



Students Experiencing Severe Difficulty in Learning Maths: What Resources are Available to Help these Students?

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ABSTRACT

A crunch point in the maths development of some children is Year 4. At this point it becomes obvious they are not only well-below national standards, but they are experiencing such a degree of difficulty in learning maths that they are still working at a Year 1 level or below. This is exemplified by a case study of a student referred to the Resource Teacher Learning and Behaviour (RTLB) service because of severe difficulties with maths learning. This paper discusses the challenge these children pose for their teachers and for the RTLB who support them. It raises the issue of whether some of these students may indeed have dyscalculia. The paper also highlights some appropriate assessment tools and discusses the particular needs of students who have dyscalculic tendencies that manifest at the Year 4/5 class level. A range of readily available resources are discussed including information on how to access them.

Keywords:

dyscalculia, mathematics assessment, mathematics learning

Practice paper

INTRODUCTION

A challenge for both teachers and RTLB alike is how to provide best for the learning needs of students who struggle to learn mathematics. Students who are deemed to be well-below in mathematics after three years at school may be assisted in Year 4 through such programmes as 'Accelerating Learning in Mathematics' (ALIM) (see: <http://nzmaths.co.nz/accelerating>) and COSMDBRIC (an acronym for counting, ordering, sequencing, making, dictating, basic facts, revise game, introduce game, check student profile) (Hirst, 2010). However, there are some students who are not yet sufficiently advanced to benefit from these programmes. Assessing just what strengths and weaknesses these students have in maths can itself be challenging. The most commonly-used assessment tools that the teachers will likely have used are 'Junior

Assessment of Mathematics' (JAM) and perhaps Global Strategy Stage Assessment (GloSS) and Numeracy Project Assessment (NumPA) (see: <http://nzmaths.co.nz/mathematics-assessment>). However, if children are working at Level One or below, none of these tools provides much useful information. Tools such as cognitive profiling systems (COPS) and 'Lucid Assessment Systems for Schools' (LASS) (see: www.lucid-research.com) may provide further guidance on visual sequential memory and the like. However, it may be wise to consider the type of indicators that typify students who have dyscalculia. In New Zealand, thanks largely to the work of leading academics such as Dr Anna Wilson, dyscalculia is now being recognised as a genuine learning disability. The field of educational neuroscience in which she is now a pioneer offers hope for such students and promises to add much quality to teaching practices in the immediate future. Experts such as Dr. Wilson and Professor Brian Butterworth of the Institute of Cognitive Neuroscience at University College, London, claim that as many as six percent of the population may have dyscalculia (Butterworth & Yoe, 2011). If this is the case, then many of the students who fall so far behind their peers in mathematics in their early years of schooling may in fact have undiagnosed dyscalculia.

Research strongly suggests that dyscalculia often occurs in comorbidity with dyslexia and other learning difficulties. It may occur with dyslexia 50 percent of the time, and with ADHD 30 percent (Wilson et al., 2015). It is thought to be a difference in brain function which may run in families (Wilson, 2008). Differences in the functioning of the parietal lobe are involved. Although there is a dyscalculia screener available online, this will only distinguish the dyscalculic learners from other low attaining learners (Butterworth & Yeo, 2011). The Dyscalculia Assessment Tool developed by Emerson and Babbie can give good data on what a child can do and what they think about numeracy (Emerson & Babbie, 2010). Their tool takes more than an hour to administer, but provides data on what the children themselves think about maths, parental voice and the voice of other professionals such as educational psychologists. It also

provides systematic data on performance in maths and considers factors such as confidence and anxiety. Designed for use with primary school-age children it covers six areas: number sense and counting, calculation, place value, multiplication and division, word problems, and formal written numeracy.

However, whilst an RTLB may be asked to support teachers of students in the lower primary who have such problems with mathematics, even this tool produces little data on what these students can do. According to Wilson (2008) three critical skills to explore are:

- subitising such that they need to count all of even small groups of objects, and may know the group name only in a small range of regular patterns;
- having a mental number line fixed in their head such that they can count forward or backwards without having to have a visual prompt and make an accurate estimate of where a number might fall on a blank number line;
- estimating accurately how many objects are in a set without counting.

Such students may know a limited number of basic facts that they have learnt by rote, but be quite unable to transfer this knowledge. For example, they may know that 3 and 4 more makes 7, but have no idea that 13 and 4 makes 17. Typically they will still be unable to image and when using concrete materials they will use their only strategy which is to count. If they are asked to do addition such as 3 plus 4, they will typically go 1,2,3, then there is 1,2,3,4 and altogether there is 1,2,3,4,5,6,7. If one measures their learning on product rather than process one could think them to be more able than they in fact are. Such students by Year 4 may have already developed compensatory strategies to hide their difficulties from others. They will most-likely have also developed a dislike of mathematics, and even be highly anxious about it.

CASE STUDY

Student X¹, an eight year old boy at the time, was referred to the RTLB service by his school at the end of Term 2 of his Year 4 year. His school requested extra support in meeting his learning needs. At this point, despite having had all the programmes the school could provide, he was continuing to have difficulties with learning such that he was deemed to be well- below national standards in maths. He was also behind in literacy, but less extremely so. Despite his seemingly

¹ Permission to publish this small case study has been given by the parent of Student X

normal oral language ability, the gap between him and his peers, in maths in particular, was now much more noticeable than it had been when in Years 1-3. His Year 4 teacher was struggling to cater for his needs in this class with its wide spread of student abilities.

At that point his parents, concerned about his low sense of self-efficacy and increased anxiety, chose to move him to another local school for a fresh start. He settled in well. His new teacher, having observed his extremely-low level in numeracy, asked the RTLB to make this his focus.

Data gathering took the form of observations of his learning behaviour at maths time, teacher anecdotal records of her work with him, a JAM assessment, and an interview with the student himself, as well as one with his parents.

The analysis of the data revealed that although Year 4, Student X was in many ways still at early Curriculum Level 1 for he was missing some of the most foundational learning for maths development; most critically:

- the ability to subitise
- the ability to image a mental number line in his head
- the ability to estimate.

Because he had difficulty with this, he counted everything from one. He could not count on, nor make accurate estimates. Even given extra time to process, he became anxious and this exacerbated his problems with working memory. This was disguised by the fact that he had learnt some things by rote such as '5+5 is 10' even though he clearly failed to understand that this meant one group of 5 plus another group of 5 makes a combined group of 10. He could not show ten with his fingers, but rather held them all up and started counting by pointing to his index finger firstly and then had trouble carrying the count over to his right hand. Although on his JAM test he came out overall around Stage Two or Three, this was not solid because in items involving counting and straight recall he did better. He said emphatically that he was 'dumb' at maths, and didn't want his classmates to see him working with "baby things". His parents' belief was that until this time the extent of their son's learning difficulties in maths had not been fully appreciated. They were in the process of arranging for him to have an assessment with a registered educational psychologist. The RTLB's hunch was that he may well be diagnosed as having dyscalculia.

The initial goals were set just for the three months remaining of the school year. They were SMART goals but were perhaps overly optimistic. They targeted a shift towards the point where the overall teacher

judgement would be that he was now working at Level One. The teacher made adaptations to her class timetable to allow for a daily slot when she would work one-on-one with him using concrete materials, subitising cards, dice, tens frames, number lines and a 100s board. The RTLB attempted to put Mathswizz in place for this student (<http://www.whizz.com>). However, the end of year review concluded that these goals had not been fully achieved. In truth the teacher had not been able to work with him as consistently as she had hoped due to all manner of factors ranging from Student X having lost some days due to sickness, and to school events that increasingly impacted on the class programme as the year came to its conclusion. The RTLB had found that for Student X one-on-one supervision was necessary with Mathswizz because without this the student just practiced his count-from-one strategy, applying this despite the oral instructions.

In the new year, with a new teacher, a new set of goals were set targeting more specifically the three foundational concepts of subitising, developing a mental number line, and estimation. The teacher attempted to work with him daily using resources provided by the RTLB, and a teacher-aide was trained to work with him providing further practice. This was funded by the Learning Support Fund (LSF).

After two terms the review produced data to show while there had been some progress overall (from Stage 1-2 to Stage 3-4 overall JAM), certain key concepts were still poorly developed. Student X struggled to consistently subitise groups up to five, though on good days he seemed to have mastered this, on other days he would revert to counting all the objects. He could count on and back on a number line when it was visibly present, but struggled to do so beyond 20 when having to visualise. Given a blank number line and being asked to mark where a number such as 42 would be, he was more accurate, being now usually within ten numbers of the correct position where initially he could be as far as twenty numbers off.

The referral, having run the maximum forty weeks as per the cluster policy, was discontinued with only two of five goals judged achieved. However, the recommendation was for the approaches being used to be continued for the rest of the year in the hope that given more time they might have yet a bigger effect. The school also created an opportunity for him to work as a pseudo peer tutor when the SENCO works with a younger ORS student on a programme focusing on number patterns.

The RTLB, reflecting on the intervention, felt that this referral had challenged the limits of his knowledge of foundational maths development difficulties despite

having been an (NDP) Numeracy Development Projects Lead Teacher and having considerable junior school experience. Both teachers had been similarly challenged. Student X's parents expressed appreciation of the new school's efforts on their son's behalf. Student X himself said he felt he was doing better, but still hated maths. Should the student be re-referred in the future, what further resources and teaching approaches would the RTLB be able to offer?

Resources: What resources are available for New Zealand teachers and RTLB struggling to provide for students such as Student X?

Resource selector tool: This tool has recently been developed to help educators provide more effectively for their students who are 'well below' in Maths (<http://nzcurriculum.tki.org.nz/System-of-support-incl.-PLD/Resource-selector/Year-1-10-students-below-mathematics-expectations>). It has tabs that hyperlink to support if there is no leadership expertise in that school, and if there is a need for help with effective teaching practice. It also focuses on priority learners with hyperlink tabs including one for students with special needs. One of the helpful new resources that this links to is a Number Framework Matrix produced by the Central Regional Special Schools Cluster. This matrix has two parts: Fuel (PreLevel 1) detailing the steps a child needs to progress through to be ready for Launch. This is the type of tool that would have been helpful for the teachers of Student X who has existed for most of his schooling at PreLevel 1 to Early Level 1. It would support the type of more systematic small step programme that these students need much more than most other students. NZMaths (<http://nzmaths.co.nz/alim-resources>) has the ALIM resources of which Resource A may be useful; in particular difficulty recognising the patterns to 10. NZMaths also has a page called Knowing Five specifically on subitising and offers suggestions of what to try if students get stuck.

Commercial publications: The Dyscalculia Resource Book (Bird, 2011) suggest some teaching strategies and games. The Dyscalculia Assessment (Emerson & Babbie, 2010) also has specific teaching points for each subset of skills.

Apps: Many apps can be found to support subitising and number line concepts (e.g Little Monkeys), however, students need to use headphones to access the instructions. This can reduce the opportunity for the student to talk about his thinking. Furthermore, while working on the iPad, he can be simply practicing the very count-all-from-one strategy that is inhibiting his progress.

Numicon: (www.numicon.co.nz) has a set shape to each of the numbers one to ten, and the holes in

each shape also help some students fix an image of a number in their heads. The highly visual and tactile nature of Numicon resources are particularly beneficial for such students. The manual *Breaking Barriers* is designed for students who are “experiencing particular difficulty in learning maths”, however, learning activities that involve using cuisenaire rods may be too abstract for our Kiwi children.

Digital: There are also a number of computer-based programmes designed to help students with dyscalculia: *The Number Race* by Dianne Wilson (<http://www.thenumberrace.com>) and the more general *Word Shark* (<http://www.wordshark.co.uk/numbershark>). Both *The Pond* (<https://www.pond.co.nz>) and *Pinterest* (<https://www.pinterest.com>) are gateways to access excellent resources on subitising, number lines, and estimating. However, here too it is vital teachers mediate this learning. If teacher-aides are to work with such complex students they will need specific training even as far as following scripts supplied by the teacher and/or RTLB. It is vital that such students are encouraged to voice their thinking in order to overcome the dependence on counting from one. A free online resource has fifty games to help these students break out of the counting trap: (www.sagepub.com/sites/default/files/upmbinaries/27870_02_Ronit_Bird_Ch_01.pdf). It may be helpful to these students to provide models of maths being used in authentic contexts.

SUMMARY

The most valuable resource for students struggling to grasp the basics in maths is their classroom teacher, especially when she/he commits to giving them a few minutes of one-on-one time daily. The missing foundations must be identified and teaching strategies must be systematically put in place in order to plug these gaps. Materials used need not be any more high tech than the old BSM maths gear or authentic materials such as shells or stones. It is vital that teachers direct teacher-aides very specifically when working with these very complex students. The challenge for the RTLB is how to assist teachers and schools as they work to achieve this.

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