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CHAPTER THREE

Beginning the Lesson: The First Ten Minutes

INTRODUCTION

Beginnings are important. Beginnings may anticipate what is to come or connect with what has happened previously. The beginning of a lesson may serve to establish the authority of the teacher or devolve that authority to the students. The tasks may revisit skills already developed or invite students to explore new mathematical territory. The beginning of the lesson provides an opportunity to arouse the students' interest and facilitate their engagement, to situate and introduce the lesson's content, and to establish the subsequent work pattern for the lesson. Whether these opportunities are exploited and in what form will vary from classroom to classroom.

In this chapter, we examine the classroom practice of 'Beginning the Lesson' over sequences of ten lessons. We define this particular lesson event as having commenced the moment the teacher undertakes the first communicative act for the whole class and as encompassing the period from this moment followed by the next ten minutes. The choice of ten minutes was not an arbitrary one. The first ten minutes constituted between twenty and twenty-five percent of most of the lessons analysed. In most cases, it was a sufficient period to include at least one transition between activity types. The patterns of practice identified by our analyses did not all occupy exactly ten minutes; rather, they represent coherent sets of actions regularly and/or effectively used specifically for the beginning of a lesson. Each identified 'Iconic Sequence' (see the section titled 'Iconic Sequences' for more detail) had its own coherent purpose, and that purpose was fundamentally introductory. Even where the activity had the character of a review, it served a purpose closely connected to its location at the beginning of the lesson.

We have investigated in detail various classrooms in the USA, Australia, Japan, and Sweden in order to gain knowledge about the possible differences in function of this specific phase of the lesson. In carrying out this analysis, we devised a coding scheme that allows us to examine closely the activity characteristics, both observable and inferred, and the nature of student and teacher participation in the event. We identified verbal and non-verbal communicative acts and the differing number of activities realised within that time frame amongst the different classrooms. In some instances, the differences in function appeared not only when

comparison was made with other classrooms but also when made within the ten-lesson sequence of a single classroom. The practices of eight classrooms were analysed in detail for this chapter and specific elements were identified as recurrent features of Beginning the Lesson. An individual teacher's practice in beginning a lesson can be characterised by the idiosyncratic ways in which that teacher selects, combines and sequences these different elements.

It is not surprising that eight different teachers in different countries should begin their lessons differently. As competent, experienced professionals, several of the teachers we studied varied their lesson beginnings in ways that reflected the situation of the lesson in the topic sequence, and the focus and structure of the lesson as a whole. There were many appealing patterns that emerged from our analysis of lesson beginnings, but among the most interesting were the occasions when an element evident in one classroom could be identified in the practices of a classroom from a different country entirely. Things that might have seemed culturally-specific recurred in classrooms as culturally-distant as Melbourne (A1, A2, A3) and Sweden (SW1) or San Diego (US1, US2, US3) and Tokyo (J1).

One of the immediate challenges confronting us was the question of when the lesson actually began. In several cases, the lesson commenced without any explicit verbal instructions from the teacher. This suggested to us that the teachers had established a routine of practice in which the students were complicit. The lesson was defined as commencing from the teacher's first communicative act to the whole class, whether this was turning on a projector, writing on the board, or giving explicit verbal instructions to the class.

Some lessons appeared to have a diffused starting point: Students entered over a period of time, rather than as a group, the teacher welcomed students individually, the students took their seats and prepared for work, but the commencement of whole class activity was delayed by several minutes. In such cases, for the purpose of adequately including a full ten minutes of class activity in our analysis, we considered the lesson to have begun from the teacher's first communicative act clearly addressed to all students present.

The coding of activities provided the basis from which we were able to identify patterns that appeared either characteristic of the practices of particular classrooms, or indicative of the pedagogical orientation of different teachers, or which the data suggested were of sufficient interest and effectiveness to warrant reporting. In the remainder of this chapter, we first set out the 'Dominant Components' for Beginning the Lesson evident in the first ten minutes of the lessons analysed, and then identify particular Iconic Sequences composed by combining some of these Dominant Components. These Iconic Sequences represent alternative ways to begin a mathematics lesson. Some will be immediately familiar, others will appear quite novel. What must be remembered is that these lesson beginnings were identified from the classroom practices of competent teachers in quite different cultural settings. Our intention is to broaden the instructional repertoire of mathematics teachers internationally, while at the same time examining the pedagogical and epistemological principles on which the various lesson beginnings are predicated.

Activity conglomerates such as 'Warm-up' have the consistency of structure and social interaction that we have elsewhere identified as 'Patterns of Participation' (Clarke, 2004). Rather than report the minutiae of this detailed coding, we have chosen to report the crux of our analysis of Beginning the Lesson in terms of these activity conglomerates. For example, Warm-up itself is a specific instance of a broader category that we have called 'Review'. Review includes other patterns of participation in addition to Warm-up (such as 'Run-through'). It is at the level of these Patterns of Participation that we feel classroom practice is most readily understood. It was the teacher's purposeful initiation and deployment of such elements as Warm-up that most clearly revealed the structure and purpose of the various ways in which these competent and experienced teachers commenced their lessons.

POSSIBILITIES AND SEQUENCES: THE DOMINANT COMPONENTS FOR BEGINNING THE LESSON

We have chosen to present these emergent patterns of participation in terms of possibilities and sequences. That is, what possible choices are open to the teacher in deciding how to begin a lesson, and how might these alternative activities be sequenced? Figure 1 sets out these Patterns of Participation and indicates the most frequent or typical relationships between them.

Using Figure 1 as a navigational tool, the reader is encouraged to move freely among the self-sufficient Dominant Component descriptions in any order. The Dominant Components are seen as separate entities and just as a teacher would choose to combine them to form various sequences, given differing purposes of individual lessons, so too the reader may choose to examine the Dominant Component descriptions in any order. Following the descriptions of the Dominant Components for Beginning the Lesson, the main findings of our analysis are reported as Iconic Sequences of these components. It is in the crafting of these Iconic Sequences that we feel the expertise of the competent mathematics teachers is most visible and most readily related to the practices of other classrooms.

The 'Pre-Education' Component

Administrative activity. A good example of an Administrative Activity is roll-taking: the recording of student presence and absence. This activity occurred in every classroom we studied. Sometimes roll-taking was a dominant activity (for example, in A3 and J1). On other occasions, roll-taking was an administrative obligation that the teacher met unobtrusively while the class was engaged in some other dominant activity.

Organisational activity. Organisational Activity included the distribution of equipment, such as rulers, calculators, protractors and string. It also included the distribution of worksheets, textbooks, and student workbooks.

Figure 1. The dominant components for beginning the lesson

In Australian Classrooms 2 and 3, the distribution of equipment was frequent and time-consuming. In most other classrooms, such activities were less intrusive and less time-demanding. In US2, the responsibility for distribution of equipment was shared with the class by devolving that responsibility to the 'Table Leaders', who would individually collect the equipment required by their group. In US1, the job of returning corrected student tests was delegated by the teacher to a particular student, allowing the teacher to carry out other functions, such as calling the roll or writing tasks on the board.

Pastoral care activity. Pastoral Care Activity included such things as a whole class discussion about students' responsibilities, particularly as learners (A2), and the coordination of students' participation in an extracurricular activity (SW1).

The 'Review' Component

Coding this particular Dominant Component provided some unique challenges. Certainly the very first difficulty we faced was how to establish whether a mathematical activity was indeed 'review' or 'new'. Most teachers are familiar with the challenge of determining to what degree a mathematical concept or skill is familiar or unfamiliar to a cohort of students of various ability levels, and as researchers we faced similar difficulties. Indeed, whether the concept or skill has been presented previously may have little connection with the students' current understanding and recalled experience with the suggested mathematical activity. We therefore decided to classify the activity as Review if: i) the work was related to the topic content and there was evidence that the teacher had covered the work in previous lessons; ii) in the case when the work was unrelated to the topic content, the teacher's introduction suggested an expectation of student familiarity. Two broad categories of mathematical activity are found in the Review component:

Focusing or warm-up activity. Focusing Activities were intended to be silent periods of student work and usually lasted between 5 and 10 minutes. This activity appeared more often in American lessons, but was not unique to the US data set.

Three distinct types of Focusing Activities emerged:

- *Short answer questions unrelated to the topic content;*

It appeared that a teacher would assign between three and five short answer questions that were not directly related to the topic content, in order to provide students with the opportunity to practise basic skills (US1) or review previous work on other topics (US1, US2 and A2).

- *Short answer questions related to the topic content;*

Short answer questions, when related to the current topic content, were used to reinforce work from the previous lesson(s), and connect this work to the current topic under study (US1, US2, A1, A2, J1 and SW1).

- *Independent homework correction;*

The principal function of independent homework correction was to provide students with correct answers to their homework, so that the teacher could

ascertain which homework problems needed further attention, and to give students an additional opportunity to solve homework questions which appeared to have been incorrectly completed (see also 'Independent Correction', a sub-category of the 'Correction' Component).

The American classrooms appeared to favour some type of Focusing or Warm-up Activity and each of the American teachers was very consistent in the way they chose to begin their lessons.

Recap or run-through. A Recapitulation or Run-through was an educational activity designed to provide an opportunity for students to revisit previously covered skills or concepts. Unlike the Focusing or Warm-up Activity, these were not silent activities. Teachers made use of:

- Routine problems (A1, A2, A3, US1, US2, US3, SW1);
- Non-routine problems (J1, US3); and
- Homework questions (US1, A1, A3, J1, SW1).

Teachers were found to lead the consequent discussion, and sometimes recorded student responses at the:

- Board (A1, A2, A3, US1, US2, US3, J1, SW1); or
- Overhead projector (US3).

At other times, teachers (J1, US2 and US3) coordinated the student discussion and invited selected individual students to record the responses/suggestions at the:

- Board (e.g. US2);
- Overhead projector (e.g. US3); and
- Averkey (television monitor) (J1 only).

In fact, this 'Student At The Board' activity appeared to be quite a popular student task, and several students were observed to call out to their teacher to express their desire to participate.

When a homework problem was used in the Recap or Run-through discussion, the mathematical function of the activity was to highlight or clarify misunderstandings, as well as to document previous approaches to problems. This differs from the Dominant Component 'Correction' (discussed later), involving a homework problem, as in this situation the activity's primary function is to provide a correctly worked example, in order for students to compare their solution with the one offered in the whole class discussion. Invariably, some mathematical activity has more than one function. This situation is addressed in more detail in the section titled 'Iconic Sequences'.

The 'Instruction' Component

The Instruction Component refers to the phase, within the first ten minutes of a lesson, when an unfamiliar skill or concept was introduced to the class. Naively, one might think that the beginnings of many lessons would consist of the introduction of new, unfamiliar content. In fact, this particular Dominant Component did not commonly occur in the beginning of the lessons we analysed. Indeed, it was absent entirely from the first ten minutes of all lessons in one

particular classroom (US3). We found that in all the identified instances of such Instruction Components mathematical problems were posed to students. When this component did occur, the key element that distinguished one instance from another was the intended purpose of the activity. We distinguished four categories within this component:

Problem posing (structured reflection, to build definitions or theory or to make connections). In this category, the problems posed were in most cases familiar to students and, at first glance, this type of activity might appear to be one that best belongs to the Review Component. The critical difference was the teacher's intention; that is, to generalise and categorise the different mathematical situations and the possible approaches to such situations. We found that in all cases, where this activity appeared in the first ten minutes of the lesson, there was a high level of teacher orchestration of the discussion (US1, US2, A1, J1, SW1). Students provided vital verbal contributions and were encouraged to be active participants, but the discussion was highly teacher-led.

Problem posing (introducing skills or concepts). This category describes mathematical activity that involved unfamiliar but routine problems. In such cases, the teacher would present a routine problem and proceed to explain or discuss possible solutions, generally involving student contributions (US1, US2, A2, A3).

Problem posing (application to a simple context). In these situations, a non-routine problem was posed involving a real-world context (US2, SW1, J1). The task may have been an extension of a previous problem (US2), had an application to the sciences (SW1), or modelled a real-world situation (J1). In one Japanese lesson (J1-L04), the teacher introduced a challenging problem, involving a familiar context, to open her lesson. The students were invited to investigate "what changes?" in the act of folding origami paper:

Transcript 1: J1-L04

- T [Takes out origami paper] Well, this here, yes. Uhh, this paper, yes, umm I have enlarged this to make it easier for everybody to see.
- T Today class, the thing we are going to think about is actually about this size. Yes. And, this paper, which everybody calls origami, this paper, yes, you fold and look at, is origami, right.
- T Okay, well, this origami, today, we are, for example, going to decide where we are going to fold, like this, and we are going to fold, like this. [Folds the origami paper]
- T Right, okay, sometimes we do this, um yes, for example, we decide where to fold like this, yes, why don't we fold a little more.
- T Yes, we try folding this rectangular origami like this, yes, fold like this. Right. Yes, and today we will examine what happens when we fold the paper, like this.
- T Yes, well, okay, when we decide where to fold, and fold, like this, umm what changes?

Key to symbols used in transcripts in this chapter

...	A short pause of one second or less.
//	Marks the beginning of simultaneous/overlapping speech.
Ss	Indicates two or more students speaking simultaneously, saying the same words.
/	Indicates that one speaker cut in, interrupting another speaker before they had finished.
()	Indecipherable speech.
(text)	A plausible interpretation of speech that was difficult to decipher.
(text a/text b)	Alternative possible readings of speech that was difficult to decipher.
[text]	Comments and annotations, often descriptions of non-verbal action.
<i>text</i>	Italicised text indicates emphatic speech.
<u>text</u>	Underlined text indicates emphasis added by the author.
....	Indicates that a portion of the transcript has been omitted.

Problem posing (use of an elaborate context). In one Australian lesson (A2-L07), problems involving compass angle constructions were elaborately introduced with a detailed story and dramatic presentation (see Iconic Sequence Six).

The 'Student Practice' Component

Tutorial. One of the practices of the Swedish classroom involved devoting an entire lesson to student independent work: referred to as 'A group/half lesson' (SW1). Students were expected to work on assigned problems. Meanwhile, the classroom teacher roamed, offering assistance to individuals and small groups of students.

The 'Student Assessment' Component

One interesting consequence of an analysis involving sequences of ten lessons was the opportunity to document formal and informal assessment practices. The inclusion of formal testing in the data collection was a direct consequence of the decision to collect coherent sequences of ten or more lessons. Such sequences typically constituted the teaching of a single mathematical topic and some included the assessment of student achievement with regard to the content taught. Both the Third International Mathematics and Science Study (TIMSS) and Third International Mathematics and Science Study-Repeat (TIMSS-R) Video studies (Stigler & Hiebert, 1999; Hiebert et al., 2003) deliberately excluded such formal testing from their sampling of single lessons. The Learner's Perspective Study (LPS) Research Team adopted the position that such assessment was an integral part of classroom practice and should not be deliberately excluded, but rather documented and analysed wherever it occurred in the lesson sequences recorded.

Diagnostic purpose. In one of the US lessons (US1-L07), students were given a commercial diagnostic test (Algebridge) to complete during a full lesson. Inevitably, the first ten minutes involved some instruction regarding the administration of the test, followed by the commencement of test completion by the whole class.

Formal assessment purpose. Full lesson topic tests were administered in three of the LPS classrooms (US3, A3, SW1). In all cases, the beginning of the lesson involved some administration, organisation and instruction: for example, students were directed to seats, instructed to prepare for the administration of the test by rearranging desks, and given advice regarding time management. Individual assistance was offered to students in one of the Australian classrooms (discussed in detail in Chapter 4, this volume: Kikan-Shido).

The 'Correction' Component

Homework Correction has already been defined as one type of Review activity. This separate Correction Component could be distinguished from the Instruction and Review Components in two ways:

- It was always preceded by another Dominant Component (for example, Correction could only occur after students had been given an opportunity to solve a problem); and
- Its primary mathematical function was to provide a worked solution and/or correct answer for students to compare with their own. One teacher cycled from Review to Instruction and then Correction several times within the first ten minutes of the lesson (US2).

Whole class correction. The teacher, with varying levels of student involvement, provided a worked solution intended for the entire class. In addition, it was quite common for students to be invited to share solutions with the rest of the class. In a number of classes, students were invited to the board to record their solutions (US1, US2, J1). However, in one US classroom (US3), individual students not only wrote their solutions on the board, but were also required to explain their thinking to the rest of the class. In this classroom, students effectively took on the role of the teacher. Most times, this also involved answering questions from other students about their thought processes and mathematical reasoning.

Independent correction. In one of the American classrooms (US3), students would commence with homework correction from answers provided on the overhead projector. Any problems completed incorrectly were required to be undertaken again. We feel that this activity, completed by students independently, constitutes a separate category. It belongs to both the Review and Correction Components as it goes beyond the passive correction of homework, requiring students to determine whether the provided answers match their own and, if not, to generate appropriate, correct solutions.

ICONIC SEQUENCES

In deciding how to begin a lesson, a teacher may choose to combine the Dominant Components (listed previously) in a number of different ways to form various sequences. From our analysis of eight classrooms, particular sequences emerged as

important because of their frequent use, and because our analysis of student actions and statements recorded during class and student descriptions and explanations provided in post-lesson interviews, suggested that the particular sequence was either highly valued by students or the teacher, highly effective in promoting student learning, participation or engagement, or sufficiently prevalent to represent a type of lesson commencement that was in widespread use. In combination, the identified Iconic Sequences represent the most generalisable result of our analysis of lesson beginnings.

Sequence One: Familiarity Breeds Understanding

Figure 2. The Review-Correction Sequence

In the *Familiarity Breeds Understanding* sequence, the first ten minutes of the lesson begin with a Focusing Activity (Warm-up) involving short answer questions which is followed by Whole Class Correction of that activity. In terms of Dominant Components REVIEW is followed by CORRECTION.

This sequence was particularly prevalent in US classrooms 1 and 2. As students arrived to class, and took their seats, they prepared to work on short answer questions that were written up on the board, or on a pre-prepared transparency. In most cases, we found that the teachers took the opportunity to greet the students and direct their attention to the work. It became quite clear that a focusing activity was a common occurrence, as not only did five of the ten US1 lessons begin in this manner, but students would enquire "We're not doing our warm-up?" (US1-L02), if the activity were omitted.

One interesting aspect of this activity was the students' immediate engagement in the learning task; minimum teacher direction was required for students to begin working.

Transcript 2: US1-L01

T Okay guys let's go ahead and get started on today's warm up.

We found that while the students were engaged in silent, independent work, the US teachers would use this time to: mark the roll; distribute assignments, tests, worksheets and equipment.

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After a period of student work that ranged from a few minutes to over ten minutes, we found two common approaches to the Correction phase of this sequence. At times the teacher was found to lead the Correction phase:

Transcript 3: US1-L01

T Alright. Let's go ahead and try these. Take a look here. Alright number one. Just a little review of some of the things we were talking about last week

At other times the Correction phase involved student sharing of solutions:

Transcript 4: US2-L01

T Alright, let's see Um ...
 T Glenna and um, Letitia come up and show us number one, the two of you. You can collaborate on the answer there.
 T Um, the second one um, how about you Sandra, and um, Ashley. The two of you decide, put your verdict up there. Mm, number three, um, Derek and um, mm ... Carl.
 T Okay, four Keegan, how about uh, with Malcolm.
 T Wait just a minute. Uh, just a moment. Excuse me, no.
 T Okay, last one, who's willing to go? Who's willing to give it a try? Alright, David, you need a collaborator? Alright, you're on your own.
 T Okay. Who worked on this one? Okay, [chuckles] alright, ladies, ladies. Um, I equals P, P, I over P T equals R. Um, where did this come from? Why did you make that decision?

The activities themselves were generally standard problems that reinforced i) basic mathematical skills, such as problems involving 'order of operations' or ii) skill problems related to the classroom topic. They appeared to be designed for completion in under ten minutes. The *Familiarity Breeds Understanding* sequence also appeared in classrooms in Australia and Japan:

Transcript 5: A1-L09

T Open your exercise books. First question. Circle, draw a circle. [Draws a circle and labels it Q1]
 First question, find the circumference of this shape. Pardon? What's ten?
 T [to S1] Good boy.
 In your exercise books find the circumference of that shape on the board.
 [Draws a circle and labels it Q2]
 Question 2 is to find the length of this curved line, please. [Draws a semicircle and labels it Q3]
 Question 3 is to find the perimeter of this shape. [draws quarter circle and labels it Q4]
 T [to Iva] You're just finding the length of that curved line. Did you do Question 1? Good girl. And Question 2? Look at Question 1. You've got a full circle. And Question 2, really it's the same circle, isn't it, but we just want the distance of that curved line.

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Transcript 6: J1-L10

- T Um, as we have done so much work in the last class, I'm a little bit afraid that you have already forgotten some of them.
- S Yeah, I might have.
- T So, let's use this worksheet to check if/
- S /Wait, wait, wait, wait, wait.
- T Okay, um, let's start working on this worksheet today. [passes out the worksheets]

Transcript 7: A3-L07

- T Okay. Could you have a look and please ... Kevin, is there any reason why your books aren't open? ... Make it quick, please. Okay. First of all, if you remember from Friday. You probably don't. We were talking about doing some rounding off. Okay. Could you please put today's date. I'm going to put ten questions on the board. I want you to round these numbers off for me, please. To two decimal places.
- T If you are having problems seeing from where you are seated, then you need to move, because the board's in a strange position here. Okay.
- T So I would like you to round off these numbers, please, to two decimal places. [writing on board] Okay, two decimal places it is.
- T We did on Friday. [marking roll as she speaks]
- T Yeah. Rounding them off, so they have two decimal places. Have a look back in your notes from Friday if you can't remember. Remember, Nat? [continues marking roll]
- T While you're doing that, how many people are going out on sport tomorrow? Can you just put your hands up, please?

In all three examples, once the teacher had completed assigning the Review questions, they engaged in a Monitoring/Guiding practice, elsewhere identified as Kikan-Shido (see Chapter 4, this volume). The Japanese teacher invited her students to assist in the Correction phase of this sequence by drawing their solutions on the board, while the Australian teachers led the Correction phase themselves.

Sequence Two: Connected Instruction

Figure 3. The Review-Instruction Sequence

In the *Connected Instruction* sequence, the first ten minutes of the lesson begin with a Recap/Run-through involving either examples from the homework or similar problems, which is followed by an instructional sequence involving an unfamiliar problem. In terms of Dominant Components REVIEW is followed by INSTRUCTION.

In the *Connected Instruction* sequence the teacher typically revisits previous work with a worked example. The following excerpt illustrates the structure of this sequence in an Australian classroom (A3).

The Australian teacher began by reminding students how to convert a fraction to a percentage using a calculator:

Transcript 8: A3-L08

- T Okay, very quickly, I just quickly want to go over a couple of things first of all. The steps, when we're using a calculator. Shayne, watch please.
- T Okay, your calculator steps. Okay, if I have three and twenty and I want to make it into a percentage, Jason, how am I going to do that please? Yes. Yep, good.
- T Three over twenty times a hundred over one if you want to put the one there as a fraction. Okay, steps on the calculator then are what Shayne? Okay, so you need to watch carefully, don't you?
- T Nat, steps on the calculator Yep, three divided by twenty, multiplied by a hundred. And my answer will be a percentage. Do it quickly please on your calculators.

The teacher continued by communicating to her students her intention to address an unfamiliar problem, however, she needed to review certain conversion facts before introducing the unfamiliar problem:

Transcript 9: A3-L08

- T Okay, there are some things you need to know, you need to know some conversions. Arpad, put your pen down and watch up. First of all, some things that we need to know for this task. One kilometre.
- T Teo, tell me how many metres Good glad you knew that one. Very important. Okay, one thousand metres. Okay. A centimetre, okay, let's do a metre. A metre is how many millimetres. Oh good.

Once the students had been alerted to the skills with which they needed to be familiar and proficient, only then do we find the teacher addressed the unfamiliar problem:

Transcript 10: A3-L08

- T We want to make things into a percentage. We've got two amounts there. We've got six hundred metres and we've got two kilometres. Okay, how we go about making it into a percentage. Any suggestions?
- T Any ideas, any suggestions? Why do you say six hundred over three thousand Cam? Don't know. Damn good guess. I like it. Was it a guess? Good.

T It's a good guess. What did you do to this, Cam, tell me
Why did you do that? You did exactly what I wanted you to do. Any suggestions why?

After some discussion involving student responses, the class had arrived at an agreed upon approach for finding solutions to similar problems:

Transcript 11: A3-L08

T Imagine an athlete has completed eight hundred metres of a two-kilometre race
T Obviously, eight hundred metres is less than half of two kilometres, so an answer of forty thousand percent is ridiculous. Yay, I agree. The error in the above calculation was in mixing different units.
T Metres and kilometres. Two correct calculations are shown below, and they've got a correct calculation down below.
T It says at the very bottom paragraph, it is important when expressing one quantity as a percentage of another, to make sure that both quantities are based on the same units.

The teacher proceeded to assign similar problems for student independent work. *Connected Instruction*, in which focused review led into new content, was a distinctive and efficient means of beginning the lesson.

Sequence Three: From the Specific to the General

Figure 4. The Review-Correction-Instruction Sequence

In the *From the Specific to the General* sequence, the first ten minutes of the lesson begin with a Focusing Activity (Warm-up) involving short answer questions which is followed by student sharing of solutions and answers with the entire class. A similar problem is then posed to give students an opportunity to make connections and to encourage students to arrive at an alternative solution process. In terms of Dominant Components REVIEW is followed by CORRECTION and then INSTRUCTION.

This sequence was only evident in one American classroom (US2). This intriguing approach of correcting work, encouraging reflection on the worked solution, with an intention to make connections with other areas of mathematics, and increase the mathematical sophistication of the initial problem was felt to be a signature characteristic of this classroom.

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The following excerpts illustrate the *From the Specific to the General* sequence in US2, Lesson 5. The three questions below were assigned as Warm-up questions:

1. $\frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \frac{1}{16} =$
2. $\frac{1}{2} + \frac{3}{4} + \frac{7}{8} + \frac{15}{16} =$
3. $>$, $<$, or $=$ to zero?

a) $1 - \frac{127}{128}$ b) $1 - \frac{15}{16} - \frac{7}{8}$

Students completed these questions independently and mostly in silence. After five minutes the teacher began the Correction phase of this sequence, whilst encouraging students to share their solutions and explain their approach:

Transcript 12: US2-L05

T Alright let's take a look. Um. How about the first one? Let's see, um ... Jong.
J ()
T How many people agree with Jong?
Ss [Several students raise hands.]
C What did she say?
T //Fifteen over sixteen, fifteen-sixteenths.
Ss //Fifteen over sixteen.
T Alright. Um, [T writes on board].

The teacher carefully worded her remarks to encourage student reflection:

Transcript 13: US2-L05

T You know what? Somebody in period one actually said that the answer was one. Um. That's not true of course. You've told me fifteen-sixteenths, but, um
T I'm wondering if somebody can think of a fast way, really fast, efficient way, to do that addition. And to convince that, that person that it wasn't one. I think that person just was lazy, maybe. Um, thought it was one.
C [C raises hand]
T But I can come up with this answer really fast.
C It's not exactly fast, but to make sure all the denominators are the same and then multiply the numerators by get it.

The teacher sought a second student response:

Transcript 14: US2-L05

T Let's hear Abbie's comment.
A I would find out the answer by, one-half plus one-fourth equals one-third, er, three-fourths. Sorry.
A And, one-eighth is even less than a fourth, and one-sixteenth is less than an eighth, so it can never add up to one.
T Okay. Okay.
C Ohhh.
T There's always a little missing piece.

The teacher sought a further response:

Transcript 15: US2-L05

- S Well, this problem is really easy though because-
- S One half is a, um, like the next ... one half of the half of that is one fourth and half of that is, is, one eighth and half of that is one sixteenth.
- S So all I do is cut the number in half and return, because I put eight if cut it in half record it after the four, plus two, plus, so that's just my logic

At this point the teacher felt she should share her own reflection with the class:

Transcript 16: US2-L05

- T Okay. There is- there is something something to do with halving here, isn't there?
- T Now, notice something about this.
- T How far is fifteen-sixteenths from one?

She then posed a similar problem to the one just discussed, to encourage students to find a pattern that would assist them to determine an alternative solution approach:

Transcript 17: US2-L05

- T Let's try this one. [writes on the board: $\frac{1}{2} + \frac{1}{4} + \frac{1}{8} =$]
- T What's the common denominator there?
- T How many eighths is this [points to board]?
- T Four-eighths. One-half is four-eighths [writes on board]. One-fourth?
- T Okay. One-eighth [writing on board]?
- T [Writes on board] What's the numerator? What's the-
- T Sum of the numerators there?
- T How far is it away from one?
- T [Teacher points to board.]
- Ss [Quietly] Ooh.

Of interest is her decision to not articulate beyond the following:

Transcript 18: US2-L05

- T Say something to you? Think about it. Okay.

After this excerpt she continued to correct the rest of the Warm-up questions. We see in this example the craft of the teacher in deciding when to elicit the students' thoughts and methods and when to contribute her own thoughts. Both actions are undertaken with the goal of assisting the students in constructing progressively more sophisticated mathematics. As has been discussed elsewhere, a major component of a teacher's skill lies in the balance she constructs between eliciting and initiating (Lobato, Clarke, & Ellis, 2005) or between monitoring and guiding (Clarke, 2005, and Chapter 4, this volume). *From the Specific to the General* illustrates this skilful practice beautifully.

Sequence Four: Student-Led Corrected Review

In the *Student-Led Corrected Review* sequence, the first ten minutes of the lesson begin with a Focusing Activity (Warm-up) involving Independent Homework Correction, an activity that belongs to both the Review and Correction Components. This is followed by Whole Class Correction of particular homework questions. In terms of Dominant Components REVIEW/CORRECTION is followed by CORRECTION.

Figure 5. The Review/Correction-Correction Sequence

This sequence began nine out of ten lessons of the US3 classroom data set. While the students were involved in the Warm-up activity the teacher performed several administrative and organisational duties, such as marking the roll and recording completion of homework.

In contrast to the other Warm-up activities, those involving short-answer questions, the students in this classroom arrived to class with attempted homework questions. They were then given the opportunity to 'grade' their work. At first glance, this appeared an opportunity for students to mark their questions correct or incorrect, however, the student discussions at their group tables offered a valuable insight into their thinking during this phase of the lesson:

Transcript 19: US3-L03

- J I got one-o-four A wrong. Hey I got one-o-four B wrong too.
- C I don't know why I got one B- I don't () I got B wrong on that one.

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- J Oh, I know why I got it wrong. I made it in a negative slope.
 Oops.
 Ta Did you get one-o-two right?
 T Who's still grading their homework?
 J Yes. Thirty? Yes I did. No, wait, yes I did. Very simple answer
 for such a big problem.
 Ta Hey, stop, it was not.
 J Simple answer, the answer was thirty.
 M What problem?
 J One-o-two
 Ta Hey, no, why are you showing everybody?
 M Hey, I got it right. I'm serious. (). Thirty (). I got it
 right.
 J Wow, Mark got something right? I'm surprised.
 M That one was easy though, all you had to do was set the ratio.
 J Oh you had- did you draw the diagram?
 M What diagram?
 J It said draw a diagram.

It appears that students were not only determining whether their answers were 'correct' but also 'making correct' those that were incorrectly completed. In the above example, Tanya appears to benefit from the conversation about question one-o-two. Her exclamation regarding Judy's perceived simplicity of the problem in question reflects her own difficulty in solving the problem. This act of 'Listening-in' is further discussed in detail in Williams (2006).

Independent Homework Correction was then followed by a phase of Whole Class Correction. Typically in this classroom, this was student-led:

Transcript 20: US3-L02

- T Who's still grading their homework?
 T Okay. Okay, everybody finished grading? Okay, any questions? Any questions? Oh, Yolanda.
 S Number eighty nine.
 T Oh, I forgot to turn this in. Shh. Rachel, were you the original author over here? Come on up.
 R Okay, the equation is ... yeah. Eight.
 R Like you have to do the A squared plus B squared is equal to C squared.
 T You wanna write that at the top?
 R (). Who's my audience? ()?
 T Yolanda, and- and Serina.
 S Serina's over there.
 T Yolanda's over there, Carter is right here.
 R Anyway, the eventual- the equation is um, I wouldn't- I don't know how to say that. Like eight root two, or eight squared or-
 T Eight times the square root of two, or eight root two.
 R Plus X squared. Um, equals nine root three squared. Um, so then you find this and it's most- like Kerri, her thing was is that she did two, um-
 T Well just show- show us how to do it right, first. Bef- so we don't get confused.
 R Um, you go two- like the square root of two times eight, which is like eleven point something, and then you square that. And that's one twenty eight. Plus X squared. Equals two forty three.

- R And then, you subtract one twenty eight from both sides ... and have X squared equals one fifteen. And then you square root it all, you get X equals ten point seven.
 C Sweet.
 T Good job.
 S Um, see the- isn't it because eight root two is a one number, right?
 S You're supposed to put parentheses around the eight times the square root of two. And then you square it. That means you're squaring the whole thing.

This teacher was most encouraging of her students and she stated during the post-lesson interview that her intention was to give everyone the opportunity to publicly explain a solution, that is, effectively, to take on the role of teacher at some point in the term.

Transcript 21: US3-Teacher Interview 1

- I You often have students come up to the board to share their answers. How did you- how do you decide which students to go up and sort of why do you- why do you do that? Instead of you know, maybe you doing it?
 T I used to do it in the beginning of the year, I do it all the time, it's always me. And then as I sensed their level of confidence in competence, then I'll say "well who got this right that would like to come up here?" I used to give them extra credit if they did it to encourage them, you know five little points added to their homework percentage or something. And they love that, they- I think they like to play teacher or something, and they like to show the other kids that they can do it. Um, and you know, they love it when they get it. How do I choose who goes up there? I try and pick everybody um, that wants to, there's a lot that never have and just try and see who hasn't had a turn. There'll be some kids that would go up there every single day if you let 'em.
 T but I make them explain, talk and direct their explanation to the person that was asking, not just write it and then go sit down. So I feel they do just as good a job as I do. But if it's really, really long, hard and confusing you know, I- I do it too.

This sequence appears to encourage student reflection, as time is intentionally allocated so that students may 'correct' their homework and 'make correct' those that are incorrect. Students are encouraged to learn from each other; from those that are in their 'study teams' and from those peers who participate in the public sharing and explaining of selected examples. *Student-Led Corrected Review* appears to be a sophisticated and effective method of Beginning the Lesson.

Sequence Five: Pastoral Care *Figure 6. The Pre-Education Sequence*

The *Pastoral Care* sequence highlights the teacher's role as encompassing duties beyond simply mathematics instruction. In the examples provided below, the entire first ten minutes of these lessons was devoted to activities that: i) assist students to become more responsible for their learning; and ii) involve coordinating students' participation in an extracurricular activity. While every teacher displayed some acceptance of pastoral care responsibility, in these two specific examples this activity dominated the beginning of the lesson.

In the Australian example below (A2), the teacher devoted the first ten minutes to giving students advice about their responsibility as students. The context of the discussion involved the punctual submission of a homework piece:

Transcript 22: A2-L09/10

- T [to all] Okay I have a few things I want to talk about before I get down to what's, what we're doing today. I know that ah, you didn't get very far with what we did last time and I'm going to spend a fair bit of time on that, as well. So don't panic about that, and yes I have your books to return. Alright, but, to get you guys thinking and joining the words Leah
- responsibility.
- T There are some things that you can control, some things that you can't control. And that's what responsibility is about. You can control things that you are responsible for. You can control your own actions. And some of us are slipping in the controlling of our own actions.
- T And I say in terms of not getting homework done, in terms of trying to find other excuses for not getting things done, or not getting our work done in class or so forth.
- T Alright. Responsibility has got a big I in it because I have to be responsible for myself. In a big way. It's got three big I's in it. To remind me three times that I have to be responsible for myself.
- T And again I'll say it, I'm not saying it because I'm wanting to have a go at people about what they've done, I'm trying to give you tactics to move on from here. We took ages to get that last homework piece done. I'm about to give you the next homework piece which will be due in a week. It should not take some people three weeks before they can get there. If you do not have the book then you ensure, you are responsible to ensure that either you have the book or you see me about getting a copy. Before it is due in. If you forgot it at home, if you did it early or something like that you make sure you are responsible for getting it in. It's the I there.

■ BEGINNING THE LESSON: THE FIRST TEN MINUTES

T So this next homework will be in next Monday.

This teacher interpreted his role as extending beyond the teaching of mathematics only, to include the encouraging of particular work patterns and personal attributes. At heart, is the desire for his students to do well; this involves making students responsible, encouraging them to take control of their own learning and to see the role they play in their own education. The selective and purposeful devolution of responsibility from the teacher to the students is a phenomenon documented in the practices of many of the competent teachers in this study.

In Lesson 14 of the Swedish classroom, the teacher devoted the beginning of the lesson of his mathematics class to coordinating student participation in an extracurricular activity. We have included it as an example of Pastoral Care as it is clear that the teacher values his students' participation in whole-school activities not just classroom activities. He appears to acknowledge that his role is broader than and extends beyond the challenges that belong to the mathematics classroom.

Transcript 23: SW1-L14

- T er my voice isn't what it should be today so let's start with () games and you Agneta spoke with you yeah little bit yesterday right?
- S yes [to T]
- T about it
- S she wrote (loads of stuff) up on the board [to T]
- T exactly, er, but we're going to hand in, er, I thought we'd start with
- V sack race //the canoe race
- M //() Viktoria it went well last year
- F (hope) ()
- T /wait the canoe race. Is there anyone who wants to row? We've got yeah whole load then let's see then so there are two girls who want to row so that's two down
- T shh shh last year it was Miraz and Faro wasn't it
- F yes
- T and who else of the guys was it who wanted to do it Johan and Hannes
- T then it's them it's them it's Johan and Hannes who are doing it (them/today)
- (J) yeah we won
- Ss [talking]
- T four yes it's got to be four
- T good er then we have the class relay
- T well it's what they usually en shh it's what we usually end er the whole day with it's that's it it was there that's where we were good so I hoping for yeah profit there this year

Sequence Six: Elaborate Problem Posing

Figure 7. The Elaborate Problem Posing Sequence

The *Elaborate Problem Posing* sequence provides an example of a detailed story delivered dramatically by the classroom teacher. In the Australian example below (A2), the teacher devotes the first ten minutes to telling a fictional story about *Captain Compass*:

Transcript 24: A2-L07

- T May the twenty-fourth is Captain Compass day, and it's a bit of a fluke that we happen to be doing things involving the compass today on Captain Compass day.
- T You go check it up in your, it's a little print in your calendar, Maurice, stick with me. Course, as a student I assume you've all heard of Captain Compass.

His story-telling involved a dramatic, costumed presentation:

Transcript 25: A2-L07

- T See, that's why we've got the hat. To celebrate Captain Compass day. Captain Compass was famous. He was from the Andorra Navy. That's why we've got this tub here today that's from the Andorra Navy. It's an old relic from the twelfth century when Captain Compass was involved in the siege of Andorra. And there he was, see, Captain Compass was very smart. He was what we call a tactician. In fact, he was better than a tactician, he was a mathetactician. Which means he was a tactician that was good at maths.
- T
- T A tactician's someone who's been good at plans and things, and . . . you know, he stood there . . . Captain Compass stood there. He was on the big walls of the city of Andorra. We had walls all 'round it.
- T
- T City of Andorra was surrounded, by the enemy, who were the um, probably the () so that they reached all the way out to Andorra. They were surrounded up there, he was standing on the walls, they had been under siege,
- T () which meant no one on the inside of the city could actually get any food or things in, or things out () and they were going nuts because they had squeaky wheels and things, and Captain Compass had to work out a way of getting everybody out.

- T And as I said he was a mathematician, he wasn't just a, a tactician. And Captain Compass had this one wooden leg, which was very handy.
[rotates on one leg]
- T And he could draw circles. Which is probably where he got his name, Captain Compass. Or maybe that's where the word compass comes from, the compass. And he stood there and he could draw circles. But he was cleverer than that, 'cause he knew he needed to do more than just draw circles.
- T
- T Um, he had to come up with a whole new tactic, a whole new angle, and he came up with ways of getting the compass to draw us more angles.
- T And that's what we're going to look at. So what you are going to need to do. What you need to do firstly is get out a piece of paper, and I'll get you out the rest.

This commencement to the lesson was followed by activities involving the construction of angles with the exclusive use of compasses, pencil and paper.

The use of elaborate contexts to frame lesson content has been advocated in curricular materials in Australia for many years. For example, the Mathematics Curriculum and Teaching Program (Lovitt & Clarke, 1988) used the term 'Storyshells' to describe such framing contexts. The justification for the instructional use of such contexts takes several forms:

- Motivational – students are interested in the story/context framing the mathematics.
- Cognitive – the context provides a form of scaffold to assist the student in understanding and internalising the mathematics embodied in the context.
- Utilitarian – the use of 'real-world' contexts in particular is often justified on the grounds that a student's subsequent use of a particular mathematical concept or skill will depend upon their capacity to recognise its relevance in a variety of contexts.

One teacher's use of such Storyshells will differ from that of another teacher according to the connectedness of the context to the mathematics that is the intended focus of the lesson. In the example provided above, the elaborate and amusing storyshell appeared to engage students' attention, but the context itself provided little justification for the relevance and/or utility of the lesson's particular mathematical skills and concepts. If the function of the context is only motivational, then some of the potential power of contextualised mathematics may be lost. Nonetheless, the use of such elaborated contexts represents a distinctive and potentially powerful approach to Beginning the Lesson.

CONCLUSIONS

Our focus in this chapter has been the question: What possible choices are open to the teacher in deciding how to begin a lesson, and how might these options be sequenced? By examining the practices of eight competent teachers in Australia, the USA, Sweden and Japan, it has been possible to identify particular Dominant Components (see Figure 1) from which these teachers crafted the effective

commencement of their lessons. However, it is in the crafting of what we have called Iconic Sequences that we feel the expertise of the competent mathematics teachers is most visible and most readily related to the practices of other classrooms.

The documentation of pattern and structure in the practices of competent teachers has its own practical legitimacy and value, but the “wisdom of practice” (Shulman, 1987) embodied in such sequences also has significance for our theorising about learning and instruction. Each sequence of activities with which a lesson is commenced presumes particular attributes in the learner and in the way the learner’s interaction with the content might most usefully be orchestrated. The teacher’s selection of a particular sequence to commence a lesson is indicative of several key elements synthesised in the practices of well-taught mathematics classrooms:

- The relative emphasis the teacher accords to the cognitive and affective stimulation of the students at the commencement of the lesson (e.g., Sequence Five);
- The situation of the particular lesson within the topic and curricular sequence and the nature of the connections (in both directions), which the teachers feel obligated to promote (e.g., Sequence Two);
- The significance accorded by the teacher to such instructional strategies as repetition (e.g., Sequence One), challenge, or the elaborate contextualising of content (e.g., Sequence Six) (at that time, for that topic, and for those students);
- The relative emphasis the teacher accords to specific or general mathematical formulations, the relationship between them, and the optimal development of that relationship (e.g., Sequence Three);
- The teacher’s devolution of responsibility to the students for such activities as ‘correcting their work’ (e.g., Sequence Four).

The decisions regarding the use of each of these Sequences is dependent on the instructional-learning situation as the teacher perceives it at that time, for that content and that class.

Some teachers were highly consistent in the way in which they began their mathematics lessons. Some teachers appeared to be more selective and vary their deployment of particular Components and/or particular Sequences from one lesson to the next. This diversity or consistency could be seen in the initial coding of Components. For example, the American teachers all made use of Warm-Up, almost to the exclusion of any other strategy for beginning a lesson. By contrast, AI and J1 varied the structuring of the lesson’s commencement as a consequence of their perception of the needs of the class and the demands of the content.

A recurrent theme of this book is that teaching competence takes many forms. This chapter sets out some of the alternative ways that good teachers commence their lessons. Our analysis has not suggested that any particular approach should be valued over any other. All of the reported Iconic Sequences catered for particular student needs and met particular instructional goals. Teachers of mathematics would do well to consider adding some of these strategies to their instructional repertoire.

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