
Chapter Five: Teacher Knowledge

Concept mapping was used to gather information about the changes to teacher knowledge and practice as a result of CMIT. The drawing of concept maps at both the start and completion of the project was accompanied by a semi-structured interview.

Nine sets of maps (initial and final) were obtained. Within school A (a decile 1 urban school), the teachers chose to construct their maps and to participate in the interview in pairs, while teachers in school B (a decile 2 rural school) worked on their own. This gave results from four pairs of teachers and five individuals.

All the teachers showed some development in their professional knowledge and classroom practice by changing their map during the final interview. Six maps were amended with the addition of extra details and three individuals chose to redraw their map completely.

In this chapter, changes to the concept maps are categorised into three main areas. These are changes in a teachers' knowledge related to:

- students' thinking (or use of strategies);
- students' knowledge;
- pedagogy

Analysis is both quantitative and qualitative. The amended maps are analysed by categorising the additions to the maps as above and by totalling the additions in each category. This gives an overview of the type and frequency of changes that occurred.

The redrawn maps are focused on in more detail, as these maps represent the teachers who appeared to have made the greatest changes to their professional knowledge and classroom practice. The maps are analysed qualitatively and the trends are observed under each of the categories.

Amended Maps

Of the nine sets of maps, six involved the addition of information rather than a complete redraw. Participants varied as to the extent of the information they added to their maps.

Tables 5.1, 5.2, and 5.3 (on the next page) show the number and subject of the additions under each of the three major categories.

Table 5.1: Information Added to Concept Maps Pertaining to *Students' Thinking*

	Helen	Lynn	Moana, Emma	Ana, Imogen	Eva, Nicola	Aroha, Kim	Total
General	1	1		1	1		4
Count on	1	1		1			3
Count all	1	1					2
Visualisation	1						1

Table 5.2: Information Added to Concept Maps Pertaining to *Students' Knowledge*

	Helen	Lynn	Moana, Emma	Ana, Imogen	Eva, Nicola	Aroha, Kim	Total
NID	1	1	1	1			4
FNWS		1	1			1	3
BNWS		1	1			1	3
Ordering numbers			1	1		1	3
Teens/ty differentiation	1			1			2
Base 10		1				1	2
Increased number focus	1						1

Table 5.3: Information Added to Concept Maps Pertaining to *Pedagogy*

	Helen	Lynn	Moana, Emma	Ana, Imogen	Eva, Nicola	Aroha, Kim	Total
Questioning	1			1		1	3
Assessment	1			1			2
Rote counting		1		1			2
Increased enjoyment (for students)			1	1			2
Grouping				1		1	2
Students sharing ideas				1			1
Resources				1			1
Increased problem solving		1					1
Increased variety activities	1						1
Modelling	1						1

These results support the findings from the analysis of the teacher questionnaire. All the details that were added to the concept maps were also raised as issues by the teachers in their responses to the questionnaire. No new areas of development were found in the case-study analysis.

In responding to the questionnaire, 84% of the teachers cited an increased understanding of the thinking strategies that students use as an outcome of participation in the CMIT pilot project. In analysis of the concept maps, four out of the six teachers who amended their maps added details regarding students' thinking strategies, with three of these teachers adding more than one piece of information in this category. Analysis of both the questionnaire and the concept mapping noted a wide variety of indicated pedagogical changes. Examples of the changes that were indicated are set out below:

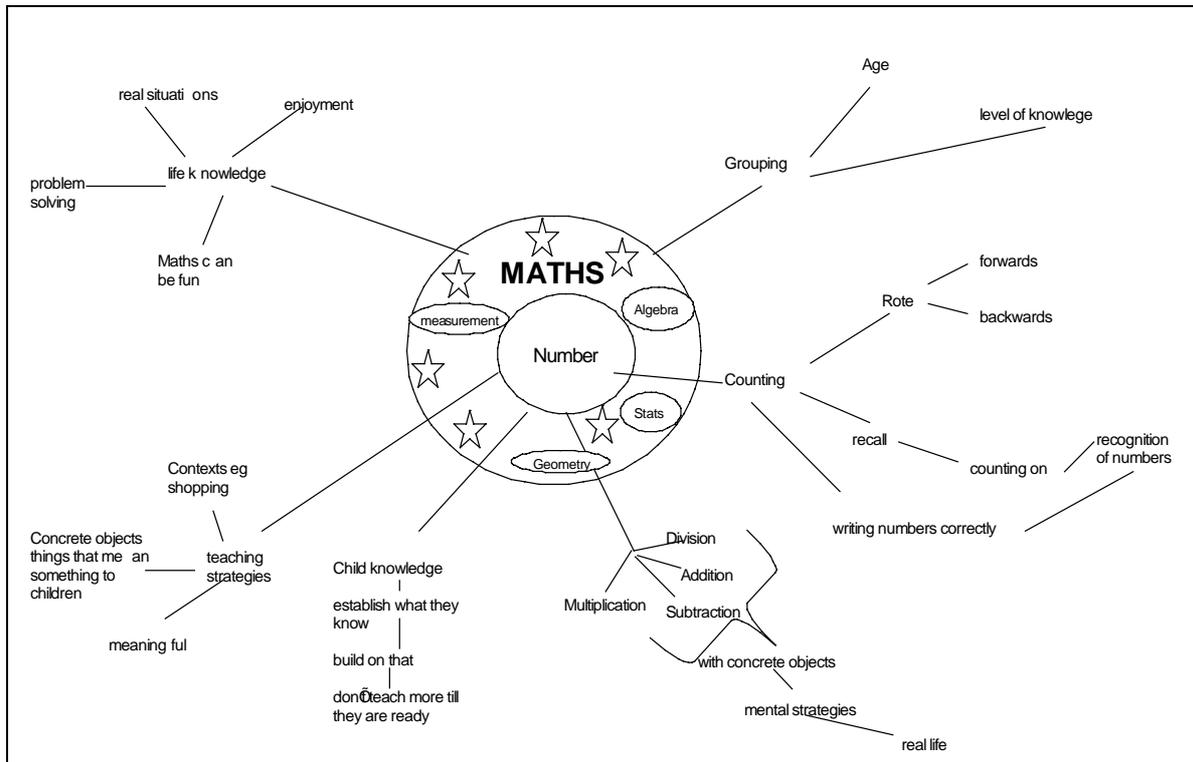
- Ten percent of the teacher respondents to the questionnaire noted that they now run more structured or organised maths sessions and two of the six amended concept maps identified grouping of students as an important aspect of the teachers' knowledge.
- Eighteen percent of the principals observed that their teachers had become more effective at assessing students' needs and two of the six amended concept maps highlighted assessment as an area of development.
- A greater focus on the strategies that students use to process numbers was identified by 29% of teachers in their questionnaire responses. Four of the six concept maps mentioned development of the students' thinking in some way, with three of these listing more than one aspect in this category.

- Concept mapping indicated some development in the variety of activities that the teachers present to students and indicated that activities were involving more problem solving. Responses to the teacher questionnaire indicated the same two points, with 14% of teachers noting the use of a greater variety of activities and 14% that they were involving the students in more problem-solving tasks.

The area where most development occurred was in the category of students' knowledge. Five of the six teachers amended their maps to include items in this category, with a total of 18 additions.

It is of note that all the case-study teachers had the categories of students' knowledge and students' thinking somewhat mixed in their maps. This can be clearly seen in Lynn's concept maps (Figure 5.1) where both of the two major points she has added into her diagram, labeled "numeral ID" and "strategies", are a mix of the mathematical knowledge that students need and the thinking strategies that students use.

Initial Map



Final Map

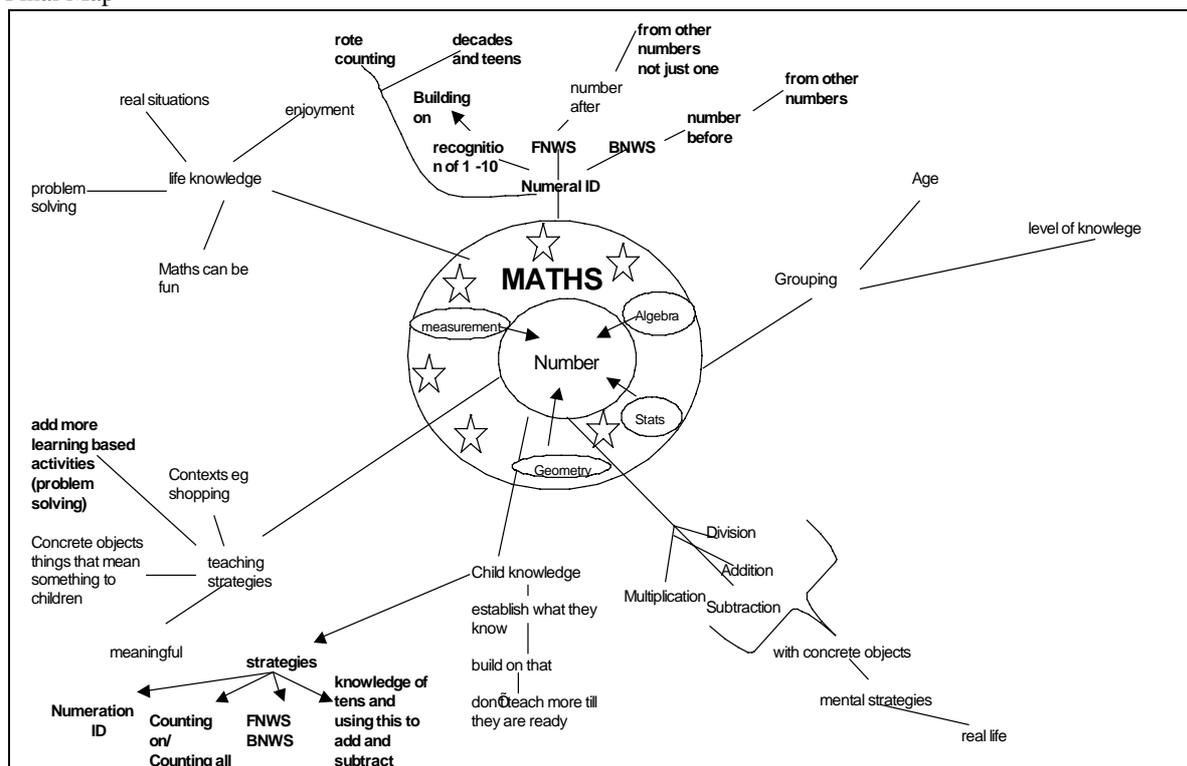


Figure 5.1: Lynn's Concept Maps.

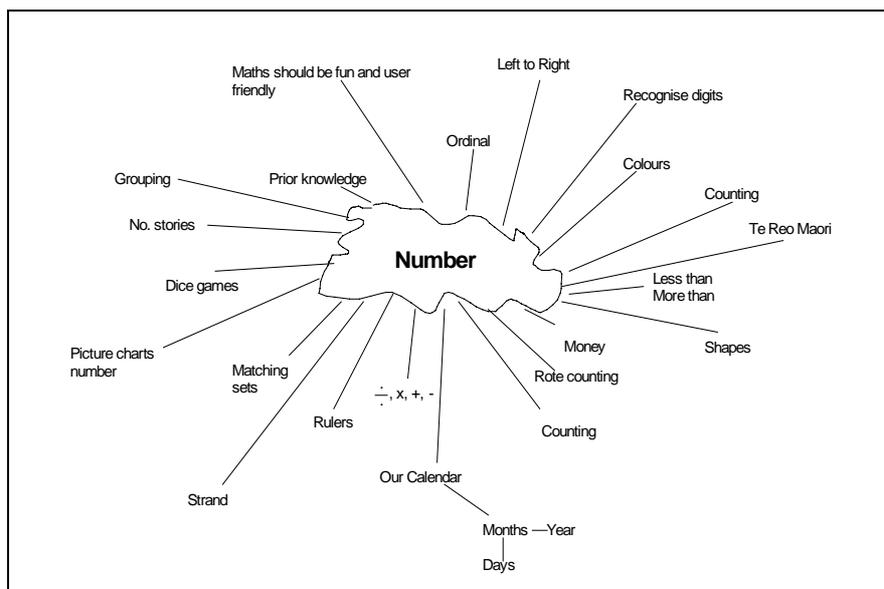
(Additions show a mix of students' thinking and students' knowledge.)

Similarly, the other amended maps show a mix in what the teachers regard as a student's knowledge and what they regard as a student's thinking. Those teachers who amended their maps all show some lack of clarity in regard to the differences between these two aspects.

The majority of the teachers who chose to amend their maps made only additions to their maps.

The map of Ana and Imogen is the exception, with the final map being considerably more complex than the initial. This pair not only added information to their map, they also moved existing information, re-grouped it, deleted information, and sub-categorised, adding further details to existing categories. In this respect, the development of their knowledge was similar to that of teachers who chose to redraw their maps, even though they chose only to amend. It is of note that the initial map of this pair was the most simple structure of all the initial maps, with no sub-categorisation (see Figure 5.2 on the next page).

Initial Map



Final Map

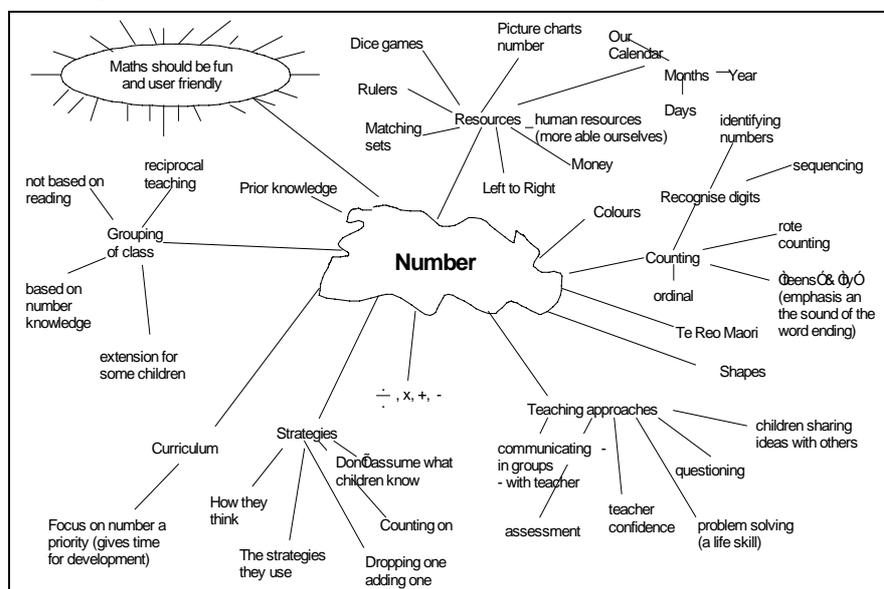


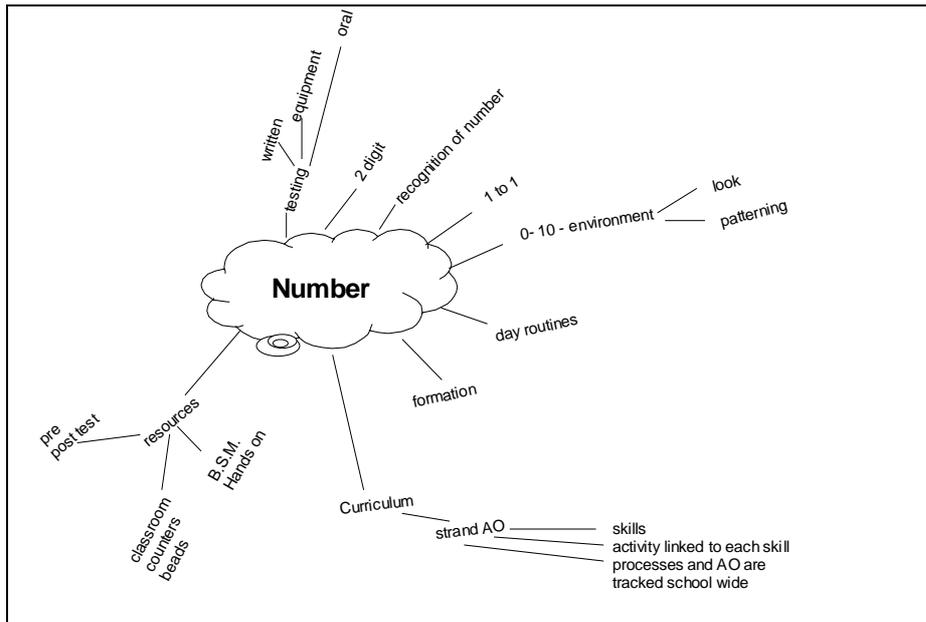
Figure 5.2: Ana and Imogen – Initial and Final Maps.
(The amended map shows increased complexity of structure.)

Redrawn Maps

Three teachers chose to redraw their maps completely. These teachers represent those who made the largest changes to their professional knowledge. Analysis of these maps, alongside the interview transcripts, shows that all the participants increased the organisation or the coherence of their overall professional knowledge. This trend of increased coherence will be discussed, then the trends in the three major categories of students' thinking, students' knowledge, and pedagogy will be identified.

One of the most notable developments in the redrawn concept maps is the apparently increased coherence and organisation of teacher knowledge. This change can be seen clearly by a comparison of the structures in the initial and final maps. Figure 5.3 illustrates the increase in both detail and organisation of Erin's knowledge.

Initial Map



Final Map

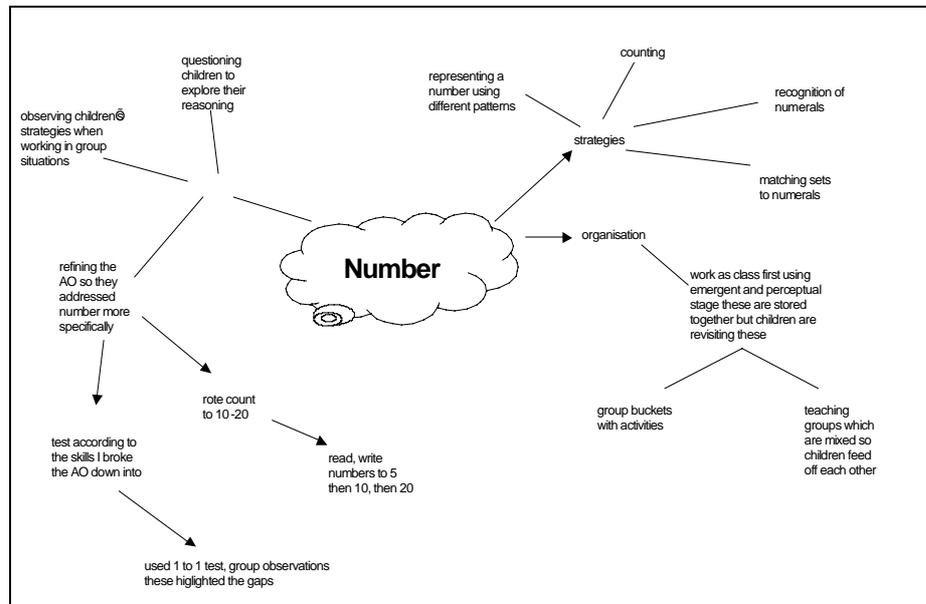


Figure 5.3: Erin – Initial and Final Maps (Increased organisation of knowledge.)

An increased hierarchy of knowledge was evident in the three redrawn maps. Pieces of information that were initially isolated now connect with other information, with categorising and sub-categorising occurring. All the redrawn maps exhibit these characteristics, with one of the teachers in the final interview noting that:

“Clearly it was hard to read, for a start, it was all over the place. There’s all sorts of ideas there. Even though I’ve got numeracy at the centre, [it doesn’t] really connect with the way I think now. It seems very patchy, it doesn’t have a *strong* framework Whereas now, I probably wouldn’t even consider some of those things.”

Students’ Thinking

Each of the three teachers who redraw their maps included substantial information on students’ thinking in their final map, with information being grouped together in a coherent way. This is in contrast to their initial maps in which Erin made no mention of students’ mental strategies and Tony listed some strategies, for example “counting aloud” and “marks on paper”.

Final Map

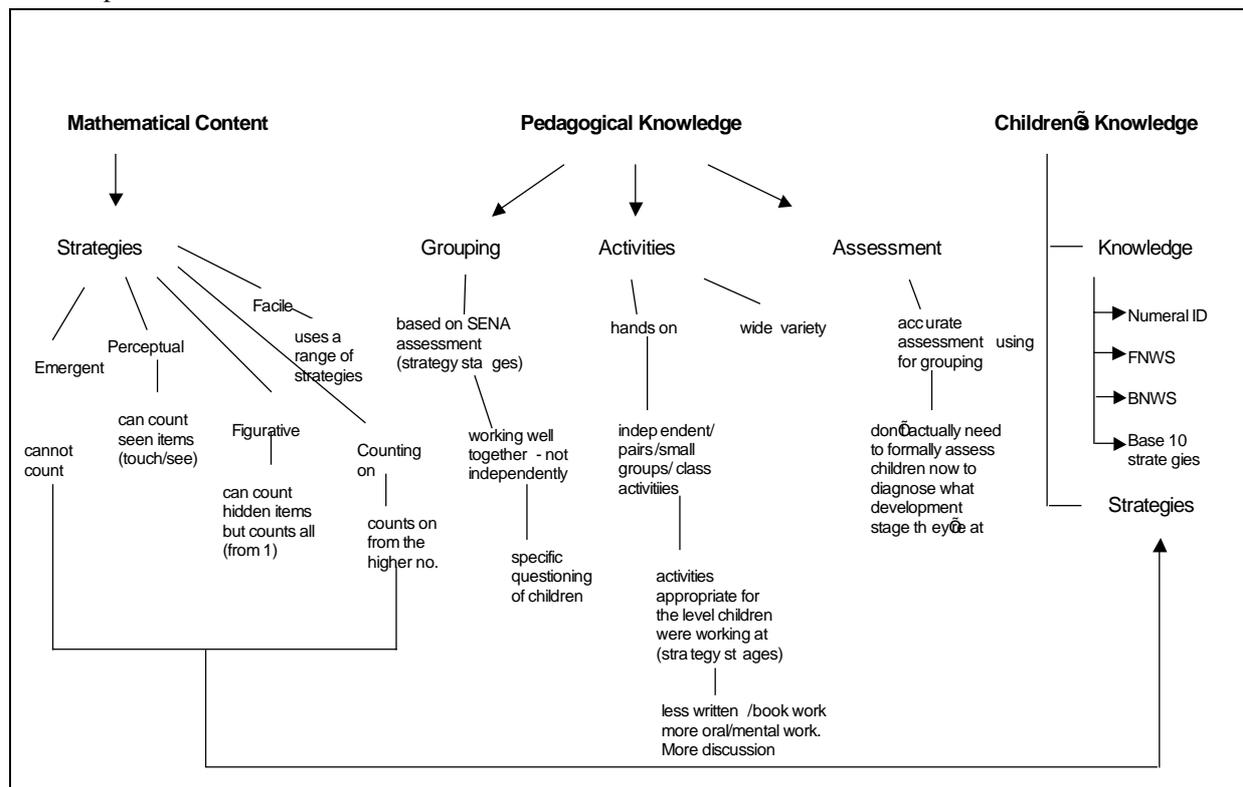


Figure 5.4: Andrea – Initial and Final Maps
(Development of knowledge of students' strategies.)

Interview transcripts show that this knowledge of students' strategies is the most important development for some participants:

Interviewer:

"All of your map has changed. Which do you think is the most significant piece of knowledge you now have, compared to what you had before?"

Erin:

"Being able to observe the strategies the students were using. That's the big thing – teaching the strategies. It's like reading recovery."

Erin goes further with her comparison of CMIT to reading recovery:

Interviewer:

"You talked confidently about reading recovery and your reading programme at the beginning of the year. Has this got strong links?"

Erin:

"Yes it has. Just being able to test the strategies and teach the strategies too. And ... it's like a running record, that test."

Erin is a trained and experienced reading recovery teacher with a strong knowledge of the reading recovery programme. She is also not the only respondent to draw comparisons between CMIT and reading recovery. It can be noted anecdotally that one of the facilitators, in responding to the questionnaire, made the observation that teachers were grouping students for maths in a manner similar to the grouping used for instructional reading in junior classrooms, with students moving freely between instructional groups as required. Several responses to the teacher questionnaire made similar observations.

Students' Knowledge

Questionnaire analysis showed that 31% of the facilitators believed that the teachers had increased their own skills with number. This belief is backed up by Tony in his final interview. He states:

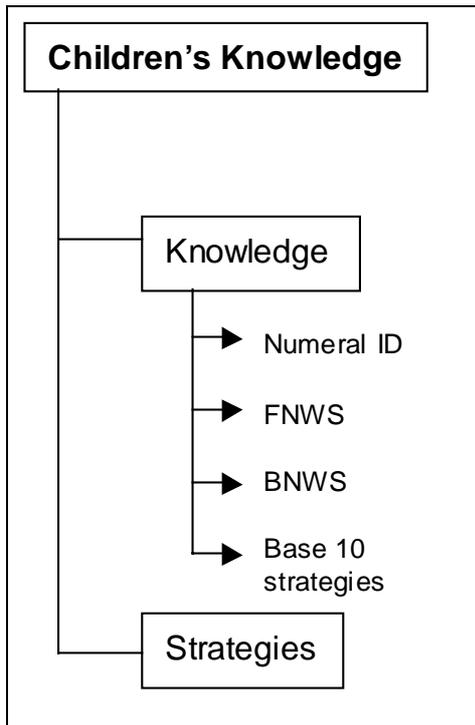
“... I liked teaching numbers at that level but my understanding is much better now and my ability [in] teaching numbers is much better than it was.”

This increased knowledge about number and, in particular, an increased understanding of the number concepts that students need to learn, are evident in all three redrawn concept maps.

Erin initially listed three isolated items relating to students' knowledge: recognition of number, 0–10, and 1 to 1. Her final map (Figure 5.3) shows an increased coherence with items relating to students' knowledge, which are listed under “refining the AO” (rote count to 10–20) and “strategies” (counting, both forward and back and recognition of numerals). She has increased the coherence of her knowledge and linked it to a greater degree.

Tony's initial diagram has no information regarding students' knowledge, while Andrea's shows a minimal amount. Andrea lists “students' knowledge” as a category, with “underlying mathematical concepts”, “how students learn”, and “what number experiences do students bring with them to school?” as sub categories. In sharp contrast are the students' knowledge components of Tony's and Andrea's final maps.

Andrea



Tony

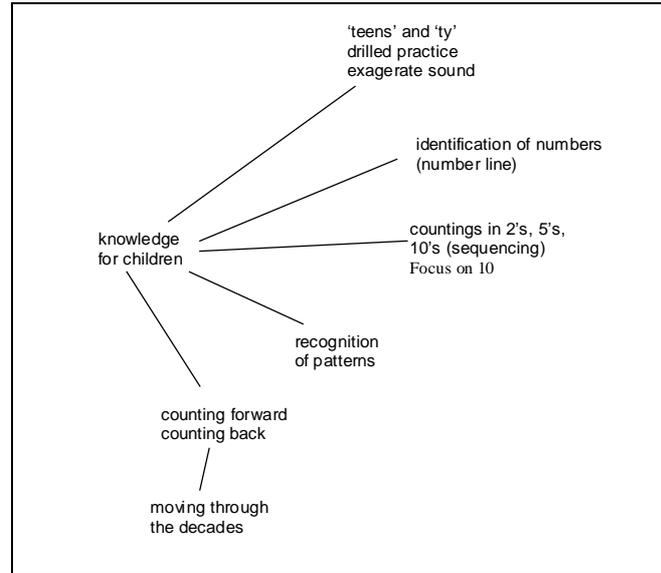


Figure 5.5: Andrea's and Tony's final maps (Components of students' knowledge.)

In their final maps, both Andrea and Tony clearly show students' knowledge as a major category, sub-categorised into four or five key pieces of knowledge. Andrea also links this knowledge to the thinking strategies that students use.

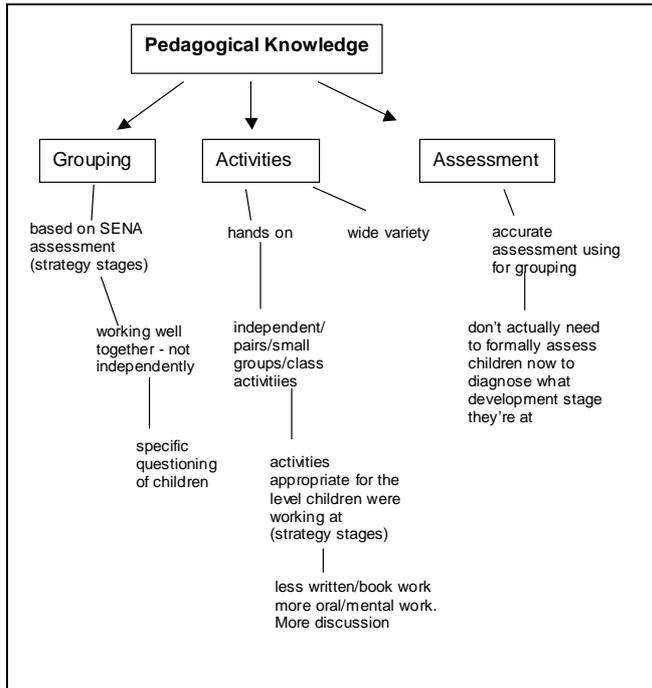
This increased focus on number knowledge is reflected in the interview transcripts. The teachers claim to be more aware of the importance of number and to see it as the basis for all mathematical learning. In her final interview Erin states:

“It was really interesting to see how number threaded through all the other strands ... It just blew me away how number ... filters right through and just to think what I'd been doing. Here I was getting students to tell me the time and they can't count. How can they tell me the time?”

Pedagogy

A wide variety of issues relating to classroom practice were identified by the concept mapping process. In general, pedagogical information became more detailed and better linked together in the final maps. This can be seen clearly in the work of both Tony and Andrea in which pedagogy is listed as a major category, with further sub-categorisation occurring.

Andrea



Tony

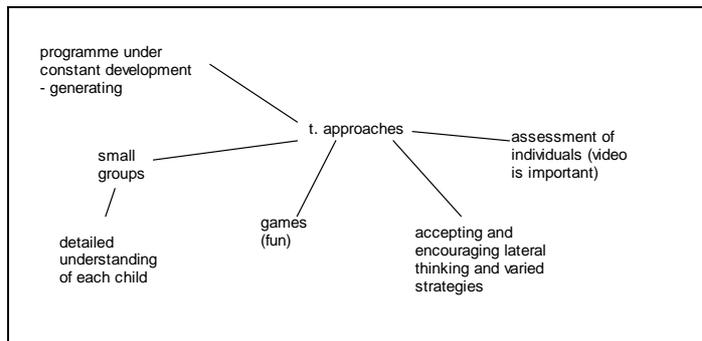


Figure 5.6: Erin’s and Tony’s final maps (Component of pedagogical knowledge.)

The pedagogical issues raised by concept mapping strongly correlate with those identified by teachers in responses to the questionnaire. Andrea’s final map has three sub-categories under pedagogy: grouping, activities, and assessment. In comparison to her initial diagram, both assessment and grouping are higher in her hierarchy of knowledge, representing the increased importance for her of these issues. In a broader comparison, 18% of the principals identified more effective assessment practices as one change in the teachers’ classroom practice and 10% of the teachers identified more effective grouping.

Andrea links these two elements of assessment and grouping in her final interview:

Interviewer:

“So you can diagnose a lot more clearly?”

Andrea:

“Yes. I think it’s really helped grouping-wise. It’s a lot easier to group after the first SENA. I think the assessment’s very accurate.”

Tony also placed increased importance on assessment in his second concept map. His first map does not include any details in this area, but his second clearly lists assessment as one of five key elements under teaching approaches.

Erin also shows an increased focus in grouping, with group work being mentioned twice under the major category, “my role”, in her second concept map, although there was no mention of grouping in her initial map. In her final interview, she indicated that the desire to focus on students’ thinking strategies led her to make this change to teaching in groups:

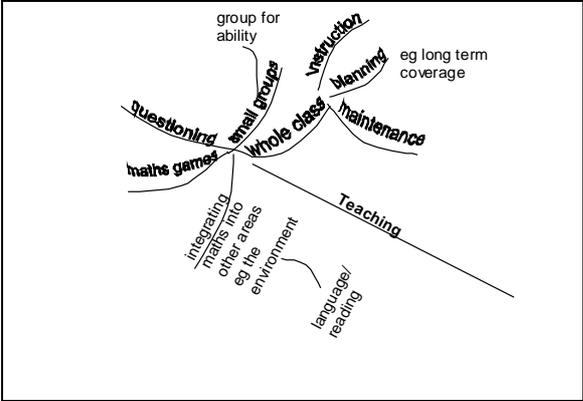
Interviewer:
“Why did you go back to using groups again?”

Erin:
“So I could focus more on the strategies that they were using within a group situation, whereas if you’re teaching as a whole class you can’t hone in on them.”

Erin’s second concept map highlights “organisation” as a major category, with sub categories indicated accordingly, although her initial map has no mention of lesson structure. This increased structure or organisation of maths sessions was also quoted in responses to the teacher questionnaire, in which 21% of the teachers indicated that they now use a more structured or organised approach.

An increased variety of activities was cited by 14% of the teachers as an important pedagogical change in their questionnaire responses. Andrea’s concept maps (Figure 5.7) also show this development clearly. She lists “wide variety” under “activities”, which is one of the three main categories of pedagogical knowledge in her second map. Her initial map lists different teaching approaches such as “questioning”, “small groups”, and “whole class”, but no information specific to activities.

Initial



Final

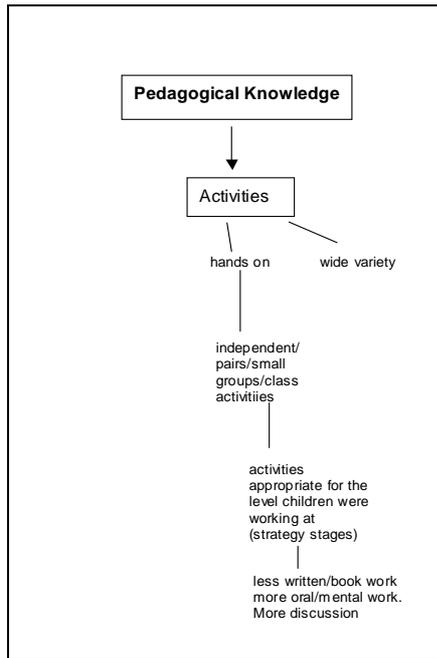


Figure 5.7: Andrea's Concept Maps
(Initial and final components relating to activity type.)

The nature of activities given to students is also commented on by Erin in her final interview. She claims:

“I’ve steered away from the old worksheets, they’ve gone.”

This corresponds with the teacher questionnaire results in which 14% of the teachers indicated that they use more hand-on activities, with students involved less in recording.

Concluding Comment

Both groups of teachers, those who amended their maps and those who chose to redraw them, showed developments in their knowledge of students' thinking, students' knowledge, and pedagogy. Some of the teachers showed a certain confusion over the differentiation between mathematical knowledge and the use of strategy. With those who made the greatest changes to their professional knowledge, that is, those who redrew their maps, the trend was to increase the coherence or organisation of their existing knowledge, as well as to extend and add to this knowledge base.