Teacher Researchers Questioning their Practice

Linda Bonne
Redwood School, Wellington
<lindabonne@redwood.school.nz>

Ruth Pritchard
Victoria University of Wellington
<ruth.pritchard@vuw.ac.nz>

Eight teacher researchers examined their own practice to analyse their use of questioning in the context of numeracy, in partnership with two researchers. Each teacher researcher devised their own question categories, from which the research team then developed common categories. Teacher researchers found the most helpful way to categorise questions was according to their purposes for asking them, and that only the teacher could reliably determine this. Dichotomies such as open/closed questions, or lower/higher order questions, did not appear to illuminate the complexity that underpins questioning. The teacher researchers discovered that they had asked more questions than they expected, and were surprised that they asked more questions of students working at higher strategy stages. The importance of context was highlighted as the teacher researchers described the many inter-related factors they considered as they formulated questions and presented questions to students.

Discourse is an important aspect of mathematics classrooms that encourages student inquiry and explanation of solution methods (Cobb, 1994; McClain & Cobb, 2001). Fraivillig, Murphy, and Fuson (1999) highlight the importance of the teacher's role in intervening to advance children's thinking in mathematics. Their framework points to the importance of questions in eliciting, supporting and extending thinking.

Teachers spend much of their time asking questions, reportedly one to two every minute (Gall, 1971; Wragg & Brown, 2001). A number of texts and professional development programmes for teachers in questioning have presented improvement in questioning practices as a technical matter which takes practice: "... good questioning is both a methodology and an art; there are certain rules to follow …" (Ornstein & Lasley, 2000, p. 184). However, it has also been argued that while furnishing teachers with a list of possible questions may give them a starting point, the most effective questions cannot be pre-planned, and must occur in response to a student's action or idea (Jacobs & Ambrose, 2003).

Many writers have suggested that higher-level questions produce deeper levels of learning (Gall, 1984; Marzano, Pickering, & Pollock, 2001; Redfield & Rousseau, 1981). A number of studies (Gall, 1984; Perrot, 1982/2002; Perry, VanderStoep, & Yu, 1993; Stigler & Hiebert, 1999; Wragg, 1993) have highlighted the low proportion of high-level questions to low-level ones when questions are categorised according to taxonomies such as those devised by Bloom (1956). However, Kawanaka and Stigler (1999) found that higher-order teacher questions did not necessarily promote higher-order responses by students.

Several writers have described how patterns of questioning develop within the classroom context (Wood, 1998; van Zee & Minstrell, 1997). Much classroom discourse is thought to be characterized by a pattern of Initiate, Respond/Reply, Evaluation/Feedback (Cazden, 1988; Mehan, 1979) where the teacher initiates, a student responds, then the teacher gives the student evaluative feedback. This pattern places the teacher in a central role and acts to test a student's knowledge, rather than to encourage them to elaborate on their ideas or to extend their thinking. International comparative studies, such as *The Third*

International Mathematics and Science Study (TIMSS) (Stigler & Hiebert, 1999) have suggested that cultural differences exist in pedagogical practices such as questioning.

Much of the recent focus in New Zealand education has been on effective pedagogy (Alton-Lee, 2003; Anthony & Walshaw, 2007; Hattie, 2003; Ministry of Education, 2006a). The synthesis of research by Alton-Lee (2003) described questions and prompts as elements of "quality teaching", forming an important aspect of pedagogy which supports students' task engagement (p. 74), and serving to "provide scaffolds to facilitate student learning" (p. ix). In professional development programmes such as the New Zealand Numeracy Development Projects (NZNDP, Ministry of Education, 2006b), teachers have been encouraged to use questioning to support students' strategic and higher order thinking. Within the New Zealand context of mathematics teaching and learning, research has explored various components of discourse (Thomas, 1994; Higgins, 2003; Irwin & Woodward, 2005).

Up until now, much of the research undertaken to investigate teachers' questioning has been synthesised from data gathered by researchers observing in classrooms. A review of comprehensive research syntheses (Houston, Haberman, & Sikula, 1990; Richardson, 2001; Sikula, Buttery, & Guyton, 1996; Wittrock, 1986) did not reveal any studies deeply grounded in teachers' perspectives. How teachers view the role and formulation of questions within a mathematics lesson, and how questioning might be shaped by contextual factors, have not been a major focus. Furthermore, existing categorisations of teachers' questions have predominantly examined only a selection of the questions asked by teachers during a lesson (Perry, VanderStoep, and Yu, 1993; Vale, 2003).

Methodology

The project had two closely interwoven strands: one strand focused on teachers examining their use of questioning, and the second strand focused on building research capability of teachers. The key objectives that focused on the teachers' use of questioning were to:

- identify the various kinds of questions teachers use in mathematics
- explicate teachers' thinking about the use of questioning during lessons
- describe patterns of teachers' questioning within mathematics lessons

The teacher researchers (TRs) taught at a variety of year levels, and were drawn from urban schools in communities with varied socio-economic backgrounds. Each of them had recently participated in a common in-depth professional development programme: the NZNDP (Ministry of Education, 2006b). The eight TRs were respected members of their teaching communities; several were lead teachers of numeracy in their schools. They had also demonstrated a willingness to share and examine their practices. The research was conducted over the 2006 school year, in five primary schools in the Wellington area.

There were two cycles of data gathering for the TRs, each taking 5 days and occurring in each of the middle two terms of the four-term school year. TRs were released for two days to analyse a transcript of their numeracy lesson, their recollection of which was supported by viewing a videotape of the lesson. A key task was for them to identify every teacher question included, and to sort these into groups of similar questions for which they then devised labels (Miller, Wiley, & Wolfe, 1986). At the end of the second day, they discussed their findings with one of the RTLs in a semi-structured, one-to-one interview

(Denscombe, 1999). In the second cycle, questions were categorised under commonly agreed headings, and TRs also completed a frequency table based on the categories.

Research team discussions formed a key aspect of the analysis and interpretation of findings. Each member of the team brought aspects of their findings to share, and similarities and differences were explored and debated. The Cycle 1 team discussion began the process of establishing common categories with which to analyse the lesson in Cycle 2. The TRs interpreted their findings in light of current research, which they discussed at a team meeting. Also at these meetings, TRs responded to summaries of emerging ideas presented by the RTLs.

Results

Development of Question Categories

The research team devised a working definition of what constitutes a question. For this project, a question was "any form of language that is aimed at eliciting a response". This is perhaps a broader definition than that found in *The Concise Oxford Dictionary* (Allen, 1990), which defines a question as "… a sentence worded or expressed so as to seek information", or "… a problem requiring an answer or solution" (p.980). Utterances such as, "Listen carefully to what Lily is saying" and, "Let's see if we can understand how the mirror, how their hands coming together helped" (Erin, Lesson transcript 2), were counted as questions. Although the definition included "any form of language" the methodology of the project allowed for a focus only on oral questions.

In the first cycle of data gathering and analysis, the TRs worked independently to devise between six and 17 categories for their questions, with three people each devising eight categories. The research team met at the end of this cycle, with the main purpose of developing shared question categories from the TRs' individual ones. This proved to be a complex task that could not be completed with sufficient discussion and debate within the time available. The seven TRs who were at the meeting had varying degrees of input into this process.

Following this meeting, the RTLs met with three of the TRs to further refine/develop the categories. These were subsequently presented at the next team meeting for discussion and feedback. At this point, seven categories of question had been developed, based on the TRs examining a question in terms of the purpose they had in mind when they asked it. The TRs used these seven common category labels when they analysed their second lesson. (Question examples are drawn from TRs' categorised questions.)

Checking understanding

- Okay, but say again, you took the 3 away first you said and then you took away…?
- Do you understand that, David?

Getting a sharp, clear, anticipated response

- Good boy, so that equals…?
- Is there a 3 in the hundreds?

Guiding and supporting (clarifying, repeating, rephrasing, taking another look)

- Excellent, so you would take away the 6 and 3 because you know they actually make 9?
- So you said that you would have 24 and then you would…?

Explaining how and why

- Why is using different colours helpful, do you think?
- How did that make it easy for you?

Making connections and links

- What is the relationship between 4 and 8?
- Is it a "-ty"? Where are some other "-ty" numbers?

Management

- Who is your partner, Victoria?
- Joseph, do you want to roll the dice?

Fostering student interaction

- So what's the number sentence, give me thumbs up if you agree with Trent.
- Ana, why are you shaking your head; do you disagree?

At the second post-analysis meeting of the research team, the TRs further condensed this list by removing the category, "Getting a sharp, clear, anticipated response", which had been categorised according to the students' responses, rather than the teachers' purposes for asking the questions. "Management" and "Fostering student interaction" were merged, as it was agreed that questions in both categories had a strong connection with classroom norms. Consequently, these two categories were combined under the label, "Fostering student interaction in a learning community". By the conclusion of the project, the team had therefore reduced the number of categories to five. For one TR the process of developing common categories meant that their original 17 categories reduced to just five categories by the end of the project.

In the early stages of the research, the TRs often referred to questions as open or closed (25 references in first interviews). Later in the project the TRs reported that their thinking about questions had moved beyond this straightforward dichotomous categorisation. Open and closed questions were referred to less often (11 references in second interviews), and the complexities of these ideas were explored. The TRs suggested that in each of the final categories, there would be examples of questions that might be considered to be open and closed.

Context shaped the TRs' categorisation of their questions. The importance of uncovering teachers' purpose in such research is supported by Erickson (1993): "The teacher comes to know teaching from within the action of it, and a fundamentally important aspect of that action is the teacher's own intentionality" (p. viii). The TRs reported that the actual purpose of a particular question could not be determined by looking at the question in isolation from the context in which it was asked. To identify the purpose of a question, it was necessary to know the conversation that happened before and after the question. Furthermore, even by referring to the full lesson transcripts and viewing the videotapes of lessons, members of the research team felt it was not possible to accurately categorise another person's questions according to purpose. The research team leaders attempted to identify questions that would be illustrative of each category, only to find that they had insufficient information to do so with any degree of reliability. For example, the RTLs thought the question, "How are you going, Jordan, alright?" might have been classified as a Management question. The TR in whose transcript the question appeared considered it fitted best in the "Checking understanding" category, as this was the purpose she had in mind when she posed the question. Similarly, the question, "I have taken away 4. That

leaves me with …?" might be perceived by one person to be a "Guiding and supporting" question, but the TR classified it as "Checking understanding". For the questions to be categorised in terms of purpose, rather than form or function, the categorising must be done by the teacher, as only the teacher had the in-depth knowledge of each student's learning needs necessary to identify the specific purpose for which they had asked each question.

Making the categorising of questions still more complex is that questions were asked with varying purposes in mind; similar questions were asked of different students for different purposes, according to the students' needs. For example, the question "So, what do you get if you add three more?" might be asked of one student with the purpose of checking their understanding, while for another student it might be asked in order to guide and support their learning.

Teacher Researchers' Reflections on Questioning

TRs described how they brought together a complex combination of considerations as they formulated questions:

Purpose – What is the purpose of my question? Where am I heading? What is the learning intention? How will I know when the students have achieved it? What will be the next steps?

Student needs – What are the needs of the students – their age, language needs (especially where English is not the student's first language), perceived abilities, established understandings? What do they already know? What pace will best suit them? How attentive are they?

Scaffolding – What will help scaffold their learning in terms of equipment and student interactions? What mathematical language or ideas do I need to include in my question in order to support the students' learning?

Who to ask – To whom will I direct this question – to the whole class or to an individual student, and in this case, which student (for a variety of purposes, e.g., deliberately setting up conflict of ideas, uncovering a suspected misconception, to quickly get the correct answer, or to re-engage a student)?

Timing – When should the question be asked? At what point should the teacher intervene when a student is struggling, for example? How much wait-time should they allow? Is there sufficient time left in the lesson for the discussion this question might elicit?

Predicted responses – What responses do I expect? How am I, in turn, likely to need to respond? What equipment is immediately accessible to support directions in which the discussion might head? (Developed from the Final evaluation meeting)

The TRs talked about how the priorities for formulating questions constantly shifted, depending, for example, on the teacher's stress or tiredness level, or whether other adults were observing the teacher.

Questions were formulated according to students' responses, in the "reflection-in-action" mode (Schön, 1983/2002). The TRs reported difficulty in devising questions when the students did not provide them with responses on which they could readily build:

> …you need the feedback to form your next thought. It's not just one-way communication…you need something to build off, so you need interaction back ... Questions are adapted to the needs of the students in context. (Quentin, Interview 2)

The TRs talked frequently of the need to adapt their questions and be flexible and responsive as a lesson progressed. In a social constructivist classroom, the teacher aims to interact with the students' ideas, rather than be a keeper of knowledge that is handed down to the students (Askew, Brown, Rhodes, Wiliam, & Johnson, 1997). For teachers to yield some of the control to students requires the teacher to have a secure pedagogical content knowledge (Alton-Lee, 2003; Anthony & Walshaw, 2007; Shulman, 1986). But although it

may not be possible to predict the exact course a lesson will take, the TRs described the importance of having an endpoint in mind when formulating questions:

> I like to have clear learning intentions and know where I'm going and how I will know that the children have got there, but maybe I'm thinking I need to be a little bit more relaxed about that, so they can take the lesson where they want it to go a little more. … And I think to have less control you have to be more secure in yourself and you also have to be more secure in yourself to guide – not in a pushy way – but to guide as a good teacher. Because it's much easier for us to work out where we want to go and just go our own little way, and do it the way our brains work. (Erin, Interview 2)

Some of the TRs described how the establishing of question categories influenced their practice in the second cycle of data gathering and analysis. Reflection on findings highlighted some potential issues in the TRs' practices, for example, whether teachers might rely too heavily on questions when, sometimes, it might be more helpful to explain something to a student.

> I think I've changed my thinking from the initial questions that we did, because this is focused on those particular headings. It might've been symptomatic of knowing what my headings were, so I kind of tailored it towards those types of questions. … Having categories heightens the teacher's awareness of questions and their purposes. I was really aware of asking questions that 'guided and supported' etc – was able to target particular types of questions. I felt my questioning was more focused – avoided trivial questions. (Quentin, Interview 2)

Patterns of Questioning

Completed frequency tables were intended to provide the project team leaders with quantitative data that could yield valid comparisons. However, it became clear that the unit of a question had been interpreted in more than one way. For example, when identifying her questions, one TR had separated every individual question in her transcript so that: "What's 3 and 3?" and the next utterance, "3 and 3?" (Erin, sorted questions, Cycle 2) were counted as separate questions. Others had counted as one question instances when a question was repeated, so that: "You can do 2 plus 5 equals 7. What would you do if you had to change that into a take away? How can you do 2 plus 5 equals 7 as a take away sentence?" (Ingrid, sorted questions, Cycle 2) were classified as one question.

Seven of the eight TRs completed a frequency table as part of Cycle 2. The total number of questions identified in the second lesson ranged from 171 to 344 (see Figure 1), with a mean of 207 questions. There was no apparent pattern to the total questions asked that related to the age group taught, or to the associated strategy stages taught.

A high rate of questioning was evident in the lesson transcripts. Given a maximum lesson time of one hour, the rate of questioning was somewhere between two and six questions per minute; this is considerably higher than the one to two questions every minute reported in the literature (Gall, 1971; Wragg & Brown, 2001). Several TRs remarked in the first interview that they had been surprised to find they had asked so many questions. While throughout the project the TRs indicated their heightened awareness of the number of questions they had asked, none of the TRs commented that this was an issue until the latter stages, when several TRs showed growing concern over this.

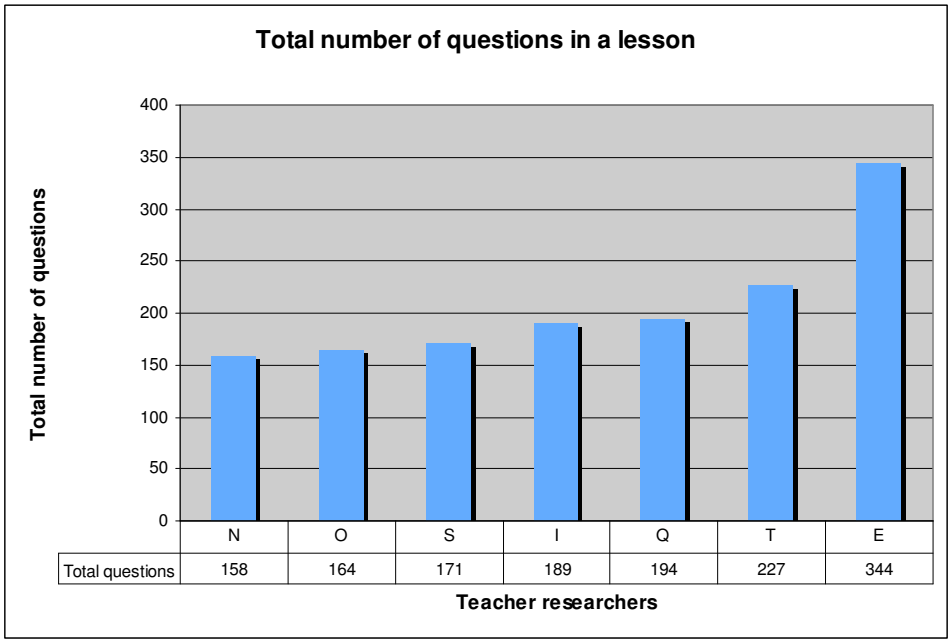

Figure 1. Total number of questions in a lesson – Cycle 2.

The TRs were asked to indicate which of their groups were working at the lower strategy stage and which were at the higher strategy stage. The graph in Figure 2 shows the proportion of the different categories of questions within identified strategy groups. Although there are minor differences between the proportions within each of the categories, the general shape of the graph for each of the groups is very similar. This means that although the number of questions differed for each of the groups, the weighting of the kinds of questions asked was essentially the same. The TRs expressed surprise at this, illustrating the mismatch in teachers' perceptions of their questioning practices, which are often not borne out by research findings (Walsh & Sattes, 2005).

There was a clear difference in the total number of questions the TRs asked the students in their lower strategy stage groups of students compared to those in the higher strategy stages (see Figure 2). A total of 298 questions were asked in six TRs' lessons with students in the lower stage groups, compared to 439 questions asked of their higher strategy stage students – close to 50% more questions.

Possible reasons for the differing numbers of questions for the two groups were offered by the TRs. It was suggested that students in the lower strategy stage groups were more likely to illustrate their strategies with materials, making it unnecessary for the teacher to question them about their thinking. Another suggestion was that teachers would see the higher groups less frequently, so perhaps their session times were of extended duration. Further ideas were: perhaps teachers expected less from this group, expected that "the higher group was going somewhere" and teachers were more active in pursuing this; the less able group tended to be less verbal, so teachers had less to work with; they took longer to work through tasks and wait time needed to be longer. For the higher group, the strategies were more complex, so more guidance was required. All of these conjectures warrant further investigation.

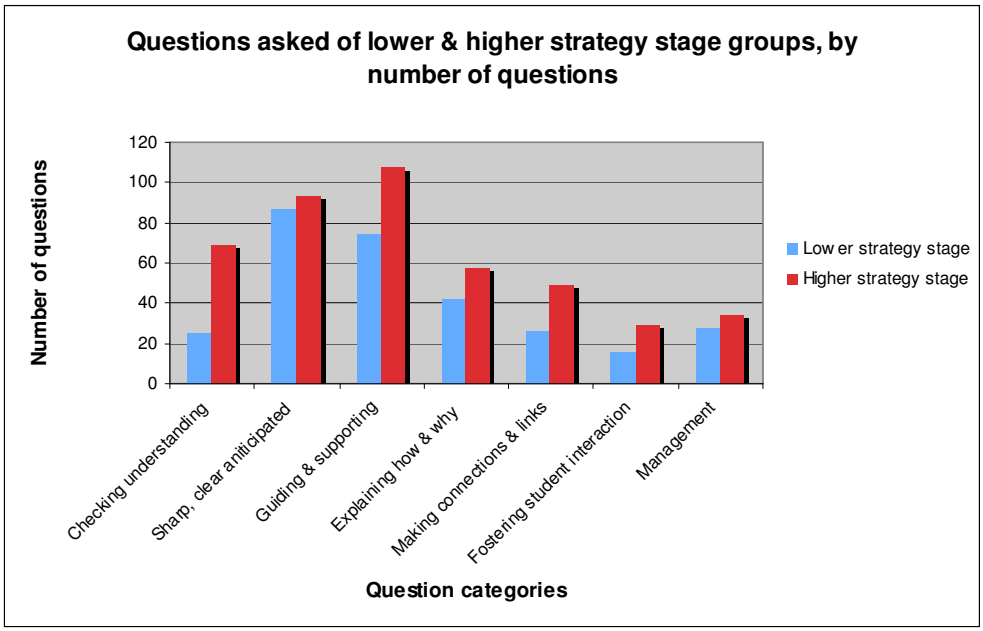

Figure 2. Questions asked of lower and higher strategy stage groups, by number of questions

The TRs were asked to describe any patterns of questioning that they used during a mathematics lesson. The frequency tables helped them to identify the numbers of each category of questions that they asked during different stages of their lesson, and the TRs referred to this data in order to identify patterns in their questioning. However, from the variety of descriptions given by the TRs, no obvious single pattern of questioning over a lesson emerged.

Conclusions

In this project the TRs categorised every question asked in their numeracy lessons. Participants discovered the most useful way to categorise their questions was to reflect on the purpose for which they were asked. This could only be reliably done with the teacher's contextual knowledge, thus it appears that the observation and classification of questions by an outside observer is an unreliable method to uncover the purpose of a teacher's questions. Categorising a question as open or closed, or as lower or higher order, did not prove helpful, as these categories were too broad, and disguised the complexity of teacher questioning. The refined set of categories gave the TRs a common language for discussing the role of questioning in their practice, and for some, helped to sharpen the focus on their purposes for questioning.

Much of the research examining questioning in classrooms has highlighted the high number of questions within a lesson as an issue. The TRs in this study identified at least 158 questions in their hour-long mathematics session and seemed initially to equate the high rate of questioning with effective practice. Also of interest was that the TRs asked close to 50% more questions of students operating at more advanced strategy stages.

Further research is needed to establish:

- the significance – if any – of the number of questions asked;
- the interrelationships between the types of questions used;
- patterns of questions within a lesson;

- relationships between teachers' questions and students' learning.

The unique perspectives of these TRs about questioning provide a valuable contribution to the knowledge base about teaching in this area. The TRs identified many diverse factors that can influence teachers as they formulate and present their questions to students during a numeracy lesson. Their detailed examination of the thinking that underlies the formulation of questions enabled the TRs to examine their metacognitive processes, highlighting some of the intricacies of questioning.

The research team concluded that all question types are important in a lesson; no hierarchy of question types was evident. While there were no common patterns of questioning over a lesson identified during this research, it was clear that the TRs believed it was the combinations of different categories of questions, rather than individual questions, that were powerful in shaping students' learning.

Acknowledgements. The project was reliant on our team of teacher researchers working collaboratively with us and with each other. We are grateful to them for their professional approach throughout the project and to their schools for supporting their participation. This research project was funded by the Teaching and Learning Research Initiative at The New Zealand Council for Educational Research.

References

Allen, R. E. (1990). *The concise Oxford dictionary*. Oxford: Clarendon.

Alton-Lee, A. (2003). *Quality teaching for diverse students in schooling: Best evidence synthesis.* Wellington, NZ: Ministry of Education.

Anthony, G., & Walshaw, M. (2007). *Effective pedagogy in Mathematics/Pangarau: Best evidence synthesis iteration [BES].* Wellington: Ministry of Education.

Askew, M., Brown, M., Rhodes, V., Wiliam, D., & Johnson, D. (1997). *Effective teachers of numeracy in primary schools: Teachers' beliefs, practices and pupils' learning*. London: King's College.

Bloom, B.S. (Ed.). (1956). *Taxonomy of educational objectives: Handbook 1: Cognitive domain.* London: Longman.

Cazden, C. (1988). *Classroom discourse*. Portsmouth, NH: Heinemann.

Cobb, P. (1994). Where is the mind? Constructivist and sociocultural perspectives on mathematical development. *Educational Researcher, 23*, 13-20.

Denscombe, M. (1999). *The good research guide*. Buckingham: Open University Press.

Erickson, F. (1993). Foreword. In M. Cochran-Smith & S.L. Lytle. (Eds.), *Inside outside*. New York: Teachers' College Press.

Fraivillig, J. L., Murphy, L. A., & Fuson, K. C. (1999). Advancing children's mathematical thinking. In J. Sowder & B. Schappelle (Eds.), *Lessons learned from research* (pp.37-38). Reston, VA: National Council of Teachers of Mathematics.

Gall, M. (1971). The use of questioning in teaching. *Review of Educational Research, 40*, 707-721.

Gall, M. (1984). Synthesis of research of teachers' questioning. *Educational Leadership, 42*(3), 40-47.

Hattie, J. (2003, October). *Teachers make a difference: What is the research evidence?* Australian Council for Educational Research Annual Conference: Building Teacher Quality, Melbourne.

Higgins, J. (2003). *An evaluation of the Advanced Numeracy Project 2002*. Wellington: Ministry of Education.

Houston, W. R., Haberman, M., & Sikula, J. (Eds.). (1990). *Handbook of research on teacher education*. New York, Macmillan.

Irwin, K. C., & Woodward, J. (2005). Advancing Pasifika students' mathematical thinking. In F. Ell, J. Higgins, G. Thomas, T. Trinick, & J. Young-Loveridge (Eds.), *Findings from the New Zealand Numeracy Development Projects 2005*, (pp. 80-90). Wellington: Learning Media.

Jacobs, V. R., & Ambrose, R. C. (2003). Individual interviews as a window into teachers' practice: A framework for understanding teacher-student interactions during mathematical problem solving. Proceedings of the 27th International Conference of the International Group for the Psychology of

Mathematics Education, July, Vol. 3, pp.33-38, Honolulu. Nottingham, UK: University of Nottingham.
Kawanaka, T., & Stigler, J. W. (1999). Teachers' use of questions in eighth-grade mathematics classrooms in Germany, Japan, and the United States. *Mathematical Thinking and Learning, 1*(4), 255-278.
Marzano, R. J., Pickering, D. J., & Pollock, J. E. (2001). *Classroom instruction that works: Research-based strategies for increasing student achievement*. Alexandria, VA: Association for Supervision and Curriculum Development.
McClain, K., & Cobb, P. (2001). An analysis of development of sociomathematical norms in one first-grade classroom. *Journal for Research in Mathematics Education, 32*(3), 236-266.
Mehan, H. (1979). *Learning lessons*. Cambridge, MA: Harvard University Press.
Miller, D.M., Wiley, D. E., & Wolfe, R. G. (1986). Categorization methodology: An approach to the collection and analysis of certain classes of qualitative information. *Multivariate Behavioural Research, 21*(2), 135-167.
Ministry of Education. (2006a). *The New Zealand curriculum: Draft for consultation 2006*. Wellington: Learning Media.
Ministry of Education. (2006b). *New Zealand Numeracy Development Projects.* Wellington: Ministry of Education.
Ornstein, A. C., & Lasley, T. J. (2000). *Strategies for effective teaching* (3rd ed.). Boston, USA: McGraw Hill Higher Education.
Perrot, E. (1982/2002). Using questions in classroom discussion. In A. Pollard (Ed.), *Readings for reflective teaching* (pp. 252-255). London/New York: Continuum.
Perry, M., VanderStoep, S. W., & Yu, S. L. (1993) Asking questions in first-grade mathematics classes: Potential influences on mathematical thought. *Journal of Educational Psychology, 85*(1), 31-40.
Redfield, D. L., & Rousseau, E. W. (1981). A meta-analysis of experimental research on teacher questioning behaviour. *Review of Educational Research, 51*, 237-245.
Richardson, V., (Ed.). (2001). *Handbook of research on teaching* (4th ed.). Washington, DC: American Educational Research Association.
Schön, D. (1983/2002). Reflection-in-action. In A. Pollard (Ed.). *Readings for reflective teaching,* (pp. 5-7). London/New York: Continuum.
Shulman, L.S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher, 15*(2), 4-14.
Sikula, J., Buttery, T. J., & Guyton, E. (Eds.). (1996). *Handbook of research on teacher education*. New York: Macmillan.
Stigler, J. W., & Hiebert, J. (1999). *The teaching gap: Best ideas from the world's teachers for improving education in the classroom*. New York: Free Press.
Thomas, G. (1994). Peer discussion and learning in mathematics. In J. Neyland (Ed.), *Mathematics education: A handbook for teachers. Volume 1* (pp.319-329). Wellington: Wellington College of Education.
Vale, C. (2003). Questions in primary mathematics classrooms. In L. Bragg, C. Campbell, G. Herbert, J. Mousley (Eds.), *Mathematics education research: Innovation, networking, opportunity:* (Proceedings of the annual conference of the Mathematics Education Research Group of Australasia, Geelong, pp. 688-689). Sydney: MERGA.
van Zee, E. H. & Minstrell, J. (1998). Preparing teachers as researchers in courses on methods of teaching science. *Journal of Research in Science Teaching, 35*(7), 791-809.
Walsh J.A., & Sattes, B.D. (2005). *Quality questioning: Research-based practice to engage every learner*. Thousand Oaks, California: Corwin Press.
Wittrock, M. C. (Ed.). (1986). *Handbook of research on teaching* (3rd ed.). New York: Macmillan.
Wood, T. (1998). Alternative patterns of communications in mathematics classes: Funneling or focussing? In H. Steinbring, M. Bartolini Bussi, & A. Sierpinska (Eds.), *Language and communication in the mathematics classroom* (pp. 167-78). Reston, Virginia: NCTM.
Wragg, E.C. (1993). *Primary teaching skills: The report of the research findings of the Leverhulme Primary Project*. London: Routledge.
Wragg, E. C., & Brown, G. (2001). (Rev. ed.). *Questioning in the primary school*. London: Routledge/Falmer.