Stimulating Reflection on Practice: Using the Supportive Classroom Reflection Process

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Although much is known about the features that contribute to the effectiveness of professional learning activities these are often not incorporated into the design of professional learning initiatives. This paper describes a mathematics professional learning process that was carefully designed to incorporate such principles, and illustrates its implementation by describing the case of one primary school teacher who participated in it. The potential wider applicability of the process and broader implications for professional learning are presented.

According to the Ministerial Council on Employment, Education, Training and Youth Affairs (MCEETYA) Report on the teaching workforce of the future (Mayer, 2003), teachers' work is becoming increasingly complex. Being a teacher in the 21st Century requires ongoing professional learning in the form of further study, participation in professional development programs and engagement in professional school-based learning communities. This paper provides a description of the implementation of a professional learning process in which reflection was central. Unlike other studies reported in the literature that have had a similar focus on encouraging reflection (e.g., Day, 1998), this paper provides a detailed account of particular strategies used to stimulate reflection and discusses their relative effectiveness.

Background

Professional Learning

The term 'professional learning' as used in this paper includes, but is not limited to, the processes referred to in the literature as professional development, staff development, teacher development or inservice education. This can include on-site or at school learning or may occur off-site, such as by attendance at conferences, workshops, on-line training and modular programs over a period of time or network activities (Rogers, 2007). The emphasis on professional learning in mathematics education is driven by recognition of the importance of focusing on the teacher as a means of improving students' numeracy (Askew, Brown, Rhodes, Johnson & Wiliam, 1997; Australian Association of Mathematics Teachers (AAMT), 2002; Clarke & Clarke, 2002; National Council of Teachers of Mathematics (NCTM), 2000). For example, Askew et al. (1997) found that:

> Highly effective teachers were much more likely than other teachers to have undertaken mathematics-specific continuing professional development over an extended period, and generally perceived this to be a significant factor in their development. (p. 5)

The AAMT's (2002) Professional Standards also emphasised the importance of professional learning, stating that, "Excellent teachers of mathematics are committed to the continual improvement of their teaching practice and take opportunities for personal professional development" (p. 3). While the nature of this professional learning is not described by Askew et al. (1997), AAMT (2002) or Mayer (2003), the use of the phrases 'extended period' and 'committed to the continual improvement of their teaching practice' imply that professional development does not mean one-off attendances at workshops and conferences. Nevertheless, this has been characteristic of many professional learning opportunities offered to teachers in the past, including in the Tasmanian context where this study was conducted. Participation in 'one-off' sessions rarely contributes to sustained changes in pedagogical practice with the participants often reporting that their knowledge of subject matter or teaching practice did not need to change (D'Ambrosio, Harkness, & Boone, 2004). Sessions such as these are also often under-resourced, brief, designed for "one size fits all", leaving participants more cynical and no more knowledgeable, skilled or committed than before (Miles, 1996, p. vii).

Principles of Effective Professional Learning

A comprehensive literature review resulted in the first author devising a set of principles which were incorporated into the design of the professional learning model described in this paper. These principles will now be briefly outlined.

1. Professional learning is more likely to be effective if it addresses teachers' pre-existing knowledge and beliefs about teaching, learning, learners and subject matter

Addressing teachers' pre-existing knowledge and beliefs about teaching, learning, learners, and subject matter contributes to successful learning opportunities for teachers (D'Ambrosio et al., 2004). Bringing about changes in what happens in mathematics classrooms depends upon individual teachers changing their approaches to teaching; approaches which, according to Thompson (1992), are influenced by teachers' conceptions. Guskey (1995) argues that significant changes in teachers' attitudes and beliefs occur primarily after they have gained evidence of improvements in student learning. These improvements can result from changes teachers have made in their practices and teachers are then more likely to believe it works because they have seen it work (Guskey, 1995). Successful actions are reinforcing and likely to be repeated, whereas those that are unsuccessful tend to be diminished (Guskey, 1995). Beswick (in press) found, for example, that a professional learning program which addressed both teachers' beliefs and practice had some success in influencing the academic expectations of teachers in relation to students with mathematical learning difficulties.

2. Professional learning is more likely to be effective if it provides teachers with sustained opportunities to deepen and expand their content and pedagogical knowledge

Many primary school teachers express considerable lack of confidence in their own knowledge and understanding of mathematics (Stephens, 2000) so it seems sensible that professional learning for teachers should provide

opportunities for a deeper understanding and expansion of content knowledge. In a review of studies that looked at the effects of professional learning on improvements in student outcomes, Kennedy (1998, cited in Meiers & Ingvarson, 2005) found that the most successful professional learning programs engaged teachers in the content that was taught and provided research-based knowledge about how students learn that subject matter (i.e., Pedagogical Content Knowledge [PCK], see Shulman, 1987). An outsider can act as a 'significant other' or mentor, serving as a content specialist, guide, provider of resources, advocate, facilitator, coach and collaborator with the goal of enhancing the teacher's practice (Loucks-Horsley, Love, Stiles, Mundry & Hewson, 2003). Access to an appropriate mentor who is on staff at the school is not always possible, so a researcher can fill this role, acting as both a mentor and critical friend. Mentors need in-depth mathematical content and pedagogical content knowledge to provide the most effective help to teachers (Loucks-Horsley et al., 2003) and research has shown that academics can effectively take on this role (e.g., Perry, Anthony & Diezmann, 2004). School/university collaborations can provide a link between theory and practice, producing more practical, contextualised theory and more theoretically grounded, broadly informed practice (Darling-Hammond & McLaughlin, 1995).

3. Effective professional learning is grounded in teachers' learning and reflection on classroom practice

Professional learning practices that have been identified as being effective in promoting mathematical reform engage the participants as learners and prompt them to reflect on their practice. Examining video-tapes and stories of classroom instruction and engaging the participants in supported experiences as teachers have proven effective in achieving this (Borasi, 1997; Borko, Davinroy, Bliem, & Cumbo, 2000). Supported experiences may include the use of a teacher educator, or other suitably knowledgeable external person, to provide support in planning and implementing classroom experiences, making classroom visits and encouraging the use of reflection with others. According to Brookfield (1986), the development of critical reflection on experiences, along with the collaborative interpretation and exchange of such experiences, is one of the most significant forms of adult learning in which individuals can engage.

Most professional learning experiences offered to teachers occur as a series of workshops, or at conferences (Liebermann, 1992). They often ignore the critical importance of the context within which teachers work. Staff development in the United States, for example, typically takes the form of a lecture by "an expert brought in from outside the school community to tell teachers at the school how they should be doing their jobs" (Brookfield, 1986, p. 249). Research suggests, however, that professional learning is most likely to succeed when it takes place as close to the teacher's own working environment as possible (Lovitt & Clarke, 1988) and is not seen as something apart from regular teaching responsibilities (Darling-Hammond & Sykes, 1999). Borko, Mayfield, Marion, Flexer, and Cumbo (1997) also found that professional development experiences that provided opportunities for teachers to explore new instructional strategies

and ideas in the context of their own classroom practice were among the most effective for promoting and supporting teacher change. In response to this, some professional learning has taken the form of support and dialogue that occurs in teachers' classrooms or has used videotapes of their lessons (Borko et al., 2000). Video-tapes have proven useful in similar studies (e.g., Day, 1998; Powell, 2005) with Powell finding that the video-stimulated reflective dialogues enabled teachers to articulate their thinking and feelings through defining a focus and context for inquiry into their professional practice.

According to Darling-Hammond and Sykes (1999), however, observing and being observed in the classroom is rare, and despite teachers acknowledging that when they did have this opportunity it impacted strongly on their practice, very few teachers actually did it.

Reflection in Action

It is generally agreed that reflection in, on, and about practice is essential to building, maintaining, and developing the capacities of teachers (Day, 1999). Reflective practice has been the subject of attention for teacher educators for some time (Power, Clarke, & Hine, 2002) with the aim being to develop life-long critically reflective practitioners (Martinez & Mackay, 2002). More than 20 years after its publication, Schon's (1983) *The Reflective Practitioner* remains a seminal source in the reflection literature (e.g., Leitch & Day, 2000; Moon, 2000). Schon refers to reflection-in-action as an "art" (p. 50) by which practitioners deal with situations of uncertainty, instability, and uniqueness. According to Schon (1983),

> The practitioner has an interest in transforming the situation from what it is to something he likes better. He also has an interest in understanding the situation, but it is in the service of his interest in change. (p. 147)

Reflection-in-action is an active process in which doing and thinking are complementary (Schon, 1983). It comprises reframing the problem and improvisation on the spot (Leitch & Day, 2000). When reflecting-on-action, actions trigger reflections and an inquirer's continuing conversation with his situation may lead to a renewal of reflection, or a cycle of reflective inquiry (Colton & Sparks-Langer, 1993). Reflecting-on-action and this cycle of reflective inquiry will be discussed further in relation to the methodology employed in the study reported in this paper.

Although many teachers may reflect on their teaching practice, Moon (2000) suggests that most do not do so in a deliberate manner which enables them to progress in their thinking or action. Hatten and Smith (1995, cited in Alger, 2006) described reflection as a "deliberate thinking about action with a view to improvement" (p. 34). Reflective practice, perhaps, is a more accurate term used to describe reflection that is deliberate and can be focused on events or incidents, and personal experiences. For Jaworski (1993, cited in Moon, 2000), reflective practice involves noticing aspects of one's own practice that may be triggered by a question from an outside observer, and then recognising and working on issues of concern.

Power et al. (2002) used a theoretical framework proposed by Van Manen (1977, cited in Power et al., 2002) to frame student teachers' understanding of their reflection and to assist them in their professional learning. According to the framework, there are three stages of reflection: Technical Rationality, which includes focusing upon what works in classroom practice; Reflection as Practical Action, which focuses on the learning experience of the student, and in which the learning situation is seen as problematic; and Critical Reflection, which focuses on what knowledge is of value and to whom (Power et al., 2002). Data were collected through personal journals and focus group meetings, with the researchers finding that the sustained opportunities to reflect helped the student teachers to move beyond the first stage of reflection to Reflection as Practical Action. Other authors (e.g., Day, 1999) have also proposed that there are different levels or types of reflection. Although the terms for these vary, they basically describe the degree to which reflection moves beyond mere description or concern with technical aspects to a critical or dialectical form whereby practice can be reconstructed (Day, 1999). Following consideration of frameworks used and adapted by other researchers (e.g., Alger, 2006; Day, 1999), a similar framework was adopted for this study and is described in Figure 1. Unlike Power et al.'s study that used a similar categorisation to evaluate pre-service teachers' reflective journals, this study involved a relatively experienced teacher reflecting on his practice in conversation with the researcher. It was anticipated that the framework would be equally adaptable to a range of contexts and personnel. It was used to inform the data analysis aspect of the methodology discussed later in this paper. Figure 1 describes three increasingly sophisticated levels of reflection, along with examples of reflective statements that illustrate each. Day (1999), suggested that not all teachers are at a stage of readiness to engage in all of the levels of reflection, but recommended that teachers should be involved in all levels during the course of a career.

When teachers reflect alone, there is a limit to what can be disclosed, what information can be collected, and the objectivity of the information (Day, 1999). Reflection often occurs unsystematically or informally, either alone or with others who have not observed the practice. In order to achieve critical reflection, Day (1999) argued that others are needed in the process. Systematic investigation of practice with the help of a 'mentor' or critical friend inside or outside the school can be beneficial in enhancing the reflective process.

Day (1998) documented an example of an external collaborator who worked with a teacher over a one year period, using observation of teaching, video recording and stimulated recall as aids to reflection on practice. The teacher initiated the collaboration, chose observation of practice as a means of assisted reflection, selected the lessons to be observed and determined the cycle of observations. Day's research revealed that it is often only where teachers perceive that their personal solutions to classroom 'problems' are inadequate that they will be moved to search for means by which they can change. Day found that Michael, the case study teacher, had not been given the opportunity to engage in any systematic reflection and that the collaborative action research
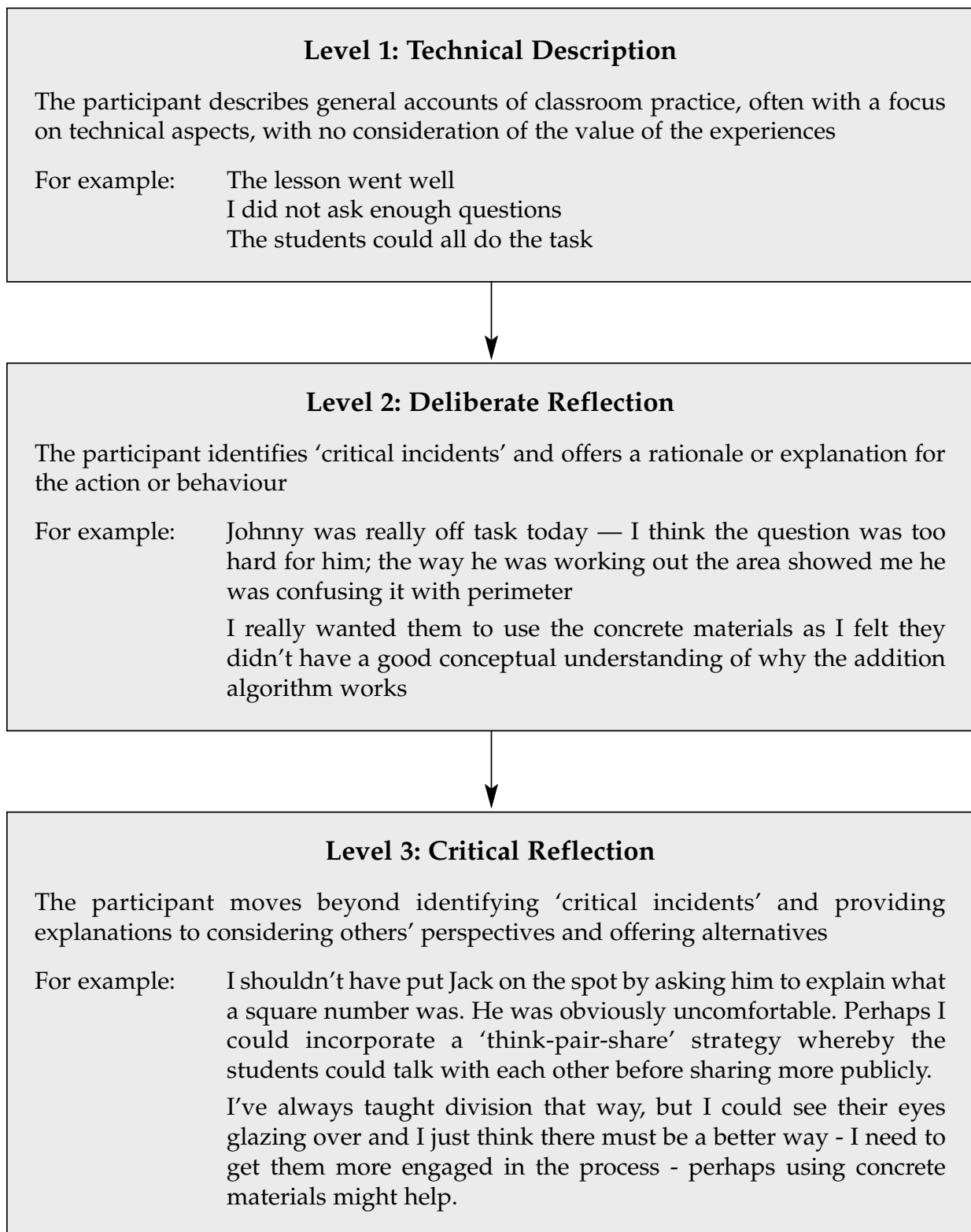

Level 1: Technical Description

The participant describes general accounts of classroom practice, often with a focus on technical aspects, with no consideration of the value of the experiences

For example: The lesson went well
I did not ask enough questions
The students could all do the task

Level 2: Deliberate Reflection

The participant identifies 'critical incidents' and offers a rationale or explanation for the action or behaviour

For example: Johnny was really off task today — I think the question was too hard for him; the way he was working out the area showed me he was confusing it with perimeter

I really wanted them to use the concrete materials as I felt they didn't have a good conceptual understanding of why the addition algorithm works

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Level 3: Critical Reflection

The participant moves beyond identifying 'critical incidents' and providing explanations to considering others' perspectives and offering alternatives

For example: I shouldn't have put Jack on the spot by asking him to explain what a square number was. He was obviously uncomfortable. Perhaps I could incorporate a 'think-pair-share' strategy whereby the students could talk with each other before sharing more publicly.

I've always taught division that way, but I could see their eyes glazing over and I just think there must be a better way - I need to get them more engaged in the process - perhaps using concrete materials might help.

Figure 1. Levels of reflection.

had the effect of altering his perceptions of both himself, and himself as a teacher. Although Michael's teaching did not change significantly, his ways of understanding it did and, although the process was not always comfortable, Day recommended action research which combines the story, the different selves of

the teacher, the action and the change. The study discussed in this paper shares similarities with Day's work in that it involved action research, the use of a critical friend and the use of video footage and stimulated recall to engage in reflection about classroom practice. Day's report of his study, however, did not include details about specific reflective techniques utilised and the findings indicated that reflection centred around teaching style, rather than a focus on any specific curriculum subject. Day noted that documentation of cases in which an external collaborator works with teachers over time is rare, and that specific curriculum areas have been neglected in the reflection literature. This study adds to the research in that it provides a detailed description and evaluation of specific techniques designed to promote reflection. It presents a case study of which there are few examples to be found in the literature and it specifically focuses on teaching numeracy, rather than the teacher's identity as a whole.

Implications for the Current Study

It is clear from the literature that professional learning needs to provide teachers with sustained opportunities to examine and reflect on their practice and hence one-off sessions are unlikely to be effective. The crucial role of reflection in effecting transformation of teachers' practice and the role of a 'guide' or 'mentor' in supporting teachers' reflective activity also feature strongly in the literature. Each of these elements informed the design of the study reported here and together they suggested the use of action research as an appropriate methodological approach to employ with the classroom teachers in this study.

The Study

The study involved two main phases. The first comprised observing and video-taping a sequence of numeracy lessons involving three upper primary teachers, and the second focused on documenting the Supportive Classroom Reflection Process (SCRP) that occurred following these lessons. References to the first phase of the study are made only when necessary to establish a context for the issues raised.

Aims

The aims of the study were:
1. To identify and document the numeracy teaching practices of a number of teachers;
2. To engage the teachers in a process of structured reflective practice (SCRP) to support improvement of their numeracy practice; and
3. To examine the effectiveness of this reflective process and to identify the strategies which facilitated movement through reflective levels to critical reflection.

Study Design

The researcher observed and video-taped the introductory and plenary sessions of between four and seven numeracy lessons for each of the three teachers. The video footage allowed the researcher to fully transcribe and comprehensively document the behaviours that occurred and formed an integral part of the SCRP. The footage was then viewed with each teacher, as soon as practically possible — typically on the same day. Professional dialogue occurred between the researcher and the teacher, during and after the viewing of the video footage, based on aspects of the lesson observed. Critical incidents, that is, particular events involving the particular teacher or student comments that appeared to provide clear examples of some aspect of practice or characteristic of student thinking, were highlighted by both the researcher and the teacher and discussion often occurred around these. The researcher also used these sessions to elicit further information about the teaching practices observed and the reasons behind them. These sessions were audio-taped and transcribed and varied in duration from 30 minutes to 1 hour.
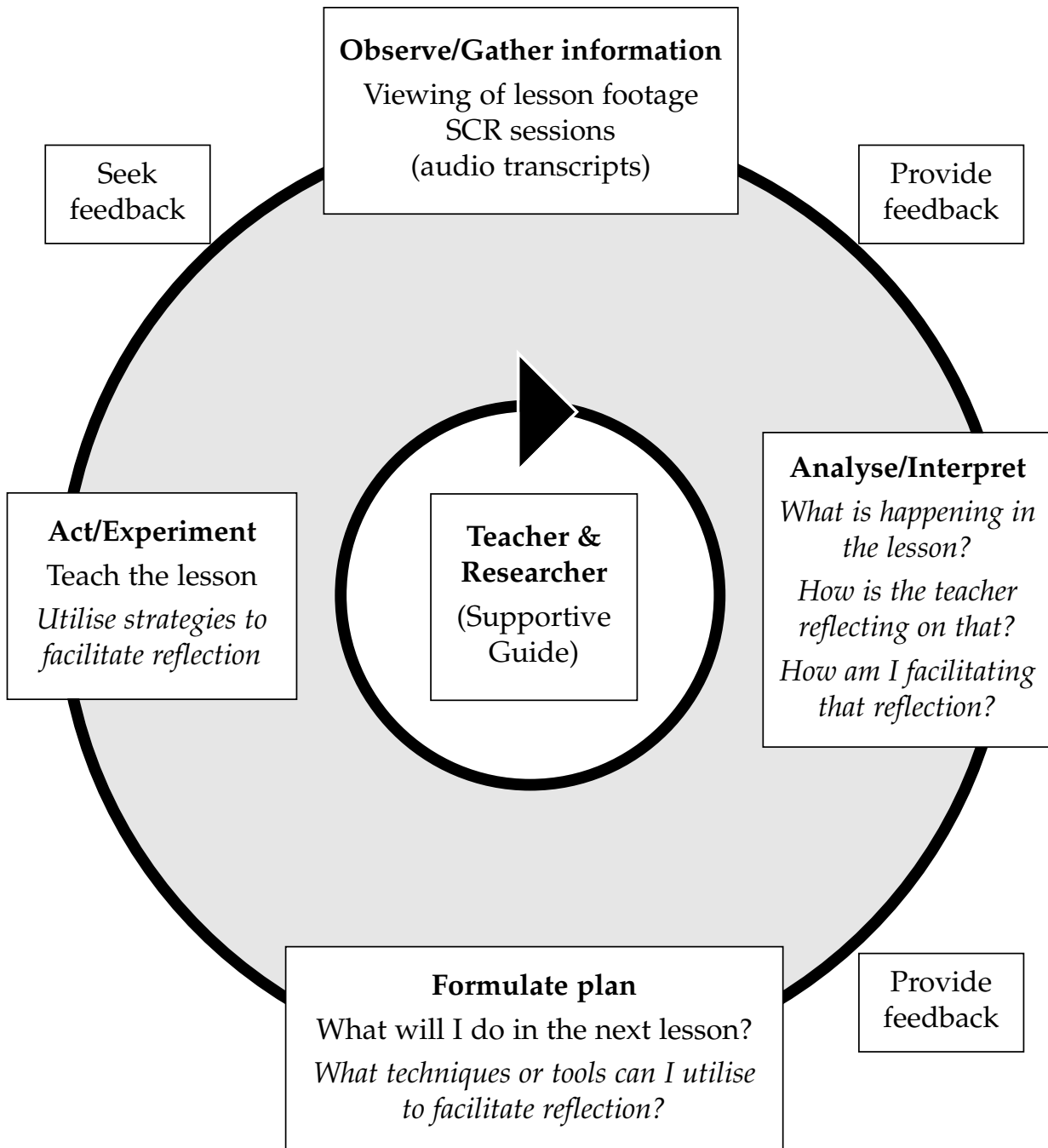
Design of the Supportive Classroom Reflection Process (SCRP)

The SCRP was a process designed and conducted by the researcher aimed at promoting teacher reflection. The concept of Supportive Classroom Reflection involved combining professional learning with enacted classroom practice and reflection using a collaborative action research approach. In order to maximise the benefits for the participants, consideration of adult learning and the three principles of effective professional learning as previously outlined were taken into account. For example, the literature recommended that teachers' learning and reflection be grounded in classroom practice so the research was located in the teachers' classrooms and focused on the teachers' numeracy practices. Professional conversation provided opportunity to engage in discussion based around the mathematical content of the lesson and the researcher fulfilled the role of the 'significant other' (Loucks-Horsley et al., 2003). The use of video footage was integral to the collection of data and used to stimulate reflection on practice.

In this study, the term 'supportive guide' was adopted to describe the role the researcher played in the supportive classroom reflection process. The term was used to alleviate any perceived inequalities in the relationship between the teachers and the researcher and the connotations potentially associated with use of the term 'critical'; the use of the word 'guide' rather than 'friend' was used to signify the active role that the researcher played. The reflective sessions were predominately unscripted, as the researcher was interested in the nature of the reflections volunteered by the teachers. The viewing of the video footage provided an opportunity for professional dialogue to occur, with the researcher's questions and probes designed to assist the teachers to reflect more deeply on their practice.

Action Research

Figure 2 shows how action research was incorporated into the design of the SCRP and details the particular roles played by the researcher and the teacher.

Observe/Gather information
Viewing of lesson footage
SCR sessions
(audio transcripts)

Seek
feedback

Provide
feedback

Act/Experiment
Teach the lesson
*Utilise strategies to
facilitate reflection*

**Teacher &
Researcher**
(Supportive
Guide)

Analyse/Interpret
*What is happening in
the lesson?*
*How is the teacher
reflecting on that?*
*How am I facilitating
that reflection?*

Formulate plan
What will I do in the next lesson?
*What techniques or tools can I utilise
to facilitate reflection?*

Provide
feedback

Key: **Bold: Teacher and researcher**, *Italic: Researcher*, Plain: Teacher

Figure 2. The respective roles of the teacher and the researcher in the action research process.

Based on Ebbut's (1983, cited in Hopkins, 1993) cyclic framework, the action research approach adopted allowed for the possibility of providing evaluative feedback within and between the cycles of action and monitoring phases, enabling the next step to be influenced by the results of the intermediate analysis of the data from the previous stage. The process described in Figure 2 was directly incorporated into the study for each SCRP session — that is, information was gathered through the viewing of the lesson footage, feedback was provided through both the researcher and the teacher and a plan was formulated as to what would occur in the next lesson. The teacher would then act or experiment, conducting their lesson as per the identified plan, after which the cycle began again.

Procedure for SCRP

The researcher had provided each teacher with a summary of the characteristics of effective teaching for numeracy derived from the literature but primarily based on the findings of Askew et al. (1997). At the first supportive classroom reflection session, each teacher was asked to identify one or two characteristics that they would like to focus on for the duration of the study. Although not required by the researcher, each teacher also identified a mathematical focus for the sequence of lessons to be observed. The nature of the supportive classroom process thus varied between teachers, depending upon their particular needs and identified goals.

A private room was used at each teacher's school for the viewing of the video footage, prior to which each teacher was asked to make any comments about the lesson they had conducted and whether or not there were any incidents that particularly stood out. The aim of this was to contrast these comments with the comments made during and after the video footage, both in terms of which aspects the teachers chose to reflect on and also to determine whether or not the video footage helped to increase the depth of reflections made. Following their initial comments, each teacher was then asked to view the video footage and encouraged to make comments and/or pause the video at any time. The researcher also paused the video at certain points, mainly to clarify the teachers' intentions or to discuss a 'teachable moment' or critical incident. Examples of these incidents included particular student comments that may have revealed a lack of understanding or particular insights into students' thinking. Specific examples are provided later in this paper. The video footage thus provided an avenue for professional conversations to occur that could be initiated either by the researcher or by the teacher. The researcher could not exactly plan for these exchanges, but needed to recognise moments when they could occur and respond accordingly.

Following the viewing of the footage and the ensuing professional conversations, each session concluded with the identification of 'where to next?' This was an integral part of the collaborative action research process and also provided an opportunity for teachers to articulate what the next step in the learning sequence for the class would be and for the researcher to provide support with this.

Strategies for Reflection

An overview of the different techniques employed by the researcher to stimulate reflection is presented in Table 1. The techniques employed were partly derived from the literature and partly devised by the researcher in response to the individual teachers' needs. Detailed descriptions of these techniques together with an evaluation of their effectiveness in relation to one of the case teachers, Richard, formed the basis of the results and discussion presented in this paper.

Table 1.
Reflective Techniques and their Purposes

Reflective technique	Purpose
Pre-viewing reflection: prompted by questions from the supportive guide	To determine the depth of reflection shown without the benefit of watching the video footage
Viewing of video footage	To allow the teachers to take on the role of an observer, rather than participant
Professional conversation	To probe further into aspects of teaching behaviours; for discussion to occur around critical incidents; for teachers to explain/justify aspects of teaching behaviour
Comparison of two students' mathematical behaviour	To encourage deliberate/critical reflection about individual students
Professional reading	To provide examples of effective numeracy practices and to determine whether or not teachers could identify with these
Self assessment checklist	To trial an instrument that could be used in the absence of the researcher; to focus the reflection on characteristics of effective teaching of numeracy

Data Analysis

Data analysis commenced during the data collection process and units of analysis were created through ascribing codes to the data (Miles & Huberman, 1984). Data analysis for the SCRP, which is the focus of this paper, was responsive, with categories derived from the teachers' responses, and then further analysed in terms of the levels of reflection (see Figure 1). Table 2 details the data collected, the instruments used and the units of analysis.

Data collected from the SCRP were analysed in terms of the nature of reflective responses (self, practice, students) and the levels of reflection (technical, deliberate, critical). The data were primarily qualitatively described, with a summary of the number of instances of the levels of reflection also provided for each teacher. Rather than attempting to code each exchange, as was done with the classroom observation transcripts, the researcher instead highlighted and coded instances of occurrence. For this paper, the data analysis directly relates to

Table 2:
Data analysis for phase 2

Phase	Data collected	Instruments used	Units of analysis	Data interpretation
Phase 2: SCRP	Interview transcripts	Semi-structured interviews (audio-taped) incorporating reflective techniques (see Table 1)	Object of reflective responses: Self, practice, students	Colour coding of instances — qualitatively interpreted
			Levels of reflection: 1. Technical 2. Deliberate 3. Critical	Frequency counts of occurrence (per session)

each of the reflective techniques employed, which were described in Table 1. The results and discussion that follow relate to Richard, one of the three teachers. Richard was teaching a grade 5/6 class in a semi-rural primary school and had been teaching for 8 years.

Results and Discussion

Previewing Reflection

Richard was encouraged to reflect on his lessons through responding to open-ended questions such as, "How did you feel the lesson went?" or, "Can you identify three positive and one less positive aspect of the lesson?" This strategy produced mainly technical responses as exemplified by the following:

> I think it went OK. I think I explained things pretty well. I was happy with the activity at the start where we were looking at where percentages were used, why they were used and by the answers I got back from the class.

There were some reflections that were coded as deliberate, but no instances of critical reflection were recorded for Richard (or any of the teachers) prior to viewing the video footage. The following response provides an example of deliberate reflection:

> It was really good that they could relate it to the fraction work that they did — once we started doing examples on the board, um, I probably picked out two or three kids that didn't quite get it and I was able to do some one on one work with them, so that I was sure that they got it — um, all the other kids I noticed as I was going around, yeah they picked it up really quite quickly — once I did a couple of more complicated ones on the board, probably three quarters of the class were picking it up, um, and that one quarter that were still struggling, they were struggling with the numbers not with the actual process um, probably stuffed up with the last example that I used — I put 24% of something, when I should have put 25% that's just one of those errors that can just happen — um, but in

another way it was an advantage because it showed me those kids who would persevere through something when they come to a problem that wasn't straight forward.

In the above excerpt, Richard selected a 'critical incident' — the use of the example 24%, rather than 25% — and then provided a rationale or explanation for the behaviour. Although he acknowledged that it caused difficulties, he rationalised it by saying that he used it as a teaching point and as an opportunity to gain insight into particular students' affective behaviour. In moving from description to rationale the reflection became deliberate rather than simply technical.

Viewing of video footage. As Day (1998) and Powell (2005) found, the video footage provided a powerful means for helping the teachers to reflect on their practice. Richard indicated that while the video footage did not provide him with any additional insights regarding individual students' mathematical abilities or understandings, he believed it was helpful with identifying "how I've questioned, who I've questioned, who tends to dominate". He also found viewing the footage to be affirming in regard to his own teaching ability:

> On the whole I think I explain things pretty well — sometimes it just makes you think, OK, did I explain that clearly enough? Is there a better way I could have explained that? And a couple of times I sort of reflected on that. I really like how it's probably reinforced a lot of belief in myself.

Richard admitted that initially he was not comfortable with watching himself, but acknowledged the value of the process and was able to "forget the camera was even there" as his lessons were recorded.

Professional conversation. Although difficult to define, this was essentially what occurred in the semi-structured interviews that took place around the viewing of the video footage. In particular, probing questions were used by the researcher to encourage the teachers to comment further and/or explain or justify particular aspects of their teaching behaviour and critical incidents. The following is illustrative of how the researcher encouraged professional conversation:

> (Video paused by researcher)
>
> Researcher: OK, so was the emphasis deliberate there on mental computation?
>
> Richard: Yes, mental computation and ... things that they can work out in their head ... I probably shared the questions around a lot more evenly and not let a few kids dominate ...

In this instance, the researcher's initial question triggered reflections from Richard about his questioning techniques and professional conversation occurred around what constitutes a 'good' question and the need for teachers to scaffold their questions to facilitate students' learning.

Further on in the lesson, the researcher paused the video again during a discussion on percentages:

> Researcher: When you put that 120 up [on the board], it was interesting — some thought that the percentages had to add up to 120 — what did you think about that?

> Richard: That almost identified to me what the next teaching point was ... because I think most of the class was finding it really easy when it was something that added up to a hundred ... but once it went over a hundred, it stumped the majority of the class ... so it's one of those things ... that shapes where you move next, because it identifies the area that they're weak in.

The video footage provided an avenue for professional conversations to occur that could be either initiated by the researcher or by the teacher. For example, Richard paused the video and made the following observation:

> One thing that I picked up with Andrew and throughout the video and while I was doing it, is he tends to have a fixation on sport and he can only relate things to sport, so one of the aims probably throughout this unit is that it's not just sport that has to do with percentages, it's in the wider world as well.

Comments such as this provided opportunities to encourage the teachers to move from technical reflection to deliberate reflection and from deliberate reflection to critical reflection. In a previous exchange, for example, Richard had moved from deliberate to critical reflection when he identified that finding percentages of numbers greater than 100 was proving problematic and that he needed to provide alternatives for this and alter his future teaching directions. Probing questions were also used to encourage deliberate and/or critical reflection on particular teaching decisions and individual students. For example,

> Researcher: The first thing, when that child said about 66.6.6, what did that tell you about his understanding of decimals and how you decided whether to leave it there, or explain it a bit more?

> Richard: I didn't want to try and explain it anymore because I just wanted him to make sure that it was um, 0.66, if he got that concept, then I was going to be happy, and sometimes I think that you need to know your kids to make that decision — OK, I'm going not to push it any further because I think by pushing it further it's going to confuse him even more and that was one of those conscious decisions. If it had been Sebastian, and I was in a private conversation away from the rest of the class, I would have probably pushed that further along and we would have explored that more, but that's very much just knowing your students.

In the above exchange, Richard deliberately reflected on the incident in that he explained and justified his teaching actions. His comment also shows evidence of considering others' perspectives and offering alternatives, in that he identified that he would have reacted differently if it had been a different student who provided the answer. Further evidence of critical reflection may have occurred if Richard had identified how he would address this misconception.

Comparison of two students' mathematical behaviour. This strategy was suggested by Askew (personal communication, March, 17, 2006) and was designed to provide an insight into teachers' beliefs about what it is to be a numerate student. It also proved useful for encouraging deliberate reflection about individual students. Richard provided examples of deliberate and critical reflection when asked to compare two students. For example, in the following excerpt he engaged in deliberate reflection when he provided an explanation of the differing behaviours of two students, and in critical reflection when he attempted to analyse the behaviours from their perspectives.

> Um, Gina gets things correct because she listens really well, concentrates really hard, she's methodical in the way she does things, she's really conscientious; Andrew tends to get some of his working out from left field, so Gina will tend to work things out the way that I present them, if I present two or three different ways, she'll stick to those two or three different strategies; Andrew will use those two or three strategies and then he'll come up with another two or three himself, so he loves exploring and he'll love to come up, Oh, I worked that out a different way! So he's always thinking for himself, where Gina tends to be a little bit more spoon-fed — not that that's a bad thing, because her understanding is really good and she can always explain it, but it tends to be one or two ways in which she can explain it

Professional reading. Particular resources and readings were provided to the teachers in the study. These differed according to each teacher's needs and served different purposes. In Richard's case these consisted of resources on the Department of Education website, and two articles from scholarly journals. Of these Richard read the article by Askew et al. (1997) entitled *Effective teachers of numeracy in primary schools: Teachers' beliefs, practices and pupils' learning*. Richard and the other teachers in the study were asked to read this article and to indicate where their beliefs were situated in relation to the connectionist, transmission and discovery orientations outlined in it. Richard indicated that he found it interesting but did not articulate any particular alignment to the different orientations discussed in the paper. Overall it seemed that the provision of resources and readings was not effective in stimulating Richard's reflection.

Self assessment checklist. In an attempt to encourage deliberate and/or critical reflection and to trial an instrument that may be suitable for individual use (i.e., without the presence of a 'supportive guide') the researcher devised a checklist which described some of the characteristics of effective numeracy teaching (see Appendix). Richard indicated that it was a useful reflective tool. He said,

> I think it's a good sheet ... I like the high but realistic expectations of all students ...
> for that lesson [it was difficult to evaluate] because it was more like a half lesson.

Richard's self-evaluation indicated (among other things) that he believed that making connections featured strongly in the lesson just taught and that he maintained a focus on important mathematical ideas. His assessments of when particular features were present, and when they were not, aligned well with the researcher's own analysis.

Was the SCRP an Effective Form of Professional Learning?

The teachers' perspective. At the final Supportive Classroom Reflection session, each teacher was asked to comment specifically on the effectiveness or otherwise of the process. Richard viewed the experience in the following way:

> There have been huge benefits. I think this is the most beneficial [compared with other professional learning] because it's hands-on and you're doing it, and you can reflect on what you're doing, you're not having to recall everything from memory; yeah, very beneficial ... I just think because it's very individualised, that's a benefit of it, whereas a lot of the stuff [other professional learning] tends to be general and you'll go to professional learning and you think, oh yeah, some of that relates to me, but a lot of it won't.

Furthermore, Richard perceived the process to have deepened his level of reflection and indicated that he would continue to reflect and would consider the use of video footage if time allowed:

> If it was possible, but time's the enemy ... but there's definitely some benefits of it, but I don't think you'd want to do it consistently, you might want to do it for one or two lessons, once or twice a year.

The researcher's perspective. In terms of the overall study, the SCRP provided information that assisted the researcher to interpret classroom observations. The incorporation of the three principles of effective professional learning described earlier in this paper ensured that the sessions were relevant to the particular teacher, in this case Richard, and ample opportunity was afforded for reflection to occur. The model described in Figure 1 proved useful for analysing the levels of reflection that occurred. Likewise, the action research cycle described in Figure 2 ensured that a similar process was used with each teacher.

Some of the strategies employed in the study were more successful than others in terms of eliciting deliberate and critical reflection and it was often when one or more strategies were combined that deeper reflection occurred. For example, the video footage appeared to prompt Richard to comment on a student's answer offering a general or technical description. The ensuing professional conversation provided him with the opportunity to offer a rationale or explanation for the answer, resulting in deliberate reflection and the offering of alternative interpretations which characterised critical reflection. Eliciting a comparison of two students in terms of their mathematical behaviour was also effective in stimulating a combination of deliberate and critical reflections suggesting that this may be a particularly useful strategy.

In Richard's case, the use of professional reading did not result in the articulation of any type of reflection. This case also suggests that the self-assessment checklist may have only the potential to result in technical and/or deliberate reflection. Although it proved useful in focusing the reflection on particular mathematical considerations and provided feedback to the researcher as to the teachers' impression of their effectiveness, the checklist format did not encourage further examination of the behaviours enacted.

Did Richard's practice change as a result of the process? Classroom observation data collected during Phase 1 of the overall study suggests that it did. For example, subsequent to his reflections following the first lesson that was the subject of the SCRP, Richard incorporated more opportunities for mental computation into his numeracy lessons and commented that he had used a greater variety of questioning techniques than previously to stimulate purposeful discussion. This was consistent with the researcher's observations related to the goals that he had chosen from examining the characteristics of effective numeracy teaching. Richard indicated that he believed that "you should probably change your teaching practice about 10% each year" and that the SCRP was beneficial in determining the "10% that I need to change, what it would be and then I change that".

There is an important limitation to studies of teachers' reflective activity that arises from the fact that such activity is not directly observable. For example, it may be that Richard did reflect on the articles that he read, but chose not to share this with the researcher. In this study, reflection with the teachers occurred in a particular context and was based around a recently conducted numeracy lesson. A different context (time, place, stimulus, company) may well have evoked different reflections in terms of both their nature and object. In addition, it may well be that each teacher reflected prior to or after the Supportive Classroom Reflection session, but the researcher had access only to that which the teacher shared.

Conclusion and Implications

The results discussed in this paper indicate, perhaps not surprisingly, that Richard judged the individualised approach adopted in the SCRP to be a more effective form of professional learning than other professional learning he had been involved with in the past. The results support the findings from the literature that among other factors, effective professional learning should be grounded in teachers' learning and reflection on classroom practice. This paper has provided a more detailed account of an individualised supported mathematics professional learning process than has been available to date. It has thus addressed both the need for detailed case studies and for studies addressing specific curriculum areas that Day (1998) identified. In addition, it provides evidence of particular techniques that might be employed by an external person acting in the role of supportive guide as they attempt to stimulate reflection.

Arguably the most important conclusion that can be drawn relates to the role of professional conversation in conjunction with other effective stimuli such as videos of classroom activity. Bearing in mind the inevitable limitations on a researcher's access to a teacher's reflective activity, the findings in this case suggest that critical reflection on practice may be unlikely in the absence of such an external voice. Lerman (1997) described the importance of a second voice and claimed that it may come in the form of written material. However, Richard's case supports Day's (1999) view that, for some teachers at least, a physically present voice may be necessary.

The SCRP is a time intensive process that requires a significant commitment from the teacher and supportive guide but this must be weighed against the likely outcomes. Given that one-off sessions often result in no change in teachers'

knowledge or practice (D'Ambrosio et al., 2004; Miles, 1996) while increasing their cynicism (Miles, 1996) the investment may well be worthwhile. Like Day (1998) the researcher is reluctant to claim that Richard's teaching changed significantly as a result of the process, but there was evidence to show that although he partly used the process to affirm his current practice, he did engage with the reflection process and, as a result, he did modify his practice, at least in the short term. Analysis of further cases of teachers engaged in the SCRP will add to data on its effectiveness.

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Appendix

Self assessment checklist

Teacher Practice	Effective characteristics	Does the teacher:	Evident
Teaching for conceptual understanding	Focus on mathematics	Focus on important mathematical ideas and make the focus clear to students?	
	Making connections	Use teachable moments as they occur?	
		Make connections:	
		With previous learning	
		Within mathematics	
		With real-life	
		With other subject areas?	
	Variety of representations	Use a variety of representations/materials and contexts for the same concept?	
	Concrete materials	Use concrete materials as a sense-making tool?	
Engaging the learner	Purposeful tasks	Structure purposeful tasks that engage students and enable different possibilities, strategies and products to emerge?	
	High, but realistic expectations of all students	Ensure that all students are challenged, not just those who are able?	
	Explanation and reasoning of students' responses	Encourage purposeful discussion?	
		Provide opportunities for students to share, explain and justify their answers?	
		Use a range of question types to probe and challenge students' thinking?	
	Motivation	Stimulate students' interest and excitement, and sustain engagement?	
		Model and encourage positive attitudes towards mathematics?	

Evidence Key: x — not evident, ⛷ present, ⛷⛷ strongly featured

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