**Numeracy Project Pathway Essay**

The role of the teacher is seen as paramount in implementing teaching of the numeracy project. In the introductory framework of the Numeracy Project, it is stated that a teacher’s “subject matter and pedagogical knowledge are critical factors in the teaching of mathematics for understanding…” and, “the focus of the Numeracy Development Projects is improving student performance in mathematics through improving the professional capability of teachers.”

This is in direct contrast to the authors of the Best Evidence Synthesis Iteration (BES) document which refers to a study done by Farquhar (2003) and backed up by Gifford, Perry and Dockett (2004) which says, “At the outset, we want to record that there is limited empirical evidence that links quality

teaching to improved educational outcomes for young children (Farquhar, 2003) and Gifford’s claim that we do not know much about systematically helping children to learn” (Gifford, 2004, p.100). BES authors conclude that “this is an issue for educators because we now have evidence that many basic mathematical understandings are present in young children.” This is a claim that is no surprise to those who have read of the discoveries of Maria Montessori and opens the door for one of the main goals of Te Whaariki’s curriculum, “Children develop the ability to make decisions, choose their own

material, and set their own problems” (Exploration – Mana Aotùroa, goal 1, p. 84).

The 2013 best report claims that highly effective implementation occurs when schools build aspects which have particular significance for school communities into the curriculum to bring meaning to the learning. It endorses a connected approach. The 2010 National Education Monitoring Report on Mathematics refers to the Numeracy framework and highlights the ‘pervasive interrelatedness’ prevalent in the concepts covered in mathematics across attitudes, contents and processes. It cautions educators against assuming that there are clear-cut boundaries in mathematics, and paints a picture of a more holistic framework. In fact, the numeracy project was just that, a project with a multi-faceted approach and guidelines. It is completed. What was supposed to come out of it was a pedagogical change in the way teachers approached mathematics to engage students in real problem-solving and meaningful contexts. It was never intended to be the paint by numbers approach and a set series of steps that it often becomes.

Montessori Mathematics fits within the framework but many of the stages are completed much earlier than national standards benchmarks (the benchmark level for year 5 and 6 students is Stage 6) and this essay will demonstrate and analyse the stages of the numeracy project and align Montessori materials to the concepts to demonstrate that Montessori lessons provide coverage of Advanced Numeracy Project’s (ANP) requirements. According to the guidelines of the ANP that sets outcomes to demonstrate competency in numeracy strategies for New Zealand students, a child who is completing Stage five and ready to move to stage six should be able to read and order numbers to 1000, for example 423, 568, 791, count forwards and backwards by ones, tens and hundreds up to 1000, say the number one, ten and a hundred less or more than another number demonstrating understanding of base ten up to 1000. They can read and order basic fractions such as ½, 1/3, ¼, 1/5 and 1/10.

They should be able to skip count forward and backward in threes (3, 6, 9, 12, 15), round three-digit numbers to the nearest ten or hundred (237 goes to 240, nearest ten and 237 goes to 200, nearest hundred) and know addition facts to 20 (example, 11+9=20, 13 + 7 = 20).

Before entering Stage 5, they will be familiar with numbers up to 100 and what makes ten, count in tens and add tens, skip count in 2s, 5s and 10s, know doubles and halves, teens and read fractions that have 1 as a numerator (unit fractions). Many of these concepts are covered at early childhood level in a Montessori setting and in the 6-9 classroom. Understanding all of these concepts are possible with Montessori materials although it may require some minor adaptations in the use of the material or extensions to lessons. Reading numbers and associating them with quantity begins when numbers are introduced and matched with materials, through cards and counters, then later using the Seguin Boards (teens and tens). As children progress to understand the hierarchical nature of base ten through the golden bead tray, and collecting materials to represent numbers, they are able to explore the quantity of numbers and link them to their numerical representation. At this point they are ready to be introduced to the place value cards and become able to identify numbers more and less up to four digits. This progression builds strong number concepts, especially around understanding quantitative value and it enables children to easily order numbers with a true understanding (as opposed to merely using a formula that they may not understand).

The use of standard colours throughout the materials to represent the different hierarchies means that Montessori children are able to move through concepts more quickly than their counterparts who have to jump from associating large materials representing bigger numbers, to understanding that bigger numbers are written further to the left. Because of the solid foundation Montessori children are given, Montessori students would cover most stage five requirements before six years of age. Similarly, using the bead chains, skip counting and early multiplicative materials means that stage five and six ideas are accessible to even young children. Lessons that have a cosmic education based delivery ensure that the child finds mathematics a meaningful and necessary part of learning, rather than a prescribed set of skills that are easily forgotten. Through stories, links to previous learning and connections to the wider world, children naturally discover and experience the true nature of mathematics.

Using the Montessori strip boards for addition, subtraction, multiplication and division, help students learn their basic facts to twenty. They are able to see patterns and as they move onto the memorisation charts, they can gain mastery at their own pace. Modelling books which are a recommended part of the numeracy lesson in mainstream are unnecessary as the materials are self-correcting and the lesson is the modelling, a shared connection with the materials. Give, share, receive methodology means that the ‘teacher’ is able to see whether or not the child has correctly received the information.

In Montessori, reading basic fractions is a task undertaken by 6-9 year old students as they explore equivalence and adding through materials. This enables students to order fractions easily and understand why.

At Stage 6, Advanced Additive Part Whole, students are required to read, say and order numbers up to 1000000 and decimals to 3 d.p (decimal places, read proper and improper fractions and order fractions with different denominators. They should be able to say numbers 1000 more or less than a given number, identify how many hundreds and tens are in a four digit number, how many twos, threes, fives and tens are in numbers to 100 and their remainders, (e.g. there are five fives in twenty seven and remainder two) and round both numbers to the nearest 1000, 100, 10 and decimals to the nearest whole number (e.g., 5.49 = 5). They will also know groups within 1000 (e.g. 370 + 630 = 1000), subtraction basic facts and how to calculate using algorithms.

Again, because Montessori develop number concepts using materials, these skills are introduced early on using materials such as the snake game which involves splitting numbers and making tens to solve addition problems ( a ‘strategy’ at stage 5/6), the dot game which prepares them for adding columns – numbers according to place value and algorithms, and the multiplication bead board. Fraction circle boards and fraction skittles enable children to move quickly beyond the scope of stage 6 ordering fractions with different denominators and progress to adding, subtracting, dividing and multiplying fractions. By the time students are using this equipment, they are also doing multiple digit multiplication and division using the checkerboard, racks and tubes, subtraction boards and the stamp game. Using the bead chains and checkerboard allows the child to develop mental calculations “spontaneously, as if by a law of conservation tending to realize the ‘minimum’ of effort.” according to Maria Montessori (1919).

By the end of Stage 7, students can confidently work with decimals, equivalent fractions, read seven-digit numbers, Find common multiples and factors, square numbers to 100and divide one digit numbers, tasks that Montessori children have mastered around nine to ten years of age. This is achieved through Large Bead Frame, Division Memorization Boards, Yellow Board (decimal) and the Squaring Material. Abstract ideas like cubing are introduced in the 9-12 classroom through concrete materials, enabling the child to master the concepts naturally. While the numeracy materials, designed to support the programme, include games, colourful dice, counters, teddy bears, and a wide range of plastic pieces and worksheets, Montessori materials have a limited colour palette and are generally made of natural materials to both enhance the child’s connection to the natural world and enable grasping of concepts without distraction or confusion in a manner that was developed through scientific process and has not changed through the decades. (Grizzani, 1977/2004)

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