Teaching for under-standing: The road to enlightenment

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INTRODUCTION

The research described in this chapter is a study of how my practice as a secondary school Mathematics teacher has changed from my early days in the profession. I have examined *where I was, where I got to* and *where I am heading.* Through a discussion of my attempts to develop, employ and critically evaluate an alternative pedagogical style, I have explored how I came to perceive the need for change in my pedagogy; how I came to believe I was a PEEL teacher; and how I examined the implications for my students' learning which resulted from my attempts to be a PEEL teacher. I have investigated how closely my perceptions of my teaching practice matched those of the students I was teaching. In seeking to describe and understand my evolving practice, I hope to illuminate for others something of the interface between what a *teacher* perceives he or she needs to do in order to carry out the rhetoric of *teaching for understanding,* and what the *students* perceive is happening in their classroom.

My PAVOT research was conducted in two stages. The first project

was the developmental phase when I had the opportunity to explore and reflect upon new teaching procedures, and the second, several years later, involved an evaluation of my students' perception of my changed practice.

WHERE I WAS

In the beginning

The method I adopted to teach Mathematics was the same as I experienced at school. It worked insomuch as I succeeded in gaining the level of mathematics needed to teach the subject. But then again, I have a certain amount of natural ability, an intrinsic interest in the subject matter and a desire to learn.

Therefore, on my first school appointment, no option for teaching Mathematics had been demonstrated to me other than the traditional exposition model—the teacher in total control of all the knowledge. This was what I aspired to. I actually ignored the strong and abiding memories of the boredom that I had personally experienced in my maths learning at school.

I did not think about the fear of failure I had experienced in my final two years of school mathematics. I suppressed memories about how certain teachers made me feel idiotic if I ventured a response that was incorrect, or how others barely even noticed whether there were any students in the class, rarely leaving their chair or putting down the chalk as they ploughed on through sets of notes they'd been using for the past x years. My teacher training did not illuminate the matter either. When I asked my first Maths coordinator what I had to teach, I was shown the text books, told it was 'all in there' and left to my own devices. There was no advice given as to *how* to impart the content and it was not discussed at meetings. I learned that the teacher closed the classroom door and battled it out alone.

The exposition model

Usually the class begins with an opportunity for students to ask questions about last night's homework followed by writing the topic of the

day's class on the chalk board, a page reference, then on to explaining the concept(s). Examples are elucidated—usually graded in terms of their difficulty. During the explanation phase, the teacher stands at the front of the room, facing the class, monitoring responses and behaviour. Usually students are asked if they 'understand', or if there are any questions. All responses, with hands raised, go through the teacher. Students are quizzed by cloze or recall questions with a one-second wait-time. Then a set of similar problems are set for the students to work through individually. The class may work quietly or silence may be insisted upon. The teacher may move around amongst the students, assisting those who are stuck, or may catch up on corrections at the front desk.

After sufficient time has elapsed, some further problems to practise the algorithm will be set. Students know what to expect: it is predictable and stable. The exposition to a group of people simultaneously is very time-efficient—preparation time is minimised, which is important for busy, overworked teachers. Confident students have the chance to display their ability whilst quiet students have the opportunity to seek assistance one to one as the teacher moves around the room.

The need for change

Initially I tried to perfect the exposition style and to develop a repertoire of methods to keep students quiet whilst I told them what they needed to know. Thus the type of questions I asked myself (see Table 10.1) about the quality of my teaching and my students' learning tended to be restricted to blaming myself—or the students—for any perceived lack of success. I had a sense of responsibility for *making* students understand and remember. It was *my* problem. I had to show them what to do. If I did not show them properly, then they would not learn and I would have failed.

An event in my first or second year of teaching was a catalyst for change. A Year 9 girl wrote a page of suggestions about how I could improve Maths classes and handed it up with some homework. I was deeply offended! How would a student know what problems a teacher

Table 10.1: Reflective questions I asked myself about teaching/learning

- Have I really taught some of these students anything?
- What must I do to explain things better?
- Why don't they seem interested sometimes?
- How do I deal with 'stupid' questions?
- Why don't these kids listen: they just aren't trying!
- I TOLD them how to do that!

faced? I chose to ignore her remarks—I can still picture her face as she collected her work looking for my response. I saw she was firstly expectant, then crushed, then disgusted. Deep down I was ashamed: part of me knew it had been perfectly legitimate for her to offer her comments—she had taken a considerable risk. Sadly, she did not bother again. She just bided her time until the year ended. I felt threatened and had not wanted to formally recognise this student's voice—the agenda was about me and my teaching. I did not realise until much later that this was a rare student. Most students do not want to be taught for understanding—or see the need for it. She helped me begin what has become a continuous process of reflection upon, and change in, my practice.

I came to realise that some of the problems I had been having helping students learn Maths for understanding were due to two factors: the inherent weaknesses of the chalk and talk transmissive model; and the fact that it was the only style I was using.

Student interest and engagement were not so easily aroused, and behaviour and classroom management problems arose as students became bored and disaffected. Some students did not understand the work and turned off, feeling like failures because they did not 'get it'. Students had little chance to experience and practise thinking skills. Students' questions were channelled through the teacher who decided what was relevant to discuss. I had no clear ideas about how to help students become independent learners and I was only vaguely aware of the ideas of metacognition, constructivism and quality learning.

WHERE I GOT TO

Implementing the changes

In 1994 I embraced the ideas of PEEL (Baird and Mitchell, 1986; Baird and Northfield, 1992) because I wanted to change my practice. The theoretical base and generic teaching procedures were the perfect vehicles for risk-taking and growth. I became involved in my first PAVOT project in 1995. During this year, I worked with a group of six like-minded teachers as we trialled new teaching procedures. We discussed them, evaluated them and wrote about them, a process which culminated in the publication of a book (Dusting et al., 1996). PAVOT facilitated a significant shift in the nature of my teaching. I hoped I was becoming a PEEL teacher, because I was doing PEEL things.

The next phase

By 1998, I was attempting to more consistently teach for understanding. I tried to base my teaching on aspects of the Twelve Principles of Teaching for Quality Learning (Mitchell and Mitchell, 1997). I began to ask myself reflective questions (see Table 10.2)—note the contrast with those in Table 10.1. Metacognition became important and deepened my understanding of my teaching.

Table 10.2: Reflective questions as a result of PEEL involvement

- Did we make any links between the ideas in this lesson and those taught in the last one?
- Did I provide an opportunity in this lesson for the students to work out some of the content for themselves?
- Is the understanding students have of the content a result of their having constructed their own personal meaning, or is it more superficial, based on processes rather than the reasons for the processes?
- Have I helped the students in this class learn how to learn?

- Do they understand how they, as learners, best learn?
- Can they distinguish between a good question and a functional question?
- Can they make their own notes, construct accurate meanings and monitor their own progress?
- Do they realise that the teacher does not have to 'tell' them in order for learning to occur?
- Can they move independently from 'confusion' to 'clarity' without needing to be bailed out every time?

ACCELERATING THE CHANGE

That year, 1998, turned out to be my year of greatest change. I attempted to continue to incorporate the best aspects of the formal traditional method and to make regular use of PEEL procedures. Most importantly, I was trying to come to a better understanding of what it meant to be a PEEL teacher.

Increased risk-taking

Occasionally, instead of writing formulae on the board and demonstrating how to apply them, I challenged my students' passivity by writing only the heading on the board and asking them to find out for themselves the information in their textbooks that was appropriate. I began to ask the students to read attentively, to memorise a new rule or procedure, because two students would be randomly chosen to come and write the information on the board and offer a brief explanation. I publicly acknowledged the students' risk-taking and there were very few negative comments from other students about 'mathematical errors'. In fact, the other students watched intently as they checked to see the information. Following some discussion, students would then assess the exercises in their texts and nominate, with reasons, the particular exercises they, as a class, now had enough knowledge to complete. Students were sometimes invited to choose how many questions of a certain type they personally needed to

complete to be satisfied that they could do the work.

As I watched students learning this way, I genuinely felt that I had created circumstances in which there was engagement with the task, concentration, active student involvement, risk-taking and increased interest. My teaching had shifted from me doing all the work *for* the students to the students now working out part of the content for themselves. They had been provided with meaningful opportunities to think and I had not taught by *telling*. This felt to me like good PEEL teaching.

Working from the knowledge base of my class

I came to recognise that many students viewed lessons as separate, isolated events. I therefore developed a variety of ways of tapping into students' prior knowledge to improve their *linking*. At the beginning of a new topic (e.g. measurement, probability or statistics), I began to use *brainstorming*. This became an effective way of collecting and considering many of the relevant words/phrases that students knew about the topic. When using this technique, I tried to ensure that everyone made a contribution. Some excellent teaching possibilities then opened up:

- The words could be written up according to a predetermined organising principle that the students had to deduce, then I could ask them to work out appropriate sub-headings to further organise the principle.
- The information could be compiled into a set of notes by individuals or groups.
- A concept map could be constructed from the information.

In providing opportunities for this type of activity, I felt I was demonstrating that their prior learning was clearly valued. Also, students would see that what they had previously learnt was useful. I believed that if they were personally involved in these processes, they would own the information. Consequently, we were also able to discuss how, during their learning, they processed information—not typical in a Maths classroom.

Giving students the opportunity to write their own notes

Sometimes, after class discussions or other activities, students would be invited to write down their understanding of a concept. For example, I asked them to construct their own definitions; identify the steps in using an algorithm; or write in their own words the steps used to solve a problem. A powerful insight emerged for me through this process. Once the students were familiar with the expectations of these approaches, they (generally) became quite accepting of the tasks. They quickly got down to the process which involved writing; they listened attentively as others read out their versions; and they checked and altered their own writing as a result of what they heard and now thought.

My understanding of what it meant to teach students to be active learners was being developed and I valued what was happening:

- I found that students were engaged and attentive when they knew they constructed their own notes.
- There was little down-time spent in copying notes off the board.
- I anticipated that through this process students would come to appreciate that recording notes from the board (or their textbook) is of limited value if they have not been involved in personally processing and constructing meaning—this is certainly a challenge considering what students' existing ideas of school learning entail (Loughran and Northfield, 1996).
- I hoped that, by providing opportunities to value students' thinking and telling them so, they would come to understand more about metacognition.
- I thought that I was helping students to see what it meant to be independent learners and to take some responsibility for working out the content for themselves.
- I felt that, by listening to other students' explanations, they were experiencing different ways of expressing the same information and that their own understanding would therefore be enhanced.
- Different learning styles were being used when students listened, interpreted and then translated the information into text.

All in all, I believed that, considering what I had experienced in Maths classes in the past, much richer learning experiences were being provided in this classroom environment.

Asking higher order questions

Another shift in my mindset was to think about and improve the quality of the questions I asked my students. This was a difficult area in which to achieve change because the day-to-day business of managing a classroom sometimes overwhelmed my best intentions. Despite my growing appreciation of what constituted excellent questions, I sometimes forget to ask them, or else they occurred to me after the event.

I have come to see that the first aspect of questioning involves stimulating students' thinking by *asking* them good questions. I have a vague memory that at some time I was once told that research suggests that 80 per cent of teachers' questioning is at the memory/recall level—minimising processing skills. I now understand what that means and what a shift in questioning entails. For example, I tried asking questions that were not the normal convergent, closed Maths-type questions. I shifted to questions like those in Table 10.3, as I thought they fostered better thinking.

Table 10.3: Thinking questions

- Are both these situations examples of the principle?
- Tell me two similarities between these questions.
- Can you justify your reasoning to the others?
- Can you provide me with a counter-example?

I came to see the importance of 'training' students to understand what a 'good question' was. When a student asked a question such as, 'What if . . . ?' or 'Does that always work?' or 'But didn't you say that . . .?' or 'Is Question 4 an example of that as well?', I would draw attention to it for both the individual and the class as a whole—I was specifically trying to build my students' metacognitive powers by

noting examples of quality questions as they were asked.

Another interesting shift was that I did not always answer a good question, but instead often deflected it to other students with responses such as 'What do other people think about that?' This was to show that I valued their views and that I was not the sole arbiter of right or wrong. This created other opportunities, as I could respond with 'I was thinking about that too' or 'See what I can come up with tonight—you can all think about that too'. This approach was designed to convey the message that I am not always certain of everything, and that it is acceptable and realistic to *not* know everything immediately.

Using longer wait-time

A further significant change to my practice was to model longer wait-time when students asked questions. I let students know that I was paying attention to my wait-time in both whole-class and one-on-one situations. I explained that this meant that I did not expect answers to be 'blurted out' before everyone had had time to think. It was gratifying when students began to patiently wait for others to respond—although this took constant reinforcement. It was satisfying to be able to thank students for their contribution after they had successfully thought through the answer to a question. This became another opportunity to not only raise students' belief in their ability to work things out, but to provide them with the *chance* to work things out. Occasionally I found that I had had formed a view of a student's ability that was drastically altered when I gave her time to demonstrate the reasoning that underpinned her statements/answers.

I have a strong image of one lesson in particular when a girl was working out the answer to a problem on the chalkboard. She was stuck, but was determined to complete the task. The rest of the class simply waited for her to get 'unstuck'. 'Look, you can see her thinking, can't you?' a girl near me whispered. They gave her quite a few minutes, waiting quietly, and the breakthrough came when the student completed the question and the class rewarded her with 'Yeah, I got that too!' and 'I agree, yes, I think that's right.' She sat

down beaming. Incidents such as this illustrated for me that my practice was beginning to fulfil my teaching aims and that students had begun to blossom as independent learners.

Promoting and using student talk

I constantly tried to reinforce the idea that, by demonstrating and explaining their reasoning, students would be provided with a very important way of homing in on misconceptions. I especially welcomed students who *volunteered* to show both me and the rest of the class their different ways of obtaining solutions. Some of the best moments were in questions like 'Can I come out and show you?' followed by taking the chalk and proceeding to demonstrate a point. One day, two Year 9 students wrote on the board their answer to a certain algebra question. I was secretly ecstatic when two girls approached me and requested that they write up their solution step by step next to that of the original girls': 'We know we mightn't be right, but our answer is different and if we compare their steps with ours we can work out what is happening.' This is exactly what occurred, and everyone watched with great interest. The initial solution was correct and the second pair worked out where they were going wrong. The rest of the class had the opportunity to see the different working out and therefore better understand the situation and the thinking that underpinned the maths being completed.

I also encouraged students to assist others (and to better develop their understanding) by allowing them to move around the room and ask for help. Sometimes several students started to explain ideas across the room to others during whole-class discussion. When this situation took off, it was very exciting. My perception was that students were valuing their own thinking and had confidence in their ability to express themselves. Creating the conditions that allowed students to teach each other required a willingness to take risks and to relinquish the power of being *the* transmitter of the knowledge—along with a recognition that I was not necessarily the one who knew how to best explain the work to everyone.

Students who are 'stuck'

Like most Maths teachers, I tire of phrases such as 'I don't get it'. My 1998 students learned that they needed to be able to identify exactly which part of a procedure or algorithm they were stuck on and frame a useful question that identified the parts they did not understand, before I would assist them. I wanted them to understand that they should share the responsibility for their learning and I tried to make this explicit for them through modelling the language of learning: 'It's important that you think about that and make the link for yourself, you will remember it better in the long run.'

If, when I returned to a student, they said 'Don't worry, I've worked it out now', I considered that I had allowed them to learn. I tried hard not to resort to just telling. I asked students whether they had checked other resources first. They began referring to their notes, looking for similar examples and engaging in discussions with other students. If a student remained stuck, then I encouraged them to re-read the question to me and to underline the key words. If I needed to explicitly explain a set of procedures, then I asked the student to paraphrase what I had said and to repeat it back to me.

WHERE I AM HEADED

Feedback from students

Towards the end of 1998, I was fairly sure I was doing quite well as a teacher who was purposefully encouraging students to be active, responsible learners. I was also beginning to better understand what teaching for meaningful learning really meant. My teaching had progressed in ways that I found much more professionally satisfying. I knew I could never go back to where I had started. However, I was still uncertain whether my teaching was actually resulting in better quality *learning* for my students. I felt a need to determine whether or not the students genuinely understood the purpose in my teaching— what were their views about the way they had been taught? I wanted to know how my teaching had impacted on their learning. Had the

students developed an appreciation of some different and independent ways of learning? Were they learning to work more effectively? An important aspect of my personal understanding of what it truly meant to teach for understanding, to enhance students' metacognition and to develop an active learning environment was to determine whether the students could discern and appreciate any differences between my teaching style and that of other teachers.

For these reasons, towards the end of 1999 I conducted a survey of the entire Year 10 level. In this way, I hoped to obtain data from two classes of students who had been in my intensively 'PEELed' classes in 1998. I was concerned that asking students to remember Maths classes twelve months after completing Year 9 could be problematic. I also surveyed my 1999 Year 9 class because I wanted to compare what turned out to be a less intensely 'PEEL' year with the previous one.

All 118 Year 10 students in the sample were given the survey to complete simultaneously and anonymously. In order to analyse the data, I grouped the two classes I had taught as Group 1 (42 students) and all other classes as Group 2 (76 students). My 1999 class became Group 3 (25 students). Groups 1 and 2's responses to the invitation to 'comment on the teaching and learning style you experienced in Year 9 Maths in 1998' were interesting.

The first significant observation was that the students from both groups definitely recalled the teaching style from twelve months before. I was surprised by the clarity of their responses. Of those in Group 1, some recognised a difference and were quite positive about it:

> We learned through a number of different methods which did assist us.

> I believe it was effective for many different ways of learning and memorising were experienced.

> The learning style was OK. We learnt to work independently because there were no explanations—the answers were from questions. It has probably benefited us as a result.

> I learnt quite a lot—it was full on.

We were taught to think for ourselves. I learned how to work in groups in problem-solving.

It was really good—I enjoyed it.

Other classmates found it difficult, however it was all right for me.

I guess . . . I learned using examples in the textbook. I also learned with my classmates, which helped me understand the topics more easily. The learning style helped me to work independently . . . when I don't understand anything then I'd rather ask a friend or figure it out myself from the examples in the textbook.

It was good in a way—preparing us for Year 10 Maths.

She taught us well.

I found that I learned by interpreting things for myself and changing the language used to help out fellow students that didn't understand. Also by asking others and discussing.

This group of comments is encouraging because it indicates that these students were clearly aware of my attempts to help them learn differently. There is implicit evidence that their learning was of a different (and higher) quality. These students' responses illustrate that they appear to have appreciated the opportunities provided for them to monitor their own understanding.

Four students did not seem to notice anything different:

The teaching style was OK where most things were done on the board. I learned a lot in Maths last year.

Pretty much just listen and learn and keep up with all your work. If you did that you were fine.

I thought that our teacher moved very quickly without giving us the time to think for ourselves or to ask questions.

Same as every other year but more group work and games.

Other students perceived the difference, but had some reservations:

Often I needed to teach myself things. It was good in a way but at the time really confusing.

It was all right and taught you to work independently but I often hated having to teach myself as I often became confused.

This was a 'Do it yourself' atmosphere . . . if I asked questions I was made to feel dumb. This year I have been taught by a very structured teacher and my marks have improved considerably. I guess learn it by yourself benefits some but it did not benefit me.

I didn't find the teaching style to be very successful but some people found it to be very good . . . there wasn't enough explanation or examples. I was encouraged to learn a lot on my own with little help from the teacher which is good sometimes but not all the time.

Asking other students for help other than the teacher was good but it also interrupted others while working.

Overall good but not enough time was taken to explain to those not understanding.

It was good but at times things were not explained clearly enough.

Still others perceived a difference but expressed some negative feelings about their experiences:

I had trouble processing and understanding some things because my teacher didn't explain things well.

The teaching style was not good. I would go to other students for help.

We were expected to do things on our own with no real explanation.

It was poor. I was taught by other students not the teacher. Other students used their time to teach each other because the teacher was not doing her job properly.

I practically taught myself. My teacher wasn't very helpful when it came to questions I didn't understand.

A year with little help or encouragement and spent most of the year trying to work things out by myself. It was a harder year than this [year] because it took longer to work things out.

I had to teach myself some things or get my family to help me because it wasn't explained in class.

Considering what I was trying to do, and despite the students' frustrations, there is an apparent mismatch between the way in which some students perceived what was happening and what I was observing and valuing. I had at times been quite delighted when students had worked out answers by themselves or had demonstrated other good learning behaviours, but for some students these occurrences may not have represented the success for them as learners that I had perceived it to be as their teacher. Further, some practices that I had actively fostered, such as setting up the classroom environment so that students could improve and reinforce their own learning by teaching a new idea to someone else, were viewed negatively by a number of students—to the extent that one student thought that the students had to explain the work to each other because I had not been 'doing my job'.

Although I thought I had consistently tried to use a language of metacognition and to clarify why I was teaching in the ways outlined above, in some cases I obviously did not overcome the deeply ingrained expectations that some students have of their Maths teachers. Telling them why I was teaching in this way did not convince all of them that it was a better way. Northfield (Loughran and Northfield, 1996) encountered similar resistance in his teaching, which he interpreted in terms of the years of experience students have with the stereotypical model of school teaching and learning. He reasoned that students grew to expect to be taught in a teacher-directed way and learn not to think too much for themselves—it is both difficult and tiring.

I have come to see that these expectations of the way Maths teachers 'should' operate are strongly reinforced by parents, whose indicative comments at parent–teacher interviews reinforce students' understanding of what teaching and learning is meant to be:

I always tell her, if you don't understand something then *ask* the teacher. That's what she is there for—to *explain* it to you.

My experiences through the examination of my teaching and my students' learning now makes statements like this to be much more revealing than I may have once realised. The implicit message is that the teacher does the learning for the students—that is the teacher's responsibility.

It took a great deal of energy and conviction to sustain the alternative teaching style I began to develop in 1998. It would have been easier to just tell. My data supports Loughran and Northfield's (1996) findings, which make it plain that there is resistance from the 'guardians' of 'correct practice' if school teaching and learning is to be more active, responsible and purposeful. I am sure I challenged many students to move out of their comfort zone and that quite a number did not like that challenge. However, I do not believe that such a view, in itself, is sufficient to neglect the need to teach for understanding.

Student responses from Group 2 (students from other Maths classes) provide further evidence that the traditional model is highly valued by many students. There was considerable diversity in the

Group 2 comments (they had four different teachers), yet a number offered a view similar to the following:

> The teaching style was very good because the teacher explained everything thoroughly and if we needed any help the teacher would be happy to explain it.

> The teaching style was great. Things were explained fully or until understood by the whole class. We did examples together on the board and then we completed our exercises.

> It was very good because the teacher made us all feel comfortable about what we had to do. She answered all our questions.

> We were given examples on the topic and everything was explained to us so we would understand. Then we would do set exercises.

Significantly, there were very few comments of this type about *my* teaching from the students in Group 1. I would have found this devastating at the beginning of my teaching career, but I now interpret this data as strong evidence that my different teaching approach was recognised—if not always appreciated.

Loughran and Northfield (1996) have indicated that many students do not distinguish between being able to do the work and understanding the work. Students in my class were often asked to try to truly understand the work. This inevitably led to learning demands that could well be perceived by many students as unnecessary; further, they believed these extra learning demands may go unrewarded in conventional assessments such as written tests.

These concerns were also raised in my mind. Despite my best intentions, some of my students felt as though I had not been drawing the threads together sufficiently well for them:

> It would have been really good to teach yourself and then have the work re-taught by the teacher so you had a really clear idea of what you were doing.

I certainly recognise that, in teaching, it is not sufficient to 'throw' out some ideas, wait, then allow time for discussion and exploration if the overall big picture, the purpose underpinning the approach, is not made clear. It seems to me that I had not done this well enough for some of my students. I personally found it very challenging to 'draw the threads together' when students had come to their understandings via different routes. The difficulty in validating different means of thinking and explaining without prescribing the method is a big ask for a teacher.

A telling response from a Group 2 student was:

> She would write out the steps and go through it with the class and leave time for questions. It is the teacher's method of teaching that puts impact [sic] on students' learning. It is only when you understand something that you like it.

Inadvertently creating feelings of confusion, and not resolving them, can be disastrous. Learning needs to be carefully monitored to avoid a greater risk of such confusion and lack of resolution occurring when pursuing teaching and learning in the way that I have described through this chapter. My uneasy feelings about this issue have been verified by my research. I have learnt that I need to use my professional knowledge to respond to contextual factors and to step in and clarify when I see the need.

Further modifying my teaching

At the beginning of the 1999 school year, I surveyed my 25 Year 11 students about 'What makes a good Maths teacher'. The majority wrote 'explains things', 'goes slowly' and 'gives good examples', and the general tenor of their comments was very conservative. This, together with my concerns about whether my teaching in 1998 had resulted in improved learning, combined to make me tone down my approach. Another pressure I felt was the need to cover sufficient content so that my classes would 'measure up' in common assessments. The paradox for me is that I know that slowing down and

allowing more time for students to construct their understanding makes for better learning and that students therefore do better on *those* sections of a written pen/paper test. However, they do worse overall if they simply do not 'recognise' some of the questions on common assessments because they have not been exposed to the content due to lack of time.

I therefore became quite curious about my 1999 students' views of my teaching and how they compared with the 1998 cohort. These are the Group 3 responses to the same stimulus question that the 1998 cohort responded to:

It was really open. The teacher really made you work things out and didn't explain everything on the board. Everyone helped everyone else pick up concepts and ideas so it was a really good working environment.

The teacher gave us a chance to use previous maths skills and expand on them. It was good because we didn't always work out of the textbook.

The teaching was usually very well explained and after each new concept was taught I understood it. I liked it when I, or anyone else in the class, wasn't sure of something the teacher would slow down and try to make it clearer ... I was encouraged to think for myself and be an independent learner which I think is very good. I also felt that I was challenged. I enjoyed this class a lot.

I like the style better this year because it was more varied. It wasn't always sit down, take notes and do exercises.

The teaching style was more intricate. Very different to that of previous years.

The class was like a forum where everyone was equal. Studying and listening are the key, and asking for help.

Maths has been fun this year ... because we all feel comfortable to ask questions.

We had to teach ourselves rather than learning at school. But it is a good experience for us because when we get to Year 12 [final year of secondary school] we'll need to study for ourselves.

It was different to that of my last teacher so it took a while to adjust but I got there. I liked the independence we were given. I enjoyed Maths this year due to the independence and freedom and the range of styles in which we were taught.

It was good. It took a little while to adjust to but I eventually enjoyed it. Very different to previous years because we had more freedom but it was very effective.

My learning speed has increased and I still understand.

It was very different: fast, enthusiastic and original.

Not all viewed the teaching and learning this way, however—some students saw it differently:

Most of the time the teacher would explain then we would do examples as a class. We would then do exercises from the book. I learnt well but at times it was boring.

The teacher spent half a lesson explaining what we were learning about and people asked questions. The class was involved in working out problems together. Then we spent the rest of most lessons working out stuff from our textbooks. I learned a lot.

It was OK. Sometimes I didn't quite get stuff but my friends would help out. Sometimes the teacher rushed subjects. It was a good learning style, sometimes confusing, but good.

So again my students recognised a difference. This year I was deliberately more balanced in my approach. I became more adept at finding appropriate responses to my students' needs. Most of these students were comfortable but still felt challenged. They acknowledged that they had been taught differently, and were aware of the purpose for that difference. This group was learning in ways congruent with the aims of my teaching but I was less concerned with watching myself *teach* than with watching the students *learn* in better ways.

CONCLUSION

Realistically, in time, I expect my students will have forgotten details of *what* they were taught but I hope they retain a real understanding, and a genuine knowledge, of *how* learning can best occur. I believe my research suggests that this is possible. Most of my students experienced a variety of ways of learning, and understood that there was an expectation placed upon them to be active participants in their own learning.

As a result of my PAVOT experience, I now have constructs and a language available to me to reflect upon and develop my practice. My mindset has changed. I am now aware of being able to abstract from one situation to another and to recognise and further develop a generalised knowledge about my own practice.

Although it is difficult, I have found that it is possible to create a classroom environment whereby my ideals are increasingly achievable aims, not just rhetoric. There will always be a difference in the perceptions and expectations of students and teachers about teaching and learning, and this will always present challenges—it is the nature of the complex world of teachers and learners. However, I now believe that I can honestly claim to have a better sense of how to shape my students' expectations of how to become better learners.

Through this research into my teaching and my students' learning, I have been reminded about how important it is to not only attend to my agenda as the teacher, but to focus similar attention on the students' agenda as well.

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