recorded on a small blackboard. When Liam moved on to Years 4 and 5, mathematics exercise books were introduced and used almost daily, whereas peer collaboration and the use of equipment became less and less frequent.

There was an overwhelming prevalence in the children's representations of "doing maths" as solitary deskwork, with an emphasis on written number tasks, such as completing equations. This distinctive common feature of their drawings indicated that individual written work was repeatedly experienced by the children at maths time, and

what they most identified as “doing maths”. Observations of mathematics sessions, teachers’ and children’s descriptions of a typical lesson, and examination of children’s mathematics exercise books for evidence of frequency of written tasks, supported these suppositions. Written work as depicted in their drawings was the most common activity experienced by the children at mathematics time. Because of this, the children attached the most significance to it, so that less frequent kinds of mathematics activities such as using equipment for measuring, or gathering statistical data, were considered by the children as less typically “maths”. Although the children were regularly seated on the mat at mathematics time either as a whole class listening to the teacher, or in a teacher-guided group learning situation, this did not feature in their drawings, and seldom in their verbal descriptions of doing maths. The teacher is notably absent from all of the children’s drawings indicating that “doing maths” was not seen as a partnership between children and teachers.

A cumulative picture of the everyday experience of mathematics was established through the children’s descriptions of typical lessons as the following excerpts show.

- Fleur: We go into our book. Our green or red books. NCM[textbooks] (Mid Year 5)
 Researcher: Does she explain it first or do you just go and do it?
 Fleur: She explains it. (Mid Year 5)
- Georgina: We get into our groups and do the worksheet. (Mid Year 4)
- Jessica: It would usually be out of a textbook and once we’ve finished that we would do a sheet. (Late Year 5)
- Rochelle: A group goes on the mat. Then the group that was on the mat does the group sheet. (Late Year 3)
 Rochelle: We do these. (*Shows exercises in her maths book*) (Mid Year 5)
- Dominic: Then we do NCM. Do you know what that is?
 Researcher: Yes, one of those textbooks.
 Dominic: Yeah, or *Figure it Outs*. (Late Year 5)
 Jared: The teacher says, ‘Go and get your maths books out.’ And she writes stuff on the board for maths. (Mid Year 4)
- Liam: We do sheets and we work with Miss Peake. (Early Year 3)
- Mitchell: You have to sit down and do some times tables or pluses or take away. (Late Year 5)
- Peter: Just do worksheets ... finishing the worksheets and sticking it into your book. (Late year 4)
- Toby: Then we mostly turn to the front of our book and do proper maths. Mrs Kyle gets the questions out of a book, and we have to get the answers.

Teachers’ descriptions of an everyday lesson, verified by classroom observation, were consistent with the children’s accounts as the following typical account illustrates:

- Ms Fell: I’ll bring everyone down on the mat and we’ll talk about what we’re doing that day. If it’s something new, quite often we won’t be doing anything in our books, we’ll be talking about a lot of things, get in a circle, and you know, talk, and then send people off for ten or fifteen minutes to do some work in their books so I can get around and work with people individually ... We’ve just

purchased halfway through last year, that AWS¹ series of books where there's one for every strand and they've been excellent ... we've been able to photocopy off class sets. (Mid Year 4)

From the children's and teachers' descriptions and 95 classroom observations over 3 years, it was found that a high proportion of mathematics time was spent on written tasks in the form of worksheets, textbook pages, or work from the board.

The Typical Maths Lesson: Stories from Secondary School

Six years later in early 2007, having just completed 3 years of secondary schooling, their 11th year at school, and their first major national mathematics exams, the students were again asked to talk about their experiences of learning mathematics including describing a typical mathematics lesson.

Dominic: Um, well, we sort of learn a new kind of variation of what we were doing like say if we were doing linear equations another like step into it, like, adding brackets or that kind of thing, and then he'll allocate us some questions to you know, and it just gets slightly harder and harder and as soon as you get through and once you're done, usually that's it for the class because it takes us ... he'll set about 10 or 15 questions, or so, it takes us the best part of half an hour. Yeah, out of a textbook usually, and whenever we come to a, you know, get stuck, Hans my teacher will go through it on the board and explain it and that kind of thing.

Jessica: We have a "notes" book and an "exercise" book and we'll come into class and the teacher will be putting up the notes or we'll write up the notes and we'll copy down the notes ... then you do a few exercises out of the book or whatever she's set us, there might be like a sheet instead of the exercise book, and then, depending on how difficult it is and stuff like that, we'll either keep doing it for the whole lesson and she'll just write up exercise after exercise and we'll have to do it, or we'll move on and have to write up more notes. And throughout the notes she'll sort of explain it to us and we'll sort of, kinda discuss it and that's where we'll do the questioning and that, discussing and all that and then we do the work. ... I've never really thought about it before but it seems like maths might be the one [subject] that's sort of, every lesson's the same, even though the work is different, every lesson's the same and because it's like numbers it seems like it's always the same and when you look at English or Economics or Science you're always doing different topics, and to me maths, even though some of the topics are different is quite repetitive and stuff like that.

Toby: The teacher gives us notes...if it gets dragged on for a long time it just gets boring.

Georgina: I get bored having the same. It just gets so repetitive and boring, (I would like) going outside and something and diagrams not just notes all the time.

Peter: We usually just do exercises and stuff and they tell us the formulas that we need to know and that doesn't change much throughout the year for different things ... we've got like a quite a big text book and it just has all the exercises that we do in it and some, like, exam questions and stuff ...

Fleur: Every day it was the textbook ... our class is like, for the first like, 20 minutes you just write down notes and then you'd have 20 minutes of doing the work and then you do it at home...3rd and 4th form we did a bit more practical. 5th form was real textbook and notes.

Rochelle: When we walk into maths it's pretty much the work's on the board or the teacher just says, "Right do this page and when you're finished bring it up or go onto the next page," and stuff like that.

¹ AWS : A.W. Stark (1997 –2000) author of mathematics worksheets and teacher guides.

Mitchell: We just like get a bit of paper, a sheet of paper and like just write the answers on the piece of paper.

Researcher: If you drew a picture of yourself doing maths now, what would it look like do you think?

Jared: Um me sleeping on my desk ... we had heaps of textbooks and stuff like that ... That was boring too.

Liam: We'd just sit down and this year there'd be like a starter on the board just like, 10 questions, not on the same topic, just reminds us... mark those, go over any problems, if there's any problems with homework, just start on the work that we're doing that day and if it's like, a new thing the teacher would explain it on the board and that, if it's the same stuff just get the books out, the homework and work through them.

The students' verbal "pictures" once again placed them alone at desks engaged in written tasks such as taking notes, doing exercises from the textbook and answering and marking questions. Once again, classmates and the teacher are remarkably absent from these pictures. When present in these accounts, teachers are positioned as the setter of work, explainer of rules, formulas and procedures, and the rescuer when students become stuck. Their accounts emphasise the disengagement and boredom created by an unrelenting diet of textbook based written work.

It comes as little surprise then, that Fleur has already decided to drop mathematics as a subject in her penultimate year of schooling, and Jessica would have done so had there been an alternative option. Although Mitchell has been severely alienated and marginalized at school in general, he is continuing to take the Basic Maths option for Year 12, and Georgina the less demanding Mathematics Numeracy option. Rochelle explains that she is pursuing mathematics only as a means of entry into a nursing degree. Liam says he is taking General Maths rather than "higher maths" because his grades were too low. Dominic, who now lives in Melbourne, has decided to drop Maths A and Maths Methods along with his long-held dream of studying for a degree in aviation having been told by his teacher that Year 12 maths will be hard work for him because he lacks natural ability. Toby has made the cut for the "full Year 12 Maths with Algebra" but Peter has just missed out, much to his disappointment. Years of struggling to make sense of mathematics has taken its toll.

Discussion

For the children in this study whose school lives have spanned the years from 1996 to 2007, most have experienced only traditional modes of teaching and learning mathematics. Oakes and Lipton (2003) describe such modes of classroom interaction as follows:

Most teachers striving for quiet and efficient classrooms organize their instruction to control or minimize activity and social interactions ... after a short time in school, students decide that real learning is what they do by themselves ... traditional modes of classroom interaction are supported by beliefs that each student must do his or her own learning and that the benefits of education accrue through individual accomplishment. These individualistic practices and norms reflect powerful cultural traditions and learning theories (p. 228).

Teachers are able to maintain tight control when teaching mathematics in this manner delivering powerful messages about what is meant by "doing maths". This management of classroom work is consistent with the observations of Doyle (1988) who described work in mathematics classes as a process in which, "teachers affect tasks, and thus students' learning, by defining and structuring the work that students do, that is, by setting

specifications for products and explaining processes that can be used to accomplish work” (p. 169). He argues that much classroom mathematics work is of the structured and familiar variety, and that, “such work creates only minimal demands for students to interpret situations or make decisions within the content domain” (p. 173). Doyle expresses concern about the meaning of the work students do in mathematics classrooms, by arguing that teachers often emphasise production at the expense of understanding, claiming that “meaning itself is seldom at the heart of the work they [students] accomplish” (p. 177). In an earlier study Doyle (1983) explained “doing mathematics” as an induction into the world of academic work. He estimated that “in general, 60 to 70 percent of class time is spent in seatwork in which students complete assignments, check homework, or take tests” (p. 179).

Repeated daily routines are the social means by which we construct our senses of “reality” (Berger & Luckman, 1966; Yackel, 2000). When asked in their recent interviews how learning mathematics might be improved, the students in this study struggled to imagine alternative realities but pinpointed important features of lessons that they wished to change as the following comments illustrate:

Toby: I’m not sure, I don’t think so, I think it’s pretty good how they teach it here already, it’s just a matter of having a good teacher really.

Rochelle: Not old teachers, teaching the old way ... they only think the old way’s easier because that’s the way they were taught it but I think that yeah, we need to know the easiest way.

Jared: Make it more useful in life ... then we’d have success because we wouldn’t spend so much time working on stuff we don’t need.

Dominic: I reckon it’s probably smaller class sizes and sort of more emphasis on teacher-to-student relationship kind of thing, rather than just everything you can get your answers out of a textbook and you can get your questions out of a textbook and you can just live off a textbook because a textbook doesn’t tell you how to do it, it has a few steps in writing, you know, a textbook doesn’t talk back.

Conclusion

Starting from Year 3 of the children’s schooling, and increasingly through subsequent years, mathematics exercise books, worksheets, textbooks and questions on the board became the everyday tools of trade for teachers at mathematics time. They represented to teachers and children alike, the solitary nature of “doing” of mathematics. Rather than fostering processes of exploration, experimentation and creativity as suggested in contemporary curricula, these tools obstructed such an approach to the teaching and learning of mathematics.

The sociomathematical worlds of the ten study children were rarely places where mathematics was taught or learned as a process through which ideas and possible solutions might be brainstormed, explored, trialed, presented, evaluated and recorded in a variety of ways. Instead, they were places that fostered a belief that mathematical knowledge and competence was to be gained primarily through conscientious application to solitary written work as defined through the authoritative directives of teacher, textbook and worksheet. Teacher emphasis on desirable work habits such as setting out, neatness, completion, and working “independently” indicated that these skills were highly valued, establishing a work ethic within classroom environments that superseded concerns about

children's mathematical understanding. It was assumed that by a certain age, children would benefit from the "structure" of this kind of work.

These taken-for-granted customary practices of teaching and learning mathematics have formed a significant part of the everyday worlds of the children. For them, there has been no other way of "doing maths". As the children have become older, written work has increased, while active exploration and the use of concrete materials all but disappeared. As early as Year 5 use of concrete materials had become largely confined to small group instruction time with the teacher, or abolished altogether for all but the most "needy" of learners. Symbolic and abstract modes of working have been privileged over the use of real objects, working in silence over group discussion, and individual endeavour over collaboration.

For most of these children, the isolation, tedium, and inaccessibility of written mathematics tasks experienced on a daily basis over a long period of time, have been sufficiently off-putting to produce profound feelings of alienation and inadequacy. By upper secondary school, mathematics has become a subject they have chosen to study only as a means to a vocational end. If the experience of these children is typical, mathematics educators must be concerned. Such findings indicate that for many of our young learners "doing mathematics" in the spirit of contemporary curriculum frameworks within which mathematical learning is portrayed as social, dynamic, active, meaningful and purposeful, has failed to become a reality enacted through classroom practice.

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