Utilising Year Three NAPLAN Results to Improve Queensland Teachers' Mathematical Pedagogical Content Knowledge

Eduarda van Klinken
Clayfield College
evk@uq.net.au

Poor results in Queensland Year Three NAPLAN Numeracy tests have provided a focus to critically review the classroom practices of lower primary mathematics teachers. This paper outlines how pedagogical content knowledge can be strengthened by emphasising conceptual understanding, by utilising dynamic classroom discourse, by an awareness of bi-dimensional thinking and with an improved understanding of children's typical learning trajectories.

In 2008 the federal government, following international trends, oversaw the first nationally based testing programme in Australia's history. Queensland's poor results in the numeracy component caused considerable alarm, even more so when the resulting state government review highlighted a marked and real decline in numeracy achievement in Queensland since the 1970s (Masters, 2009). The report expressed concerns that teachers lacked *pedagogical content knowledge*; that is, knowledge about "how students understandings in a subject typically develop, how to engage students and sequence subject matter, the kinds of misconceptions that students commonly develop and the most effective ways to teach a subject" (p. 63).

It is the contention of this paper that deepening teachers' pedagogical content knowledge will improve students' mathematical skill development in the years leading up to the Year Three National Assessment Programme – Literacy and Numeracy (NAPLAN). To do this, teachers must utilise the work of various learning theorists, re-balance the emphasis on different aspects of knowledge, increase their awareness of issues related to bi-dimensional thinking and further develop their understanding of children's typical learning trajectories in key topics. Without this, Queensland teachers have the potential to suffer from "shallow teaching syndrome" (Vincent & Stacey, 2008, p. 82), characterised by a dependence on textbooks, low procedural complexity, a high degree of repetition and an absence of reasoning in classroom discussions.

This paper will firstly outline how three influential learning theories can provide a rich platform for teachers as they make day-to-day classroom decisions. The second half of the paper outlines the work of various researchers who have quantified children's typical learning trajectories in mathematical domains that were problematic in the Queensland Year 3 NAPLAN. This pedagogical knowledge assists teachers to critically observe the subtleties of children's responses and to make decisions about where to focus subsequent teaching.

Theories of Learning

When making decisions about how to teach mathematics, it is important that teachers have a deep understanding of how children learn, why some concepts are difficult and how to make teaching choices that will best facilitate students' pathways to mathematical success. Three learning theories will briefly be outlined because of their value in assisting in this task. Cognitive development theories (Siegler & Alibali, 2005) focus on typical developmental steps in children's cognitive development, information processing theories

L. Sparrow, B. Kissane, & C. Hurst (Eds.), *Shaping the future of mathematics education: Proceedings of the 33rd annual conference of the Mathematics Education Research Group of Australasia.* Fremantle: MERGA.

(Hallahan, Kauffman, & Lloyd, 1996) explore how the brain learns, and socio-cultural theories (O'Shea, O'Shea, & Algozzine, 1998) have an interest in how social interactions shape children's learning.

Cognitive development theories are particularly pertinent to this paper because of the developmental changes that are thought to take place around the age of eight, the median age of Queensland Year Three children during NAPLAN testing. At this age, researchers have observed children as being increasingly able to consider other points of view by taking into account competing dimensions (Case, Okamoto, Griffin, McKeough, & Bleiker, 1996; Goswami, 2008). This bi-dimensional thought process is integral to mathematics: being required, for example, to integrate the value of the hour and minute hand on clocks, the value of tens and ones columns in two digit numbers, the dollars and cents when dealing with money and visualising three dimensional shapes from differing perspectives. These are areas in which many Queensland children performed poorly in the NAPLAN test. Critically, they are also foundational to later mathematical success in secondary school as well as giving opportunities to live independent lives.

The second group of theories, information processing theories, do not place the same emphasis on stages of development, but rather focus on the processes involved in human thinking. These theories are interested in how the brain responds to incoming information, the role of memory, automatisation and strategies. They are of particular interest to mathematics teachers because efficient number fact retrieval from long term memory (Baroody, Bajawi, & Eiland, 2009), the flexible use of mathematical strategies (Geary, Hoard, Nugent, & Byrd-Craven, 2007) and an effective memory system are all linked to mathematical performance (Butterworth & Reigosa, 2007).

The role of working memory is of particular interest as it is known to be an important predictor of mathematical proficiency (Wilson & Dehaene, 2007). Swanson and Beebe-Frankenberger (2004) have demonstrated that working memory contributed about 30% to the variability between students' mathematical accuracy when problem solving. Working memory capacity increases with age bit remains problematic for many students with learning difficulties. Therefore, there are important implications for teachers as they make decisions on how to teach concepts in an age-appropriate way and seek to understand why children may be having mathematical difficulty. Teachers must find ways of reducing working memory demands by the development of efficient strategies and the linking of new and old learning to promote long-term memory (McGowan, 2009).

Long-term memory, essential for mathematical performance, is facilitated by the development of schemas. Schemas are the connection in memory of similar ideas and are constructed by the individual after experiencing a number of similar situations (Marshall, 1995). Thinking schematically is a powerful tool in mathematical problem solving. Teaching students to think this way has had positive results in research projects with Year Three students, particularly with low-achieving students (Jitendra, Griffin, Deatline-Buchman, & Sczesniak, 2007). Students are taught to approach problems in a "top-down" approach, searching for patterns in structure before depicting these patterns in diagrams aimed at clarifying the dynamic mathematical nature of the problem. Students taught with a schema approach are able to make mathematical links more easily, become more flexible in their approach, improve their computational skills and maintain their skills over time (Griffin & Jitendra, 2008).

An important tool in making the most efficient use of our memory systems is by the use of effective strategies (Siegler & Alibali, 2005). For most children, strategies are constantly developing as they develop more efficient and reliable methods to solve new problems. By contrast, students that struggle in mathematics rely on oversimplified and inefficient strategies that may be inappropriate to the task (Landeri, Bevan, & Butterworth, 2004). Teachers can facilitate strategy acquisition through classroom discourse that focuses on verbalising strategies, comparing them for efficiency and accuracy (Klein, Beishuizen, & Treffers, 2002). Repetition and revision are important in consolidating strategies and improving their fluency.

The third group of theories, socio-cultural theories, focus on the learning that comes from interaction in society. The theories emphasise the way social discourse, in the form of language and symbols, acts as a means for people to share their ideas, thereby generating new learning. Familiarity with these theories is critical for classroom teachers because of the protracted time students spend interacting with their peers and teachers, either formally or informally. Effective classroom discourse develops conceptual understanding (Kazemi, 2002), improves students' memory for what they have learned (Coffman, Ornstein, McCall, & Curran, 2008), assists in developing a shared understanding of mathematical symbols (Munn, 1998) and is a bridge between concrete and abstract thought (Hopkins, Giffird, & Pepperell, 1999).

Unfortunately, because mathematics is considered to be a subject concerned with symbols, the language of mathematics is not always recognised as important and the particular characteristics of the genre is rarely touched upon in the classroom. Yet an emphasis on teaching the language of mathematics has been shown to be a pivotal point in children's understanding of mathematical tasks (Kenney, 2007). A central argument of Hipwell (2009) is that if teachers are testing mathematical literacies, they need to be planned for and taught.

Teachers need to be aware of complicating factors that are unique to mathematical texts. These include the lack of cue words, the density of the writing, the critical role of small words in giving precise meaning and mathematically specific vocabulary. Texts become more difficult when in the passive voice, when sentence length increases or becomes more complex, when the order of events does not match the order of the required mathematical procedure or when sentences contains negatives that tax young children's developing memory systems (Boaler, 2002; Remillard, 2005).

Mathematical learning is complex and based on the interplay between many skills. This is reflected in the draft of the Australian Curriculum (Australian Curriculum Assessment and Reporting Authority, 2010) which has proposed four strands of mathematical proficiency — conceptual understanding, procedural fluency, problem solving and adaptive reasoning. It is known that the incompatibility between these types of knowledge can lead to systematic mistakes and misconceptions (Westwood, 2000). Teaching procedural fluency in isolation is unlikely to meet with success. Studies where conceptual knowledge has been emphasised above procedural knowledge have found that students with strong conceptual understanding demonstrate knowledge that is more long-lasting and thorough, have greater flexibility in their use of strategies, are more efficient in learning and are more successful in problem solving situations. (Canobi, Reece, & Pattison, 2003).

The development of conceptual understanding is however time consuming. Time constraints on teachers and a desire to reduce the complexity of the task often results in them specifying a procedure, particularly for weaker students (Chan & Dally, 2001). Unfortunately, without conceptual understanding, a student is unlikely to generalise these procedures to similar problems, resulting in them having to learn new procedures for every situation or to unsuccessfully apply one procedure to a related exercise. It is essential then that Queensland teachers have the expertise to spot the "wise point of entry that can move the student to more sophisticated and mathematically grounded understanding" (Walshaw & Anthony, 2008, p. 32).

Using NAPLAN Results to Improve Teacher Pedagogy

An overview of the Queensland NAPLAN results shows weaknesses in some key areas. Some of the difficulties have already been touched upon in this paper — the language demands of some questions are problematic, students may have a mismatch between procedural and conceptual knowledge and the requirement to process two things simultaneously may cause difficulties for others. There are, however, a few subject-specific concepts that have proven challenging for Queensland Year Three students; namely place value, time, money and geometry. These topics will be discussed in more detail with the aim of outlining what researchers believe may be causing the difficulty as well as providing a necessarily brief overview of learning principles and trajectories that can assist teachers in pacing the development of new skills.

Number Sense

The development of place-value concepts is closely linked to a general "feel for numbers" or *number sense.* Number sense is the confident, reliable and efficient grasp of number concepts as well as the ability to flexibly adjust and invent procedures to suit a given mathematical problem (Wilson & Dehaene, 2007). Queensland teachers in the lower primary years need to develop number sense skills in their students by teaching such subset skills as subitising, fluent forward and backward counting patterns, partitioning of numbers, adding and subtracting strategies, comparison of numbers, estimation and the development of a secure internal number line (Anghileri, 2006; Wright, Stanger, Stafford, & Martland, 2006).

Much can be learned about the development of number sense, and in particular the development of mental strategies, by analysing the core ingredients of the Realistic Mathematics Project in the Netherlands (van den Heuvel-Panhuizen, 2008). This project places emphasis on the critical skills that have been highlighted earlier in the paper; teachers understanding of children's typical developmental pathways, the importance of discourse, the use of realistic problems as well as the careful development of conceptual understanding. Mental arithmetic and the development of an internal number line are seen as foundational for developing computation and problem solving strategies. Students are encouraged to develop informal strategies that are used as a starting point for classroom discussion; however, there is also an emphasis on students' learning, recognising and naming commonly used strategies. This gives students a shared language to use with their peers when explaining and justifying their responses. The teacher, with the advantage of specialised training, is able to listen to students' responses, ascertain the degree of sophistication and move to present appropriate follow-up activities.

Time

Questions relating to time rated poorly on Queensland NAPLAN results. This is not surprising as the reading of clocks is one of the most complex of the major symbol systems that confront children, requiring the manipulation of multiple processes (Meewissen, Roelefs, & Levelt, 2004). It is also an essential life-skill, giving all the more urgency for strong foundational skills. Burny, Valcke and Desoete (2009) have listed the skills for reading a clock as including number sense, operations, fractions, geometry, vocabulary, linguistics, visuo-spatial, visual imagery as well as an understanding of arbitrary rules or conventions. Teachers instinctively know what Piaget (cited in Smith, 2009) also found, that the concept of time takes years to develop.

Two distinct parameters of time must be connected in the mind of the child for real conceptual understanding to occur. Firstly there is the concept of *experiential time* (e.g., while an hour may take a long time when one is hungry, it is a short time when one is asleep). Experiential time cannot be "played with" or manipulated in teaching situations, but must be experienced. This is in contrast to *logical time,* which can be induced entirely through reasoning (e.g., if one leaves home at 10.00am, an hour's trip will mean arrival at 11.00am). The complete integration of these two parameters is the aim of classroom tuition (Burny et al., 2009).

Friedman and Laycock (1989) described two distinct developmental levels of clock knowledge that are required before this integration can occur. Teachers must be aware of which level individual students have achieved so that they can provide activities commensurate with their developmental understanding. The most basic level is the ability to look at a digital or analogue clock and read the time. As was discussed earlier, this requires the ability for bi-dimensional thought — simultaneously calculating the movement of the slower moving hour hand and the faster moving minute hand. The second of Friedman and Laycock's levels is the more difficult task of extracting relationships between times by, for example, comparing times or transforming times by adding or subtracting minutes or hours. These tasks require multiple skills and were particularly difficult for Queensland students.

Further confusing the issue are the literacy issues related to time. A quarter to four, 3.45 and fifteen minutes to 4, bear little resemblance to each other. Moreover, children's experience of quarters or halves is often related to shape or a number of objects, rather than the precise moment when a moving minute hand crosses a certain point in its cycle (Brizuela, 2005). If Queensland teachers were aware of the specific problems associated with time, they may not approach the teaching of time in the traditional curriculum sense. Instead they may choose to relate time frequently to real life scenarios to develop the idea of experiential time; and remove either the minute or hour hand altogether to reduce working memory demands until students have a secure sense of the varying roles of the clock hands (McMillen & Hernandez, 2008).

Money

Money related problems on the NAPLAN show that while Queensland students were mostly successful in totalling a number of coins, problems that required further mental steps were more problematic. In this topic, the themes of this paper can usefully be applied by teachers: the use of realistic problems and real coins, the developmental of conceptual understanding, a schematic approach to money problems and a focus on number sense, particularly place value.

In one of the few research projects into the development of money skills, Case et al. (1996) have proposed four stages of development, each increasing in complexity. Stage one relates to problems with large and readily apparent differences (e.g., Which is worth more, dollars or cents?). Stage two requires some sort of numerical focus, but only one type of skill is required for its solution (e.g., How much is 50c and 25c?). Stage three requires bi-dimensional thought, when students might compare quantities along two scales such as dollars and cents (e.g., Which is more, $8.10 or $2.85?). The final stage requires integrated bi-dimensional thought. Students not only focus on the two different scales, dollars and cents, but must also perform some sort of operation on the amounts (e.g. If three apples cost $2, how many apples could you buy for $10?) These final two stages were tested on a number of questions on the NAPLAN and were amongst the most poorly completed on the test. To improve students' understanding, teachers must be aware of the increasing difficulties provided by various complicating factors in money problems and provide teaching that is in keeping with the current conceptual understanding of the individual student.

Geometry

The final topic covered in this paper is geometry. For most questions relating to geometry in the 2008 NAPLAN, Queensland students achieved less than 50% accuracy, making it a key area of concern for teachers. A leading cause is that teachers themselves have a limited understanding of geometry. They misunderstand important geometric definitions and utilise limited and rigid examples when teaching geometric shapes (Clements, 2004). As it is not possible for students to successfully utilise the deductive thinking that is necessary in their secondary school years if prerequisite geometric foundations are not firmly established, it is imperative that primary school teachers further develop their geometric content knowledge in this area.

Geometry, or spatial thinking, is made up of two main skill-sets — spatial orientation and spatial visualization. *Spatial orientation* is the ability to know where an object is in space and its relationship to the position of other objects (such as in mapping). *Spatial visualisation* is the ability to form a mental picture about 2D and 3D shapes as well as the ability to manipulate them by mentally turning them in some way. It is the area of spatial visualisation that proved particularly difficult for Queensland Year Three students and requires increased teacher focus.

The aim for lower primary teachers is to have students consciously, analytically and verbally classify shapes by referring specifically to properties of shapes, such as the number of sides or angles. By teachers providing the widest possible number of examples, students should gradually progress from classifying shapes by their similarity to other shapes, to a more abstract and sophisticated understanding of their properties. These skills may be developed through drawing, measuring, model making and computer programmes that make motion accessible and dynamic (Clements & Sarama, 2007; van Hiele, 1999).

Kosslyn (1983) identified four processes children need to develop when developing expertise in visual images of shapes. These processes can be developed simultaneously in the classroom. The first process is the ability to generate an image though drawing or to identify an image from a picture or object. Secondly is the ability to refer to the specific properties of a given shape. The third process is to maintain a sense of the image when it is moved into another environment (for example, deciding whether the book in your hand will fit onto a bookshelf). The last of the processes is the ability to transform or operate on an image. Clements (2004) found that the easiest of these transformations is to slide an object; more difficult is flipping and the most complex is rotating an object in some way.

Conclusion

The need for teachers to improve their mathematical pedagogical content knowledge was highlighted by the poor NAPLAN performance of Queensland students (Masters, 2009). This paper has outlined the role learning theories and associated mathematical research can play in giving practical guidance to classroom teachers. These include an understanding of typical learning trajectories, difficulties associated with bi-dimensional thinking, the need for balance between conceptual and procedural understanding, issues surrounding memory acquisition, the literacy demands of mathematics as well as the importance of classroom discourse in deepening students' thinking.

The challenges for teachers are enormous. Mathematics in the lower primary school covers many topics that need to be squashed into a limited amount of time. A strong pedagogical understanding allows teachers to meet students at their point of conceptual understanding and to move them purposefully forwards. To improve NAPLAN results and, more importantly, to improve children's mathematical proficiency, Queensland teachers must be given the opportunity to develop this expertise through increased access to high quality professional development and the opportunity to critically reflect on their classroom practices.

References

Anghileri, J. (2006). *Teaching number sense*. London; New York: Continuum.

Australian Curriculum Assessment and Reporting Authority. (2010). *Draft Australian Curriculum*. Retrieved March 6, 2010. from www.acara.edu.au.

Baroody, A. J., Bajawi, N., Prija, & Eiland, M. (2009). Why can't Johnny remember the basic facts? *Developmental Disabilities Research Reviews, 15*, 69-79.

Boaler, J. (2002). Open and closed mathematics: Student experiences and understandings. In J. Sowder & B. Schappelle (Eds.), *Lessons learned from research* (pp. 135-142). Reston, VA: National Council of Teachers of Mathematics.

Brizuela, B. M. (2005). Young children's notations for fractions. *Educational Studies in Mathematics, 62*, 281-305.

Burny, E., Valcke, M., & Desoete, A. (2009). Towards an agenda for studying learning and instruction focusing on time-related competencies in children. *Educational Studies, 35*(5), 481-492.

Butterworth, B., & Reigosa, V. (2007). Information processing deficits in dyscalculia. In D. B. Berch & M. Mazzocco, (Eds.), *Why is math so hard for some children?: The nature and origins of mathematical learning difficulties and disabilities* (pp. 65-82). Baltimore, Md: Paul Brookes Pub. Co.

Canobi, K. H., Reece, R. A., & Pattison, P. E. (2003). Patterns of knowledge in children's addition. *Developmental Psychology, 39*(3), 521-534.

Case, R., Okamoto, Y., Griffin, S., McKeough, A., & Bleiker, C. (1996). Exploring the macrostructure of children's central conceptual structures in the domains of number and narrative *Monographs of the Society for Research in Child Development, 61*(1/2), 59-82.

Chan, L., & Dally, K. (2001). Learning disabilities and literacy and numeracy development. *Australian Journal of Learning Disabilities, 6*(1), 12-19.

Clements, D. H. (2004). Geometric and spatial thinking in early childhood education. In D. H. Clements & J. Sarama (Eds.), *Engaging young children in mathematics* (pp. 267-298). Mahwah: Lawrence Erlbaum Associates.

Clements, D. H., & Sarama, J. (2007). Early childhood mathematics learning. In F. K. J. Lester (Ed.), *Second handbook of research on mathematics teaching and learning* (pp. 3-26). Charlotte, NC: Information Age Publishing Inc.

Coffman, J. L., Ornstein, P. A., McCall, L. E., & Curran, P. J. (2008). Linking teachers' memory-relevant language and the development of children's memory skills. *Developmental Psychology, 44*(6), 1640-1654.

Friedman, W. J., & Laycock, F. (1989). Children's analog and digital clock knowledge. *Child Development, 60*, 357-371.

Geary, D., Hoard, M. K., Nugent, L., & Byrd-Craven, J. (2007). Strategy use, long-term memory, and working memory capacity. In D. Berch, B & M. Mazzocco, (Eds.), *Why is math so hard for some children?: The nature and origins of mathematical learning difficulties and disabilities* (pp. 83-106). Baltimore, Md: Paul H. Brookes Pub. Co.

Goswami, U. (2008). *Cognitive development: The learning brain*. Hove, East Sussex: Psychology Press.

Griffin, C. C., & Jitendra, A. K. (2008). Word problem-solving instruction in inclusive third-grade mathematics classrooms. *Journal of Educational Research, 102*(3), 187-201.

Hallahan, D. P., Kauffman, J. M., & Lloyd, ? (1996). *Introduction to learning disabilities* (2nd ed.). Boston: Allyn and Bacon.
Hipwell, P. (2009). *Towards a whole school approach to literacy teaching: Practical professional development for teachers of literacy at Clayfield College.* Paper presented at the School Literacies Professional Development, Clayfield College, Australia.
Hopkins, C., Giffird, S., & Pepperell, S. (1999). *Mathematics in the primary school* (2nd ed.). London: David Fulton Publishers.
Jitendra, A. K., Griffin, C. C., Deatline-Buchman, A., & Sczesniak, E. (2007). Mathematical word problem solving in third-grade classrooms. *Journal of Educational Research, 100*(5), 283-302.
Kazemi, E. (2002). Discourse that promotes conceptual understanding. In D. L. Chambers (Ed.), *Putting research into practice* (pp. 21-24). Reston, VA: National Council of Teachers of Mathematics.
Kenney, J. M. (2007). Mathematics as language. In J. M. Kenney (Ed.), *Literacy strategies for improving mathematics instruction*. Alexandria: Hawker Brownlow Education.
Klein, A. S., Beishuizen, M., & Treffers, A. (2002). The empty number line in Dutch second grade. In *Lessons learned from research* (pp. 41-44). Reston, VA: National council of teachers of mathematics.
Kosslyn, S. M. (1983). *Ghosts in the mind's machine: Creating and using images in the brain*. New York: W.W. Norton.
Landeri, K., Bevan, A., & Butterworth, B. (2004). Developmental dyscalculia and basic numerical capacities: A study of 8-9 year old students. *Cognition, 93*(2), 99-125.
Marshall, S. P. (1995). *Schemas in problem solving*. Cambridge: Cambridge University Press.
Masters, G. (2009). *A shared challenge: Improving literacy, numeracy and science learning in Queensland primary schools*. Retrieved from http://education.qld.gov.au/mastersreview/pdfs/final-report-masters.pdf.
McGowan, J. (2009). *Working memory.* Brisbane: SPELD.
McMillen, S., & Hernandez, B. (2008). Taking time to understand time. *Teaching Children Mathematics, 15*(4), 248-262.
Meewissen, M., Roelefs, A., & Levelt, W. J. M. (2004). Naming analog clocks conceptually facilitates naming digital clocks. *Brain and Language, 90*, 434-440.
Munn, P. (1998). Symbolic functions in pre-schoolers. In C. Donlan (Ed.), *The development of mathematical skills* (pp. 27 - 46). Hove, East Sussex: Psychology Press.
O'Shea, J. L., O'Shea, J. D., & Algozzine, B. (1998). *Learning disabilities: From theory toward practice*. Upper Saddle River: N.J. : Merrill.
Remillard, J. (2005). Examining key concepts in research on teacher's use of mathematics curricula. *Review of Educational Research, 75*(2), 211-246.
Siegler, R. S., & Alibali, M. W. (2005). *Children's thinking* (4th ed.). Upper Saddler River: Prentice Hall.
Smith, S. S. (2009). *Early childhood mathematics* (4th ed.). Boston: Pearson.
Swanson, H. L., & Beebe-Frankenberger, M. (2004). The relationship between working memory and mathematical problem solving in children at risk and not at risk for serious math difficulties. *Journal of Educational Psychology, 96*(3), 471-491.
van den Heuvel-Panhuizen, M. (2008). *Children learn mathematics: A learning-teaching trajectory with intermediate attainment targets for calculation with whole numbers in primary school*. Rotterdam: Sense Publishers.
van Hiele, P. M. (1999). Developing geometric thinking through activities that begin with play. *Teaching Children Mathematics, 5*(6), 310-325.
Vincent, J., & Stacey, K. (2008). Do mathematics textbooks cultivate shallow teaching? Applying the TIMSS video study criteria to Australian eighth-grade mathematics textbooks. *Mathematics Education Research Journal, 20*(1), 81-106.
Walshaw, M., & Anthony, G. (2008). The teacher's role in classroom discourse: A review of recent research into mathematics classrooms. *Review of Educational Research, 78*(3), 516-549.
Westwood, P. (2000). *Numeracy and learning difficulties: Approaches to teaching and assessment*. Camberwell: David Fulton Publishers.
Wilson, A. J., & Dehaene, S. (2007). Number sense and developmental dyscalculia. In D. Coch, G. Dawson & K. W. Fischer (Eds.), *Human behaviour, learning, and the developing brain*. New York The Guildford Press.
Wright, R. J., Stanger, G., Stafford, A. K., & Martland, J. (2006). *Teaching number in the classroom with 4 - 8 year olds*. London: Paul Chapman Publishing.