IT'S ABOUT LEARNING: FROM PURPOSES TO BASIC-LEVEL CATEGORIES TO METACOMMENTING

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In my work as a teacher educator, teaching on a PGCE secondary mathematics course and as a mathematics teacher in a classroom, I am interested in how students learn in situations where they, initially, do not know what to do. What is the process of coming to know? For the ICMI Study Group 15 - The professional education and development of teachers of mathematics - I have submitted a short, distilled paper on the theoretical principles underlying my practices. I report here on the explorations of those ideas - purposes, basic-level categories and metacommenting - that occurred within the group of teachers and teacher educators attending the session at the University of Sussex BSRLM day meeting .

I read *Steps to an ecology of mind* by Gregory Bateson in 1972. His theory of logical types distilled for me into saying "that's 'shift-level'" at times when I noticed a shift in the communication I was taking part in from being within the area (*e.g.*, doing mathematics) to being 'about' that something in some form. In this paper I will share the experience of working with a group at the University of Sussex BSRLM meeting, doing activities that would allow us to shift to talking about 'about learning' through discussions focused on our ideas of what learning is.

WHAT IS LEARNING?

The first activity was simply inviting members of the group to write a few thoughts down about what learning was for them. Since we were all teachers or teacher educators (or learning to teach) then it was likely that each of us had a position on learning. My own view is that the teacher's or teacher educator's enacted views of learning are more central than either the pedagogical content knowledge or subject knowledge discussed in teacher education literatures. Images of what people think mathematics is are related to teaching styles complexly through images of what individuals and cultural groups think learning is.

I collected a few statements on an OHT:

- Thinking differently
- Pebbles and surf
- Noticeable change
- Essential human characteristic … you can't stop people doing it …
- Something you can reflect …
- Being stuck and overcoming being stuck

- Accompanies all activity – don't have to notice it for it to exist (implicit) but if you do, then it might be different …

My view of learning is underpinned by the belief that we are what we do – all our past experiences contribute to our current actions – and that the way we develop the embodied actions that make us who we are is through coming to see more through the process of making finer and finer distinctions, in other words, categorising:

> Every living being categorizes. Even the amoeba categorizes the things it encounters into food or nonfood, what it moves toward or moves away from [...] We have evolved to categorize, if we hadn't, we would not have survived. Categorization is, for the most part, not a product of conscious reasoning. We categorize as we do because we have the brains and bodies we have and because we interact with the world in the way we do (Lakoff and Johnson, 1999, p. 18).

So, it is natural for me to categorise as I collected the statements on the list. What else would I do? Given that I have previously spent time categorising similar thoughts on learning, I was able to model and comment upon the process of categorising that I was doing: 'Noticeable change' struck me as being similar to learning being a process of seeing distinctions; some other statements are actions, such as, 'being stuck and overcoming being stuck'. However, 'essential human characteristic' does not seem so closely related to action. 'Pebbles and surf' (I will not go into details of the discussion we had of this statement because of space) was different again – a tool to think with – a metaphor.

TEACHING IS … LEARNING IS …

In the next activity I asked for labels for incidents that had happened in the classrooms or teaching rooms of the people in the BSLM session during the previous week. They were asked to bring to mind an incident that they could describe through completing the phrase 'Teaching is …' and also bring to mind an incident that they saw when asked to complete the phrase 'Learning is …'. We did not spend time in the session sharing the stories themselves, but did share the completed phrases. This is an activity that I do at the start of the year with the PGCE mathematics students. They have just spent time in a primary school and I want them to start linking their actions with such labels in a process that can be described as experiences to issues to actions (Jaworski, 1991, p.64). Here are some of the statements from the BSRLM session. I was again categorising and marked some of the statements as we progressed in square brackets:

Teaching is …

- providing a situation that enables students to learn
- negotiating
- educating awareness
- helping progression that smiles

- [difficult and in interesting ways]

- creating situations in which learners encounter phenomena and then use their powers to makes sense and directing their attention

- [transferable skills … mentoring]

Learning is …

- developing new knowledge and/or skills

- entering other people's thinking

- becoming aware

- [progression that smiles]

- uncomfortable

- transformation of structure of attention that occurs over time

Looking at these lists typed up, I suppose that one distinction I seemed to be making was that many of items were 'ing' words and some were not (feels like I could have closed the square bracket after transferable skills). This seems to fit because what I am aware of in my own teaching is that this activity lead to statements that are more closely linked to actions than those in the previous activity. There was only one 'ing', 'thinking differently' in the first list. I want student teachers to find statements that link closely to what they can then, in the move from issues to actions, see most easily in their new world of mathematics teaching and learning.

Where does this activity for PGCE student teachers fit in with activities for students at the start of their life as mathematics learners in secondary schools? What are the theories of learning that underpin my practices as teacher educator and as teacher?

PURPOSES

I started teaching at the University of Bristol, Graduate School of Education in 1990. The questions that engaged me were to do with ways of working with student teachers to develop the effective practice of mathematics teaching. My first explorations were in some senses naïve, but out of those practices grew a theory-in-action (Schön, 1991) in which I started to use the word 'purposes':

> Beginning teachers need to temper idealistic goals given the reality of how much skill might be required to achieve them. I found that engaging with a student on a philosophical level of debate did not seem to allow practical development or change of implicit theories or attitudes […]; nor did giving 'tips for teachers' at a behavioural level do much for their developing sense of who they might be becoming as a teacher (Brown (with Coles), 1997, p. 104).

The dictionary (Chamber's Twentieth Century, 1976) definition of purpose reads: *idea or aim kept before the mind as the end of effort; power of seeking the end desired.* There is nothing here about actually getting to the end, although that is not

precluded. With purpose, however, we give ourselves the motivation to make effort in relation to some 'idea kept before the mind'. Purposes emerged for me as a description of the sorts of guiding principles that student teachers found energising when learning from their own experience. Purposes seemed to be in the middle position of a hierarchy between philosophical attitudes and teaching behaviours in the classroom. These labels, arising from sharing stories from their classrooms (*e.g.,* ways of sharing students' responses; how do I know what they know?), are the student teachers' purposes, allowing them to begin to collect a range of behaviours to try out in their classrooms.

BASIC-LEVEL CATEGORIES

In 1995 I was at a conference in Recife, Brazil (PME, 19) where I attended a discussion group based on the ideas of embodied cognition. From reading after this discussion group (Varela, Thompson and Rosch, 1995) I was excited to find that my thinking about purposes seemed to have parallels with 'basic-level categories'. The idea is that we develop hierarchies of categories, *e.g.*,'Chino' is a 'dog', which is a 'mammal', which is an 'animal'. The basic-level categories are most important in our capacity to interact effectively with the world. They are the most useful distinctions we can make around which most of our knowledge is organised (Lakoff, 1987, p. 49). These categories are again in a middle position where, for example, when the basic-level category is 'dog', there is too much detail in any particular dog (interactional properties) and 'animal' as a label is too abstract for linking directly to actions (superordinate category). To give you a feel for the theory here are the four conditions through which Lakoff and Johnson (1999) characterise basic-level categories:

> Condition 1: It is the highest level at which a single mental image can represent the entire category. (p. 27)

Lakoff and Johnson (1999) suggest 'car' and 'chair' as basic-level categories in contrast to the higher level 'vehicle' and 'furniture'.

> Condition 2: It is the highest level at which category members have similarly perceived overall shapes. (p. 27)

One interesting aspect of travel for me is when I find it hard to recognise common objects. For instance, when in Japan and travelling, it was not always easy to recognise 'bed' (a roll in a corner of a room with little furniture). I was aware of having to educate my seeing.

> Condition 3: It is the highest level at which a person uses similar motor actions for interaction with category members. (p. 28)

In our cognitive unconscious are automated behaviours which embody similar motor actions for interaction with any basic-level category member, such as 'sitting' for 'chair', 'stroking', 'feeding' for 'dog' or 'parking' for 'car'. There are usually no such patterns of everyday behaviour at the more abstract, superordinate level *e.g.*,

consider 'furniture' where there is no single motor action which could be appropriate for interaction with all category members for most people. However, for a manager of a self-storage firm there might be similar motor actions for 'furniture' and hence it is possible for 'furniture' to be a basic-level category.

Condition 4: It is the level at which most of our knowledge is organised. (p. 28)

If I only learn how to mend one car I will have a lot of detailed knowledge that will not necessarily help me to mend a car of a different make. Once I engage in learning about a second make of car, I begin to learn about the properties of the general category 'car' *e.g.*, all cars have engines but not always under the bonnet! Since it is around this category that my new knowledge gets organised 'car' is basic-level.

So, given that I believe that this is how we learn my practices support students in classrooms and student teachers in developing their actions and one behaviour that I have found supportive has developed out of Bateson's (1972) work on meta-communication.

METACOMMENTING

What a teacher can do is focus students' attention on behaviours. The 'about learning' tasks do this explicitly with student teachers. How does this look in the mathematics classroom?

- There were some counterexamples to that. Remind me what that is.

~ One that does not fit the conjecture.

- OK, pupil 1 has done something very mathematical. He's *gone back and looked again and changed it* [the conjecture].

~ [Later in the same lesson.] All two digit numbers will add up to 99. [David's conjecture is written on the board.]

~ I've got another counterexample to pupil 1's.

- This is how mathematicians work; *Are there counterexamples? Are two conjectures actually linked* and so on. (11-year old students, 2004)

The teacher here is Alf Coles who has worked with Bateson's ideas for some years and it is now natural for him to comment 'about' the actions of his students as they work in his classroom. Other metacomments that Alf has used are 'getting organised', 'asking and answering your own questions' and 'listening and responding (to what other students say)'. Alf is talking about what students are doing that fits with 'thinking mathematically' and over time he has developed these basic-level categories of behaviours that are most easily seen in his world of being a mathematics teacher looking at the behaviours of his students. Some of these metacomments capture the attention of the students and become their purposes, giving them a sense of knowing what to do. Early in their first year of secondary schools this mixed ability group are already using the language of conjecture and

proof for themselves – this is what they do in the culture of this mathematics classroom.

AN ILLUSTRATION OF A STUDENT TEACHER SHIFTING LEVEL

In conclusion, here is a piece of writing from a student teacher who, as part of an assignment, was focusing on an issue arising for them out of their first school practice:

> I wrote the question on the board, and asked for hands up for the answer. The first child gave me the answer to which I said 'Correct'. Belatedly, I asked if anyone else had anything different, but of course the children were then unwilling to offer an alternative answer that they now knew was definitely wrong. I realised immediately that I could not now see what the rest of the children had done. Since that occasion I have been attempting to gain answers from several members of the class [...] An advantage in listing the variety of answers to a question is to show children that they are not alone in making a mistake and that others have had the same (or different) problems. Similarly, multiple equivalent answers can be highlighted whereas otherwise a child may feel that their answer is wrong just because it does not look identical or is in a different form. Hence the art, as a teacher, of 'being expressionless' as a variety of answers are given to a problem appears to be a very useful one.

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