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The cost of not counting: Developmental Dyscalculia and low numeracy

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Awareness amongst educators of the specific learning disability *dyscalculia* is limited compared to awareness of the better understood condition *dyslexia*. Perhaps as a consequence, dyscalculia attracts far less research funding. According to Butterworth, Varma and Laurillard (2011), the National Institutes of Health (NIH) had spent $107.2 million funding dyslexia research in the United States since 2000, but had spent only $2.3 million on dyscalculia research. This is despite the prevalence of the two conditions being similar. This apparent lack of awareness and action may have consequences for both the individual and the community.

International comparative measures such as the *Programme for International Student Assessment* (PISA) and *Trends in Mathematics and Science Study* (TIMMS) show a decline in mathematics performance in Australia over a period of years. This trend is particularly notable amongst disadvantaged students, with up to 52% of disadvantaged students in Year 4 having difficulties with mathematics (Thomson, 2016; Thomson et al., 2012). While some students may not have been exposed to the necessary high quality teaching that would enable their mathematical skills to develop optimally, others seem to experience difficulties despite appropriate instruction.

In Victoria, the Department of Education and Training (DET) use the Diagnostic and Statistical Manual of Mental Disorders 5th Edition (DSM-5) to define dyscalculia thus:

> Dyscalculia is an alternative term used to refer to a pattern of difficulties characterized by problems processing numerical information, learning arithmetic facts, and performing accurate or fluent calculations. If dyscalculia is used to specify this particular pattern of mathematic difficulties, it is important also to specify any additional difficulties that are present, such as difficulties with math reasoning or word reasoning accuracy.

Dyscalculia can be contrasted with more general arithmetical difficulties as the difficulties are more likely to be persistent. According to Dowker (2004), arithmetic is multi-componential, so children can and do have difficulties with many aspects of arithmetic. Dowker also suggests that these general arithmetical difficulties may be caused by the child's environment, by maths anxiety or by inadequate instruction.

Dowker (2005) suggests that about 20% of students are likely to experience difficulty with mathematics, and Butterworth and Kovas (2013) give the estimated prevalence of dyscalculia as about 3.5-6.5% of the population. Extrapolating to Australian data, this means that there is likely to be about 117,000 students experiencing difficulties with mathematics in Victorian schools alone, with about 29,000 of these experiencing the more severe disability, dyscalculia.

One confounding factor in the diagnosis and amelioration of dyscalculia is the high co-occurrence between various specific learning disabilities (Gathercole, Woolgar, Kievit & Astlr, 2016). About 50% of students with dyslexia are also likely to have dyscalculia (Wilson & Waldie, 2010). If a child is diagnosed as having, for example, dyslexia or attention deficit hyperactivity disorder (ADHD), the difficulties the child experiences in mathematics may be assumed to be due to the dyslexia or ADHD (Butterworth & Kovas, 2013). Although intervention strategies may be implemented to remediate the students' difficulties with literacy or behaviour, it is frequently the case that interventions to remediate the dyscalculia are overlooked.

In turn, this lack of intervention can lead to poor self esteem (Williams, 2012), maths anxiety, and possible behavioural issues (Ashcraft, Krause, & Hopko, 2007; Watson & Boman, 2005). The link between learning difficulties and later delinquency has been established (Morrison & Cosden, cited in Watson & Boman, 2005), with 76% of

juvenile delinquents having literacy and numeracy levels at the middle to upper primary school level.

Recommended instructional models for mathematics instruction incorporate evidence-based strategies such as Bruner's Concrete - Pictorial - Abstract (CPA) approach (Butterworth & Yeo, 2004) or the Concrete - Language - Pictorial -Symbol (CELPS) approach (Liebeck; cited in Westwood, 2000). These approaches may be beneficial for all students, including those with difficulties in mathematics.

The relative lack of awareness amongst teachers about dyscalculia and low numeracy may have a serious impact on students at a personal level and result in an economic cost to the community. This situation could be ameliorated if effective intervention strategies to help such students were used by all teachers.

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