This edition explores the broad range of strategies educators utilise to provide an engaging and inclusive mathematics program. Our contributors also address the broader questions of assessment and/or intervention strategies that effectively support students in mathematics learning, explore the role of language in contextualizing mathematics and unpack how we can personalise mathematics to make it relevant.

The first article provides a summary of the Maths for Learning Inclusion initiative. This DECS initiative is managed by the Learning Inclusion Team and supports cluster coordinators across the state in improving maths teaching and learning in the primary years. In this article, Vivienne McQuade explains in detail the Intervention Kit developed to assist students who need intervention in number concepts.

This is followed by an article from Elspeth Harley, DECS Early Learning and Curriculum. She outlines the importance of bringing together the powerful mathematical ideas and learning outcomes into a numeracy matrix that support and encourage early childhood educators to plan, implement and assess their practices.

The DECS Literacy and Numeracy National Partnership (LNNP) is part of the Smarter Schools National Partnership Agreement. Fourteen Numeracy Partnership Coaches are currently working across 49 schools providing in-class support to teachers as they trial and implement new approaches. The next three articles are contributions made by Maureen Davidson, Brianna Jordan and Karly Hefferan who are Numeracy Partnership Coaches.

Simon Fuller from Kensington Centre has provided an article around how neuroscience is assisting in developing a neuro-cognitive profile of students with mathematical learning difficulties.

In the final article, staff at Prospect Centre outline the role numeracy plays in programs that support the development of transferable life and work skills for students with disabilities preparing for post school options.

This edition also includes a new feature entitled Resource Spotlight. It will complement other sections of the publication by highlighting in greater detail a resource (or group of resources) that is related to the topic. The Spotlight article in this edition outlines the importance of barrier games in developing the conceptual language of mathematics.

Jim Sprialis
A/Assistant Manager

For some students, a math disability is driven by problems with language. These children may also experience difficulty with reading, writing, and speaking. In math, however, their language problem is compounded by the inherently difficult terminology, some of which they hear nowhere outside of the math classroom. These students have difficulty understanding written or verbal directions or explanations, and find word problems especially difficult to translate.

Misunderstood Minds http://www.pbs.org/wgbh/misunderstoodminds/mathdiffs.html
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40. **Upcoming Events**
Maths for Learning Inclusion (M4LI) is an initiative focused on improving the teaching and learning of mathematics in clusters of primary schools serving low socio-economic communities. The 2009-10 project, based on a successful Phase 1 version, is currently operating in 28 schools across 6 clusters.

**Aims**
The program aims to systematically improve the engagement and learning outcomes of two specific groups of learners in Years 3-5; students from low socio-economic backgrounds and Aboriginal students. Many of the students in the clusters are identified as having a disability and some of the teacher inquiries into improving pedagogical practice had these students as a focus group.

The aims of the Project are supported by the definition of Key Goals:
- All students achieving
- Challenging and engaging curriculum
- Sustainable professional learning communities
- Improvement informed by evidence.

The agenda for more inclusive and effective pedagogies for learners from low socio-economic backgrounds and Aboriginal learners is supported by resources including:
- A developing research base of successful pedagogies for inclusion
- Learning Inclusion Indicators
- Evaluation data from Maths for Learning Inclusion Phase 1
- Teaching and learning resources evolving and developing in both Phase 1 and Phase 2 of the project.

In 2010 there was greater focus on developing inclusive pedagogies. Teachers with Year 3, 4 or 5 students chose a Pathway inquiry designed to build on professional learning from 2009 while focusing their classroom practice and professional learning on inclusive pedagogies.

The Pathway inquiry supported teachers to use new approaches for teaching and learning. There was significant negotiation about what teachers could do eg.
- introduce new teaching practices into their repertoire.
- trialing various teaching and learning approaches to see which are most successful at increasing the engagement, participation and achievement of low SES and ATSI learners

- using successful strategies from 2009 eg Family Maths Days, increased use of ICT and further identifying the explicit pedagogies most likely to support low students at risk to be successful.

A significant part of the Pathway inquiry was the Show Share Shine concept in which teachers reflected on their learning at Show Share Shine presentation days to their own or other cluster colleagues. Some of the learning about inclusive pedagogies and teaching and learning programs are shared with you in this edition of SERUpdate by other contributors.


Strategies from M4LI are currently being incorporated in other maths initiatives including Maths for All.

**The Learning Inclusion Indicators**
Over Phase 1 and Phase 2, a key focus of the initiative has been developing and increasing teachers’ understandings of our learning inclusion indicators.

The indicators are available in three formats:
- As a list of themes and their indicators
- As a proforma to be used with staff.
- As a PowerPoint which is especially useful for staff PD. It illustrates each statement and has examples of how various schools have used the indicators to reaffirm and further their understanding of learning inclusion.


The Learning Inclusion team are conducting their New Angles on Maths 2010 EXPO on October 25 and 26. See back page of SERUpdate for details.
Intervention Kit
Maths for Learning Inclusion team

The M4LI team addressed assessment strategies to effectively support students in mathematics learning through the development of the Intervention Kit.

The purpose of the Intervention Kit is to:
• discover more about individual student’s mathematics knowledge and the strategies they use in order to improve their understanding and/or address misunderstandings
• use information gained from assessment to plan appropriate intervention.

The Intervention Kit is recommended for Year 3 students and above who need intervention in number concepts. Assessments should be administered to students in a one-to-one setting. Each test takes approximately 20 minutes. All resources needed are in each assessment pack and includes a recording sheet for each assessment.

Schools, teachers and SSOs in M4LI Phase 2 have focused on
• running workshops to create the kits
• establishing structures and practices so that teachers can work with individual students
• developing whole school approaches to using the Intervention Kit
• working with SSOs to develop their mathematical understandings so that when teachers write programs for individual students the SSO can support implementation of the program
• familiarising themselves with the kit
• embedding strategies into classroom routines.

Professor Bob Wright from Southern Cross University in NSW specialises in mathematics education, specifically early number learning and he has led several ARC funded projects on intervention with low-attaining students. He developed the intervention program Mathematics Recovery which is widely used in the US, UK and elsewhere. Professor Wright has co-authored three books on mathematic intervention and classroom teaching of number. He has worked with the Maths for Learning Inclusion initiative for its duration. The initiative’s Intervention Kit is based on his research and has been developed with his collegiate support.
Tasks To Move Students On

A Tasks To Move Students On kit was developed after it was realised that once the Intervention Kit had highlighted areas of concern, teachers needed learning activities to focus the students' learning.

The purpose of the Tasks To Move Students On series of activities is to follow up with identified areas of concern in either the one to one or small group situation which has been identified through using the Intervention Kit. The “Tasks To Move Students On” is for individuals or small groups. All resources needed are within each Tasks To Move Students On pack.

Many teachers have expressed that their learning and understanding of the Intervention Kit and Tasks To Move Student On has been enhanced by having ‘making’ workshops where a whole staff, including SSOs, make and collate kits for their school.

Everything needed to make the Tasks To Move Students On kit is on the website. The six sections encompass activities in which to work one to one with students. The Tasks To Move Student On Kit connects directly with the Intervention Kit. Teachers identify where the child is at by using the Intervention Kit and then work individually, small group or whole class from these tasks to move students on.

In 2010 SSOs working with the Intervention Kit were able to apply for accreditation in the nationally accredited Certificate 3 in Education Support. SSOs working with the Maths for Learning Inclusion Student Assessment and Intervention Kit were able to demonstrate the competencies in three units:

- Numeracy
- Communication
- Diversity (working with student with diverse backgrounds, experiences etc).

The fundamental principle in helping a child with a disability in mathematics is to work with the child to define his or her strengths. As these strengths are acknowledged, one uses them to reconfigure what is difficult.

Maths Monster
The Maths Monster is a take home pack designed to encourage mathematics learning in the home and community. The pack includes the Monster which is a delightful soft toy that goes home with the students. It encourages the student to look for opportunities to both see and engage with the mathematics in the world around them and to bring this learning back to the classroom to share with others. This supports building up the vocabulary of maths in a variety of settings and contexts.

The success of the Maths Monster has been around externalising some negative attitudes to maths. For example the ‘Maths Monster attempted the activity’ as compared to ‘I don’t like maths so I don’t want to do this.’

One important element of the Maths Monster has been allowing students to take a camera home and record the Maths Monster involved in mathematical activity.

For example the Maths monster in the fridge looking for weights and measures or the maths monster helps count money.

… or Take Maths Monster shopping.

Many parents enjoyed supporting their children look at maths through the eyes of the Maths Monster because it was refreshing and non-threatening. Teachers enjoyed the process of students recording their learning and building their mathematical vocabulary. Some teachers used a class take home journal.

For more information about how Maths Monster can support students to connect with mathematical ideas go to http://bit.ly/d621MA.

Providing effective mathematics instruction for diverse and inclusive groups of students required systematic planning and powerful instruction.

In M4LI, Strategies Boards were used to personalise mathematics for individual students. In one class all students were supported to use the Strategy Board. However to scaffold the learning for some, the blue strategy card was developed where it was made very explicit to think about choosing one of three strategies. Each of these strategies was broken down to smaller parts.

Thank you to Kaye Wilson from Marion Primary School for her story of adapting strategy boards for her students. Thank you also to many of the project colleagues, including Matt Skoss, who shared their ideas using strategy boards.
Think Boards

When an answer is given by a student, how do we know what they are thinking? Through the use of a Think Board, students can represent their thinking in a variety of ways. Far too often students are bombarded with mathematical equations involving mathematical symbols that require only one answer represented in one format.

In most cases, the answer is placed in the middle and students are required to create their own questions or representations of that answer. However, for students who have had limited exposure to open ended questions, the Think Board provides a supportive resource for mathematical thinking. The concept or question is placed on the Think Board. The students are required to respond to the question or answer in the following ways:

- **Word problems** – written questions that the students are required to solve
- **Picture** – drawing a picture of what they may be visualising
- **Materials** – readily accessible materials are used to represent the subjects / items within the question posed
- **Number sums** – an opportunity for students to use mathematical symbols.

The Think Board is quite often used as an assessment tool that delves deeper into a student’s understanding of concepts. A question may be given to a student at the beginning of a topic and then again at the end of the topic to compare the learning that has occurred.

The four most important words that could be used within Mathematics are heavily embedded into the use of Think Boards i.e. ‘How do you know?’ The next time you have a student respond to a question you have posed, ask them those four important words and your level of what they understand will provide you with a much richer understanding of what they know.

Think Boards support student learning through exploring one problem more deeply rather than by being overwhelmed by having to complete many problems of the same kind.

Thank you to many of the project colleagues, including Andrea Dineen and Sandra Knox, who shared their ideas using Think Boards. Think Boards have also been reinforced by First Steps in Maths, VELS website and Nelson Maths.

Vivienne McQuade
Curriculum Manager
Learning Inclusion, DECS
Ph 8226 0164
### The Intervention Kit - A Sample

**Maths for Learning Inclusion (M4LI)**  
**Structuring Number: Numbers 1 - 10**  
**Counting Strategies**

<table>
<thead>
<tr>
<th>Counting</th>
<th>Tick what you observe the student doing</th>
</tr>
</thead>
</table>
| a | Trusting the Count:  
Counts each item only once  
Says the number names in the right order  
Moves the counters or keeps track of their starting point |
| b | Needs to recount from the start  
Knows how many there are without recounting |
| c | Recounts from the start each time you rearrange the counters  
Restates the number without counting |
| d | Counting all:  
Counts from the middle counter and includes all of the counters in the count  
Counts from the middle, leaving out the first few items in the row |

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The Intervention Kit brings together a range of resources and ideas from various educators including academics and teachers.

In Phase 2 the Cluster Coordinators have worked with teachers and SSOs to develop understandings and to implement this kit.
**Tasks to Move Students On - A Sample**

### Tasks to Move Students On

**Beginning Multiplication and Division**

**Making Equal Groups**

<table>
<thead>
<tr>
<th>Equal Groups</th>
<th>Counters, calculator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ask the student to make __ groups of __. Ask ‘How many altogether?’ Discuss link between multiplication and addition (i.e. use a calculator, 4+4+4 and compare with 3x4). Encourage student to use summaries to describe their groupings eg. 3 fours, 3 lots of four, 3 groups of four, 3 sets of four and record them as 4+4+4 and later as 3 fours then 3 x 4.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Groups Of</th>
<th>Counters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ask the student to make 4 groups of 5 counters. Ask them to work out how many counters they used without counting. Draw attention to ‘groups of’, counting by 5s, addition (5+5+5+5). Ask the student to write a description of the groups (4 groups of 5 is 20) and then a number sentence (4 x 5 = 20), when they have understood the ‘groups of’ concepts. Repeat with different amounts.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dice Groups</th>
<th>Dice, counters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roll two dice. Ask the student to make groups of using these numbers (i.e. 3 and 4 – student makes 3 groups of four). Ask ‘How many counters altogether?’ (Reinforce ‘groups of’ and skip counting as strategies for working this out)</td>
<td></td>
</tr>
</tbody>
</table>

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“I found that the best thing about using the tasks to move students on was that it developed my own understanding of each of the sections—right back to the basics! It’s like when you just fill in that little gap for the kids the rest makes sense! The example below gives you a taste of the potential of the intervention kit.”

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**Teacher Phase 2**

To move students on if they experience difficulties in Question 1 of Intervention Kit (purple section)

**Tasks to Move Students On**

**Structuring Number: Numbers 1 - 10**

<table>
<thead>
<tr>
<th>Counting Strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ask the student to make __ groups of __. Ask ‘How many altogether?’ Discuss link between multiplication and addition (i.e. use a calculator, 4+4+4 and compare with 3x4). Encourage student to use summaries to describe their groupings eg. 3 fours, 3 lots of four, 3 groups of four, 3 sets of four and record them as 4+4+4 and later as 3 fours then 3 x 4.</td>
</tr>
</tbody>
</table>

**Addition & Subtraction: Numbers 1 - 20**

<table>
<thead>
<tr>
<th>Simple addition and subtraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ask the student to make 4 groups of 5 counters. Ask them to work out how many counters they used without counting. Draw attention to ‘groups of’, counting by 5s, addition (5+5+5+5). Ask the student to write a description of the groups (4 groups of 5 is 20) and then a number sentence (4 x 5 = 20), when they have understood the ‘groups of’ concepts. Repeat with different amounts.</td>
</tr>
</tbody>
</table>

**Using the Base 10 System**

<table>
<thead>
<tr>
<th>Dice Groups</th>
<th>Dice, counters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roll two dice. Ask the student to make groups of using these numbers (i.e. 3 and 4 – student makes 3 groups of four). Ask ‘How many counters altogether?’ (Reinforce ‘groups of’ and skip counting as strategies for working this out)</td>
<td></td>
</tr>
</tbody>
</table>

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**Tasks to Move Students On**

**Saying, Reading and Writing Numerals**

**Beginning Multiplication and Division**

**Multiplication & Division**
Editors note:
This article has an emphasis on effective integration of learning in the early years that allows for the different developmental pathways of individual students. As such, it would have a strong resonance for educators developing a mathematics program for students with disabilities and learning difficulties at other levels of schooling.

In Australia, pressure on first-year-of-school teachers to lift their expectations of young children’s mathematical potential has exerted pressure on prior-to-school educators and parents to ensure, wherever possible, that children starting school can perform at a higher mathematical level than previously expected. This expectation that young children will succeed at more formal mathematics leads to conflict between structured activity and teaching and the play-based, child-centred philosophies of prior to school settings, including child care and preschool.

Inquiry based projects
DECS Early Learning and Curriculum have initiated several numeracy inquiry based projects aimed at building early childhood educators’ confidence and competence in the observation, development, implementation and assessment of meaningful mathematical learning for young children. A focus has been to suggest ways in which this approach can improve the mathematics education of young children without compromising the strongly held traditional principles of sound early childhood practice.

Research
Researchers including Perry & Dockett (2005) have demonstrated that young children are capable of accessing powerful mathematical ideas that are both relevant to their current lives and form a critical foundation for their future mathematical learning. Children should also be given the opportunity to access these ideas through high quality child-centred activities in their homes, communities and prior-to-school settings. Baroody (2000, p.66) suggests that “preschoolers are capable of mathematical thinking and knowledge that may be surprising to many adults”.

Powerful Mathematical Ideas
The notion of powerful mathematical ideas has been used for some time to plan, observe, facilitate and assess young children’s mathematical learning. These powerful mathematical ideas synthesise the finer points of mathematics learning and teaching into the following areas and were used as the basis for planning and assessment by project participants.
- Exploring, analysing and modelling data
- Measurement
- Number
- Pattern and algebraic reasoning
- Spatial sense and geometric reasoning
- Mathematisation
- Connections
- Argumentation.

Learning Outcomes
Belonging, Being and Becoming, The Early Years Learning Framework for Australia documents the following outcomes for children birth to five years and through the transition to school. Early Childhood Educators across Australia are accountable for these outcomes which are broad, observable, and assessable consequences of curriculum that reflect the integration of learning and development and allow for the different developmental pathways of individual children. The outcomes are:
- Children have a strong sense of identity
- Children are connected with and contribute to their world
- Children have a strong sense of wellbeing
- Children are confident and involved learners
- Children are effective communicators.

One of the project strategies was to bring the powerful mathematical ideas and the learning outcomes together into a numeracy matrix that supported and encouraged early childhood educators to plan, implement, and assess their practices.

The Numeracy Matrix
The theoretical basis for the numeracy matrix is that the key determinants of children’s successful outcomes are the pedagogical relationships and practices of educators (Laevers & Heylen, 2004). The elements of the matrix that bring together the outcomes and the powerful mathematical ideas are “pedagogical questions” – questions asked of early childhood educators as to what practices they are using to ensure that their children’s learning outcomes and understanding of the powerful mathematical ideas are developing. The matrix consists of cells in which each cell provides examples of pedagogical questions early childhood educators can ask of themselves to inquire into and reflect on their practice.

Do not worry about your difficulties in mathematics. I can assure you mine are still greater. — Albert Einstein
The answers to these questions will affirm those educators who are working towards these goals, as well as to suggest to them that more experiences might be needed to help the children develop further. These pedagogical questions have relevance to other key learning areas, thus emphasising integration of mathematics with other learning areas. The matrix is a work in progress and as early childhood educators using the matrix become more confident they will make changes to reflect their own context.

See pages 15-16 to view the matrix in its entirety.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Powerful mathematical idea - Connections</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children have a strong sense of identity</td>
<td>How do we encourage children to play and interact purposefully with the mathematics they experience in their lives?</td>
</tr>
</tbody>
</table>

Angela an early childhood teacher working in a preschool setting used the above inquiry question from the matrix to document the following work undertaken with her group of four year olds.

**Mathematicians at work…**

**Spiders need maths when they build their webs.**

Jessica, Molly, Michael, Stirling, Bridget, Sienna, Carla, Rose, Sarita and Faith – Feb 2010

- They construct a web by estimating spaces that are not too big to let insects through and small enough to catch even the tiniest critter.
- They make a repeating web pattern that uses ‘trap’ lines, corners and spirals.
- They somehow spin a web using radial lines to estimate distance and build the frame. They look a little bit like this……..

After strengthening the first thread, the spider will continue to make a Y-shaped netting. The first three radials of the web are now constructed. More radials are added, making sure that the distance between each radial is small enough to cross. This means that the number of radials in a web directly depends on the size of the spider plus the size of the web.

After the radials are complete, the spider will fortify the center of the web with about five circular threads. Then a spiral of non-sticky, widely spaced threads are made for the spider to easily move around its own web during construction, working from the inside out. Then, beginning from the outside in, the spider will methodically replace this spiral with another, more closely spaced one of adhesive threads. It will utilize the initial radiating lines as well as the non-sticky spirals as guide lines. The spaces between each spiral will be directly proportional to the distance from the tip of its back legs to its spinners. This is one way the spider will use its own body as a measuring/spacing device. While the sticky spirals are formed, the non-adhesive spirals are removed as there is no need for them anymore.

**Orb Web Facts**

During the process of making an orb web, the spider will use its own body for measurements. Many webs span gaps between objects which the spider could not cross by crawling. This is done by letting out a first fine adhesive thread to drift on the faintest breeze across a gap. When it sticks to a suitable surface at the far end, the spider will walk along it and strengthen it with a second thread. This process is repeated until the thread is strong enough to support the rest of the web.
Feedback from one of the project participants who trialled the matrix:
When I thought about shapes and geometry I thought all that was needed was for the children to know the names of some regular shapes. It was really not something I thought they would be inquisitive about. By using the matrix, I can see that they can develop their inquisitiveness by asking lots of questions about lots of different shapes in their environment – not just triangles and circles – and can investigate why things are the way they are. This will take them into asking about how things are used, where they come from, whether some shapes are better than other for a particular job, and why some shapes look better than others. It is exciting for the children- and for me!

Learning Stories and the Assessment of Powerful Mathematical Ideas
Learning Stories are qualitative snapshots, recorded as structured written narratives, often with accompanying photographs that document and communicate the context and complexity of children’s learning (Carr, 2001). They include relationships, dispositions and an interpretation by someone who knows the child well. They are “structured observations in everyday or authentic settings, designed to provide a cumulative series of snapshots” (Carr and Claxton, 2002, p.22). Learning stories acknowledge the multiple intelligences and holistic nature of young children’s learning, educators’ pedagogy and the context in which the learning takes place. Educators use their evaluation of the learning story to plan for future, ongoing learning.

Evaluation
By recognising and labelling the pattern on the snails shell, Charlie had demonstrated that he had transferred his learning from the previous week when we used the electronic Smartboard to show the children some ‘fibonacci patterns’ on the shells of some creatures –(Fibonacci, is essentially a mathematical formula used to measure a spiral pattern.) He was able to manage the drawing of a spiral, count 1-1 up to 6 and was able to use planning strategies to set up and draw a race track allowing for some distance for the snails to travel. The race demonstrated Charlie’s thought processes which were very mathematical – he considered distance, time, verbalised knowledge of place values, direction and measurement of size and speed. Using the word ‘both’ is a wonderful word for 2!
Clever Charlie. His concentration was intense and we were so excited to see Charlie so animated and satisfied. Charlie is indeed using mathematical strategies to sort out his understanding of the world around him.

“Snail Pace”
Charlie smiled when given the opportunity to hold his very own snail race. He had been observing the snail collection with the magnifying glasses to, in his words, “see the pattern of the Fibonacci!” A table of snails had been arranged for the children to draw their interpretation of a snails and its shell. Charlie replied ‘okay’ when asked if he would like to join the table to draw the snail and the pattern on its back. He is often reluctant to draw and so my suggestion around perhaps racing them after he had drawn them attracted his attention! He drew 6 beautiful snails with Fibonacci – like patterns on each shell. Charlie counted his 6 snails when requested. Then the racing began…….. I asked Charlie how he would know who was going to finish first or second or third. Without a word (Charlie quite often thinks without verbally expressing himself) Charlie picked up the craypas and drew a vertical line at the right end of his paper. Lining the 3 snails up next to each other on the left side of the paper, and with a smile he said “GO!”. To his obvious delight (he constantly jiggled up and down in his chair and didn’t lose eye contact with the snail’s progress for one second) one snail moved off immediately. “The biggest one is going the fastest!” said Charlie. “C’mon, c’mon”, “yep”. “The littlest is going the wrong direction!” he exclaimed, as one of the snails headed off to the side of the paper. “That way, this way” said Charlie as he pointed to the finishing line, “Ohh, he’s gonna come second.” At that point, another child picked up the misdirected snail and placed it on the back of the snail which crossed the finishing line at the same time. “They both wonned!” exclaimed Charlie laughing as he got up out of his chair leaving the snails for their next adventure.

What next?
Racing!!!
Can Charlie design other animal races keeping in line with our Numeracy in Nature project? Could we engage Charlie in the process of considering how to measure time and distance? Providing him with mathematical tools such as a Pedometer, tape measures and timers may help but requesting his ideas first around measurement is paramount. I must get better at explicitly telling the children in their incidental play that they are being mathematicians when they observe patterns, measure and count. Offer Charlie the scenario – what would happen if we couldn’t measure things like how fast a car was going or how far we had to go? Can he generalise his maths thinking?
The learning stories assessment methodologies allow preschool educators to meet their reporting obligations while remaining true to early childhood philosophies including play and authentic assessment. The development and use of a narrative form of assessment has been a powerful tool in documenting children’s mathematical learning.

**Conclusion**

The inquiry based projects have enabled early childhood educators to:

- Deepen their own mathematical understandings
- Recognise the mathematical learnings children demonstrate in the context of play
- Integrate all areas of mathematics
- Develop knowledge and confidence in assessment and in particular the writing of learning stories and subsequent evaluation of learning
- Share children’s mathematical learning with parents
- Use the matrix and an inquiry question to explore in depth and aspect of children learning.

One educator commented; “my ability to focus on mathematical learning and extend children's individual learning as well as assess it positively using learning stories has been very empowering.”

Children have the potential to be powerful mathematicians but they need enabling learning environments and passionate educators who challenge and nurture their knowledge and understandings. The challenge is for early childhood educators to explore their beliefs and understandings about how children develop their understanding of mathematics and how this effort can be supported through the teaching program.

This paper is adapted from a longer paper written by Bob Perry (Charles Sturt University), Sue Dockett (Charles Sturt University) and Elspeth Harley (DECS) and was published by Early Childhood Research in Practice 2007.

**References:**


Thank you to Angela Plisko for her willingness to share examples of children’s work.

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Policy & Program Officer
DECS Early Learning and Curriculum
elspeth.harley@sa.gov.au

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**CELEBRATING YOUNG CHILDREN’S POWERFUL MATHEMATICAL THINKING**

This series of blackline masters, designed for older students, focuses on everyday practical activities and includes:

- **My Home Skills:**
  - Forms, Food, Measurement
  - Time, Calendar

- **My Community Skills:**
  - Following Directions, Safety, Telephone, Newspaper
  - Goods and Services, Signs
  - Accommodation, Travel, Time
  - Direction, Map Reading

- **My Financial Skills:**
  - Money, Money Handling, Money Management

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- **My Financial Skills:**
  - Money, Money Handling, Money Management
| OUTCOME 1 | Children have a strong sense of identity | How do we encourage children to develop a notion of fairness in their lives? | How do we encourage children to work collaboratively with peers during measurement activities? | What opportunities do we provide for children to seek new challenges and persist in their problem solving? | In what ways do we assist children to represent varied physical activities and games through patterns and symbols? | In what ways are children able to demonstrate flexibility and make choices when playing with collections of everyday shapes and objects? | How do we encourage children to use the process of play, reflection and investigation to solve mathematical problems? | How do we encourage children to play and interact purposefully with the mathematics they experience in their lives? | How do we encourage children to use different communication strategies to organise and clarify their mathematical thinking? | How do we encourage children to demonstrate flexibility and to manage different mathematical ideas as they are presented to them by peers? | How do we assist children to gain confidence in their ability to negotiate possible solutions and share their mathematical learning? |
|-----------|-----------------------------------------|------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| OUTCOME 2 | Children are connected with and contribute to their world | How do we assist children to gather information, ask questions, seek clarification and consider possibilities about their own lives? | What opportunities do we provide for children to see the purpose of measurement in their world? | In what ways do we establish an environment that promotes children’s exploratory drive? | In what ways do we provide opportunities for children to reflect upon their mathematical pattern making? | In what ways do we encourage children to explore relationships among collections of shapes? | What opportunities do we provide for children to develop awareness of similarities and differences among shapes and objects? | What opportunities do we provide for children to explore different perspectives as they attempt to solve mathematical problems? | What opportunities do we provide for children to develop new mathematical ideas? | How do we encourage children to reflect upon and respect diversity and connections between people’s mathematical knowledge and strategies? | What opportunities do we provide for children to develop mathematical thinking with their communication skills so that they can justify their opinions? |
| OUTCOME 3 | Children have a strong sense of wellbeing | How do we encourage children to make choices in their daily routines? | How do we provide the best possible environment in which children can create and synthesise using measurement? | How do we give children opportunities to expand their measurement language? | How do we encourage children to take risks when developing understandings about number? | What opportunities do we provide for children to generate a range of ideas and to use the processes of play, reflection and investigation to find answers to problems? | How do we encourage children to take risks as they seek to find the mathematics in every day life? | What opportunities do we provide for children to use mathematics to help predict and manage change in their daily lives? | How do we encourage children to interact with others to explore ideas, negotiate possible solutions and share their mathematical learning? | What opportunities do we provide for children to develop confidence in expressing their mathematical ideas? | |
### OUTCOME 4
**Children are confident and involved learners**

<table>
<thead>
<tr>
<th>Belonging, Being and Becoming Outcomes</th>
<th>Exploring, Analysing and Modelling Data</th>
<th>Measurement</th>
<th>Number</th>
<th>Pattern and Algebraic Reasoning</th>
<th>Spatial Sense and Geometric Reasoning</th>
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<th>Connections</th>
<th>Argumentation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Outcome</strong></td>
<td><strong>Children are confident and involved learners</strong></td>
<td>How do we support children to explore groups to which they belong, based on particular attributes? What opportunities do we provide for children to explore the ideas and concepts of data representation?</td>
<td>How do we ensure that children have confidence to access and use resources for measurement? How do I support children to choose what to measure, how to measure and how to represent their measurement?</td>
<td>What opportunities do we provide for each child to accept new challenges, make new discoveries and celebrate effort and achievement?</td>
<td>What opportunities do we give children to explore the local environment and record what they see using visual means?</td>
<td>How do we encourage children to actively explore mathematical problems and investigate relevant problems through mathematics? How do we encourage children to use technology to help them solve mathematical problems?</td>
<td>How do we encourage children to use mathematics to be a critical consumer of everyday products?</td>
<td>How do we encourage children to question why their and other people’s mathematical ideas work?</td>
</tr>
</tbody>
</table>

### OUTCOME 5
**Children are effective communicators**

| How do we encourage children to collect, analyse and represent data about their physical activity? How do we encourage children to begin to recognise, discuss and challenge unfair attitudes and actions? | How do we assist children to use pattern making and pattern continuation for problem solving and investigation? | What opportunities do we give children to explore, hypothesise, take risks and engage in symbolic and dramatic play with confidence? How do we encourage children to represent number in a variety of ways? How do we encourage children to talk about and represent their findings? | How do we encourage children to demonstrate an understanding that symbols are a powerful means of communication? | How do we encourage children to participate in group discussions and brainstorms around the properties of shapes? How do we encourage children to use different communication strategies to describe shapes and their properties? | How do we encourage and support children to talk about and represent their efforts to solve mathematical problems? | How do we encourage children to contribute to collaborative group work in mathematics through taking on a variety of roles? | How do we encourage children to participate in group discussion and justification about the solution of mathematical problems? |
Using the Diagnostic Tools to meet Individual Learning Needs

Through my role as a Numeracy Coach the diagnostic tools have been an integral part of working with teachers. The information gained by using the tools has been critical for teachers in developing a deep understanding of their student’s knowledge in the Big Ideas in Number. This has had a positive impact on classroom practice and there has been a noticeable improvement across the school in Numeracy. An increase in time dedicated to teaching Number was evident. Trusting the Count has been a focus of the Early Years Learning Community and students’ understandings of number has dramatically improved. Having worked closely with the diagnostic tools and with students and teachers over the past 12 months the increased knowledge and understanding about Number across the school has been invaluable.

Using the Diagnostic Tools?
Diagnostic testing helps teachers identify what students understand and therefore what needs to be taught in order to meet their immediate learning needs. The diagnostic tools within the Big Ideas in Number are designed to test what students know and identify gaps in their knowledge by unpacking their thinking and understandings. Professor Dianne Siemon of the RMIT University Melbourne, developed these tools and she has specifically chosen diagnostic tools related to significant key concepts, which “if not understood will undermine a student’s capacity to engage meaningfully with core aspects of the Number Strand in subsequent years” (Professor Dianne Siemon, RMIT University, 2009).

Each individual diagnostic tool provides
- detailed information about common misconceptions
- a script for administering each tool
- a list of the materials required (usually common materials in schools, such as popsticks, Unifix cubes and MAB blocks)
- an Advice rubric that suggests further learning activities depending on the student's response.

It is important that when administering the tools teachers are familiar with the script, the materials and the advice before starting, as this gives a clear picture as to what each individual tool is assessing.

The diagnostic tools in the Big Ideas in Number are designed to support six ‘big ideas’: Trusting the count; Place Value; Additive to Multiplicative Thinking; Partitioning; Proportional Reasoning and Generalising. The image below highlights the crucial year levels for understanding in each of the Big Ideas. This is useful when determining which of the diagnostic tools could be used for particular students or year levels.

As educators we understand the challenges associated with providing activities targeted specifically to the needs of each individual. Whether you are working within a small or large class context, the challenges can be very much the same. Students learn and progress at different rates and stages, and will often arrive at your classroom with different understandings or, in some cases, little understanding of a concept. Using the diagnostic tools to identify where students are at provides a strong foundation for teaching and learning.

The first of the tools, Trusting the Count, is an excellent starting point for any student and in particular those who experience difficulties when working with small numbers. This may be from instant recognition of a number (subitising), through to understanding number facts, such as 4 and 3 is 7, and determining an unknown (e.g. “I have 7 objects, if you can see 5 how many are hidden in my cup?”). It is crucial that automaticity of number facts and number knowledge is developed in order for students to work flexibly with larger numbers. As this is a quick tool to implement, it is easy to use with each student in your class to gain an in depth view of where your students are at.
Big Ideas in Number

One of the main benefits of the diagnostics is that you may choose to repeat a tool or part of a tool at several stages through the year to monitor student progress.

Once you have completed assessing all students or a selection of students (such as 3 or 4 students below, at and above standard) it is likely you will find there are several differing levels of understanding that needs to be addressed. There are of course many ways of approaching this and this may depend on the structure of your maths lessons, your daily or weekly timetable and any support a student receives beyond the class teacher.

One of the significant outcomes of the Big Ideas tools is that there is a large focus on students thinking and learning strategies. This encourages students to explain their reasoning, which if adopted as an everyday strategy in maths opens many doors for endless discussions, explorations and reasoning behind why something may or may not be. This caters for students at all levels of learning as they are able to enter conversations and ask questions based on what they know or have discovered. By introducing hands-on equipment into all aspects of learning, students have a platform to work with. You may also be pleasantly surprised as to how older students respond when working with manipulatives.

Using Questioning as an Approach to Meeting Learning Needs

Discussions in classrooms can be used as a springboard for exploring and understanding simple or complex problems. Effective use of questioning and discussions creates an inclusive environment where the learning needs of a class, a group of students or an individual can be addressed as a whole. For example, if you have students who have difficulty with a particular aspect identified by the tools you can use that as a basis for your exploration. Ask students “if someone was having difficulty with knowing a strategy for doubling numbers, (or multiplying a number by four, or recognising 7 on a 10-frame, etc) what strategies do you use that you think could help them?”. By asking students in the class you are allowing the more confident or capable students to further demonstrate what they know by asking them to explain it, or explain something in a different way. You can also encourage others to join in by asking “(student’s name) I know that you enjoy using the counters how might you use the counters to help you do this?”. This offers a variety of understandings for students to try. When using subitising card sets or dot cards questions such as “How many?” “How do you know?” “What can you see?” are excellent questions to encourage discussion points for the multiple ways that numbers can be formed. This knowledge is then transferable into many hands-on classroom activities and extension activities including using counters, 10-frames and class sets of subitising cards where students can practise asking the questions.

After your discussions have taken place, students could participate in activities identified through the tools, to support their needs. This would allow you to work with groups of students more explicitly. Individual groups could share their learning and their strategies. These could also be recorded for the class.

It is important that all students are exposed to a range of strategies that they can use in their everyday maths, regardless of their learning abilities. By using questioning as a part of your daily maths activities, students become more confident and more able to explain or explore the multiple whys of mathematics, eg. why is 5, 5? or why are 3 fours the same as 3 threes?

How Have the Diagnostics Supported Teachers in Classrooms?

Nicky Taylor is a Year 4 teacher at Reynella Primary School and has been using the Big Ideas in Number program and tools since the beginning of 2009. Nicky currently teaches a class of 30 students, including a proportion of students with significant needs. Subitising is a regular activity in Nicky’s mathematics lessons. Nicky’s weekly mathematics program is based on a minimum of 70% Number, focusing on exploring strategies, posing questions and using plenty of hands-on and engaging tasks.

“The diagnostic testing has been a valuable tool in assisting the students in my class with their individual learning. I’ve been able to easily identify concepts in need of extra practice hence bridging the gaps of their learning and boosting their confidence and attitude towards maths.”

Lyn Modistach is a year R/1 teacher at Reynella Primary School. Lyn teaches a class of 26 students, with a range of significantly challenging behaviours and learning needs.
BIG IDEAS IN NUMBER

“I have gained a deeper understanding of the learning needs of all the students in my class by using the Big Ideas in Number diagnostic tools. Trusting the Count tools have helped me too:-

- Assess all student’s mathematical knowledge
- Provide a framework/guideline for all students learning
- Cater for a wide range of abilities
- Address specific learning difficulties
- Implement activities and ideas to further develop all students’ learning needs
- Provide a fun and ‘hands-on’ activities based programme that promotes mathematical learning in a positive way
- Improve my teaching methodologies of mathematics to students in my class.

I can confidently match all students’ performances to the diagnostic rubrics and this tool helps me to provide relevant and practical learning experiences to further extend and support all student’s learning needs. Some children in my class had limited number knowledge, but after participating in lots of Trusting the Count activities their ability to match and count numbers has really improved.”

If you are interested in using the Big Ideas in Number diagnostic tools they can be downloaded at http://bit.ly/I5yWa.

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ENGAGING STUDENTS IN NUMERACY THROUGH TECHNOLOGY

The face of education is changing in this ever advancing technological world. To prepare our students for their future, we need to provide them with the opportunity to use a variety of technological tools as well as the ability to develop new skills as these technologies develop further. It is important that students have a positive relationship with technology where they feel confident to take risks in their learning, challenge their thinking and are immersed and engaged in the development of their understandings. If technological tools are used effectively they can empower learning, transform understandings, ensure higher levels of engagement and provide for the inclusion of all students. This has proved to be all the more important in the development of Mathematical concepts in students in the primary school years.

At Wallaroo Mines Primary School, students have been immersed in technology across the learning areas, with a significant focus on Numeracy. Our goal is to create a learning community where technology can be utilised to enable anywhere, anytime personalised learning. This has put the learning into the hands of the students at the moment they need it rather than only being exposed to technology during the one hour scheduled computer room time. The incorporation of a range of portable technological learning tools has proved to be highly engaging for students of all ages and has allowed for a more authentic inclusion of students with special needs.

Over the past 18 months, Wallaroo Mines Primary School has invested in a wide variety of technological learning tools that have transformed classrooms and pedagogies for the improvement of student engagement and learning. This includes iPod touches, iPads, Netbooks, Flip video cameras, Beebot and Smartboards. These are learning tools that many of the students are familiar with at home and children of this generation relate to, understand and are engaged in already. It makes sense that we take advantage of this technology in schools to provide better learning opportunities for all of our students. Making these tools available means that children who have not been exposed to these technologies at home, will have the opportunity to develop the vital skills and knowledge required to be a technologically literate adult in a future world that we can only imagine.

WMPS purchased five iPod touches in 2009 but recently increased this to 20. These devices currently have 90 educational applications and are fun and easy to use. Students are instantly immersed in their learning through a large range of highly engaging games and activities that are at the tips of their fingers. Students are able to pick up the technology extremely quickly.
Reception students have mastered the art of navigating the software in only a few seconds. Teachers have identified specific apps to deepen the learning with their students and have used them in a diverse range of ways including; small group intensive learning, individualised support for gifted and talented and special needs students, opportunities to practice new concepts and as an incentive to reward quality work and positive behaviour. The iPods are wirelessly connected to the internet and allow the students to access a variety of interactive resources. Students can go from setting up a ‘mini business’ where they are developing their financial literacy skills by working with a budget, supply and demand and advertising. Next they can playing a maths strategy game with a child on the other side of the world and within moments be looking at the streets of the town where that child lives on Google Earth.

The school has also purchased four iPads with the aim of increasing this number to six before the end of the year to enable each class to have their own. iPads are a larger version of the iPod Touch and are proving to be extremely beneficial for students with special needs. They allow students to hold the device and touch the screen directly rather than requiring the hand eye coordination of the mouse on a computer. Students in the early years are developing their fine motor skills as well as engaging extensively with the mathematical concepts that they are developing. The enormous range of educational games and activities range in ability levels from toddler to university level learning and many of them are free to download. Although the applications that have been chosen for the devices cover a range of learning areas many of them are aimed at specifically developing our students’ understanding and confidence in the area of Number. The apps that are regularly used in the Junior Primary and to support the learning of students with disabilities include number tracing, subitising, part whole understanding, number recognition and the development of basic number facts. These apps also support the students’ conceptual development within these concepts by structuring the learning in a familiar and engaging way. KidsCalc is a popular app that allows students to make the link between the addition and subtraction of numbers using visual icons next to the numeral. Upper Primary students can access a range of apps specifically designed to challenge their thinking while practicing mathematical concepts learnt during a lesson. We have found that these devices provide for an extremely inclusive lesson that can be designed to meet the individualised needs of our learners. While participating in an activity, students of varying abilities can be accessing a range of apps, each with varying levels of complexity. This enables students with special learning needs to feel that they are actively participating in a lesson rather than being excluded to work on their own or given a separate activity that may identify them as being ‘different’. Gifted and talented students have also benefited from using the iPods as they are able to continue in an app to the full extent of their ability. This allows them to be challenged in a way that is not always practical in a large class.

Smartboards are utilised in every classroom and the school library. At Wallaroo Mines we have encouraged a culture that immerses the students in technology across the learning areas as well as in the daily routines. The extent at which a Smartboard can be used goes far beyond being a large computer screen or display. Students are encouraged to take a very interactive role in their learning, ensuring the depth of understanding and conceptual development is reached to their highest potential. Data is collected regularly to measure the improvement in students learning. Over the past term, the teachers have recorded significant growth in achievement as well as improvements in the student’s depth of learning and their ability to transfer these skills into other number based activities.

Beebot is a recent addition to the Wallaroo Mines Primary learning community. It is a small robotic bee that can remember up to 40 basic instructions at one time. This learning tool is highly engaging and supports the development of visual and spatial awareness in students of all ages. Beebot has helped students from Reception to Year 7 with concepts of direction, distance, estimation, problem solving, spatial awareness and angles. Junior Primary students have also explored the numbers to 20 on a number line designed specifically for Beebot (eg, if Beebot is on the number 5 how many...
ENGAGING STUDENTS IN NUMERACY THROUGH TECHNOLOGY

During surveys conducted at the beginning of 2010, we found that changes needed to be made to improve the attitudes about numeracy across the whole school community. With this motivation we developed the WMPS Numeracy Blog. This website has been designed to inform students and parents of the wonderful numeracy learning that is taking place at the school. It includes class pages, assembly updates and whole school numeracy events and numeracy challenges that we encourage students to work with their families to solve. This site is still building momentum but has proved to be very popular as interest across the school grows. This website can be accessed at http://wmpsnumeracyblog.primaryblogger.co.uk/ or Google search for ‘WMPS Numeracy Blog’.

The classes at WMPS have also included Flip Video cameras and Netbooks into their daily programs and assessment strategies. The students have the opportunity to film their tasks and explain their learning in an easy and independent way. The Netbooks are wirelessly connected to the internet and will soon be able to connect to the network. We strongly believe that for teachers to be able to prepare students for their future, teachers must have access to current technologies so that they are able to feel confident and provide the best learning opportunities for students. Therefore, all teachers have been provided with a laptop, an iPod (with all apps including the draft of the Australian Curriculum) and a Flip Video camera. Through the immersion of technology across the school, we are creating an environment that will optimise learning, be more inclusive and prepare students for the highly technologically advanced world in which they will live.

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SWITCHING TO MATH

We have 250 students, including 11 mainstream classes, 4 special classes, CPC and specialist Indonesian instruction. Due to the commitment toward student wellbeing and inclusion within our school, students from our special classes are integrated into mainstream classes. This integration occurs through home class activities in the early years while the upper primary attends social inclusion programs within similar mainstream year levels.

As a Numeracy Coach my role has been to implement the Big Ideas in Number (BIN) project which has built on our teachers’ prior knowledge of the Maths for Learning Inclusion Project - a project that our school was fortunate enough to be part of in 2006-2007. The model (displayed overleaf) identifies the conceptual features underpinning our whole school reform in numeracy (adopted from ‘Towards a Profile for Improving Numeracy for all students’ www.thenetwork.sa.edu.au/phna/index.htm).

Staff from both sites have a commitment to research based pedagogical improvement. Our commitment has included professional development on BIN - a research based project from the work of Professor Di Siemon, RMIT University of Melbourne.

As a combined staff we have undertaken extensive professional development on the theory behind the BIN as well as learning how to use the BIN diagnostic testing to inform our practice. The diagnostic information gathered from individual student testing is extremely valuable both for how we teach, and for planning the next step for each student along the learning continuum.

During our daily hour of structured mathematics lessons we are scaffolding students learning, building upon known strategies, working flexibly and developing a deeper understanding of number. Scaffolding the development of our students learning through social interaction with others enhances their ability to work towards individual ‘zones of proximal development’ (Vygotsky 1978).

When learners have lost (or never had) the connection between mathematics and meaning, it is helpful to encourage them to estimate their answers before they begin computing. When children work together in small groups to solve problems, they often ask more questions, get more answers, and do more quality thinking than when they work quietly, alone.

The observable benefits of the partnership across the two schools have included:

**Student outcomes:** high levels of student engagement, students engaging in a technical mathematical language to discuss mathematical strategies such as doubling, producing assembly items, daily maths buddies, producing mathematical activities and exploring mathematics websites at home, using subitising daily, learning strategies for automatic recall and efficient use of number facts and mental facts. This has resulted in students being less reliant on using inefficient strategies such as counting on fingers and using one to one counting.

**Teachers:** reflecting on current research, building pedagogical content knowledge of the Big Ideas in Number framework, taking risks with teaching and learning, working alongside the numeracy coach and using diagnostic data to inform practice, assessment and reporting. Another significant outcome has been working with teachers to identify and plan ‘where to next?’ with teaching for student learning. Teachers have been involved in modelling of best numeracy practice to visiting teachers. The development of home mathematics resources by teachers to support individual learner needs has also been a positive outcome for all.

**Parents:** Newsletters informing parents of strategies and activities that will support their child’s learning, assisting with maths club during lunchtime, participating in numeracy activities during morning drop off times and provision of reception transition session including take home numeracy packs. This has resulted in a stronger school-home relationship and understanding about current numeracy methodologies.

At the recent annual ACER Research Conference 2010, Paul Ernest of Exeter University UK, talked about the social outcomes of learning mathematics: standard, unintended or visionary?

He categorised the outcomes into three areas:

1. **Standard aims of school mathematics:** That we aim to develop numeracy skills that enable our students to function in society, solve problems etc (as demonstrated above in the observable benefits)

2. **Unintended outcomes of school mathematics:** The values, attitudes and beliefs that students develop.

3. **Visionary goals for school mathematics:** mathematical confidence, posing and solving problems, social empowerment through mathematics, and an appreciation of mathematics.

In many classrooms the unintended outcomes are predominantly negative. Students develop negative attitudes to mathematics and the belief that they cannot be successful in mathematics learning.

In my work with Sue Durant and her Junior Primary Special Class at Morphett Vale West Primary School, we have tried to improve student learning outcomes through practices that also lead to positive attitudes and beliefs thus making the ‘unintended’ outcomes positive and intentional. Below Sue describes some of her experiences with having the in-class support of a Numeracy Coach.

I have a class of eight students with a range of intellectual disabilities. My students have been traditionally disengaged when it comes to Maths. Some of this, I believe is due to the fact that I personally have not been very accomplished or enthusiastic when teaching Maths.
However, since our Numeracy Coach, Maureen has been supporting both staff and students at our school all of this has dramatically changed. I am now confident and enthusiastic, and my students are engaged, progressing significantly and most importantly, having fun. They love maths time, especially when Maureen comes into the class, and regularly choose Maths activities during free time.

Some of the student comments about maths are:
Sana – I like doing Maths with Mausie.
Joshua – Doing Maths makes me happy.
John – I like playing Maths games.
Lachie – I love Maths. It’s fun. I like learning my numbers.
Isaac - We do some good work and learn about counting. It’s good fun.

Maureen’s enthusiasm and excitement is infectious and the activities she has introduced are fun and exciting, leading to much more effective learning in a positive environment. Maureen has helped me to assess my student’s knowledge and apply the results to effectively design an appropriate learning program which not only meets their needs, but switches them on to maths in a way I would not have thought possible.

The program is varied, interesting, appropriately targeted for maximum results, engaging and presented in a fun, success oriented manner. The use of new concrete materials introduced through exciting learning games encourages the students to engage in their own maths learning. My students can now all count beyond ten and recognise numerals to ten. By far the most exciting development has been the introduction of the “Trust the Count” idea. This has taught my students to trust their own instincts and take risks with their maths learning that they never would have previously.

The wide range of resources that have been introduced to the class, many of which have had to be altered to cater for my students, has encouraged them to immerse themselves in Maths activities. This includes during free time, as they see the activities as fun games first and learning opportunities second.

These activities are designed to specifically target the special needs of my students and a significant number have needed to be redesigned to achieve results. The outcomes achieved by all students have far surpassed the goals originally set for each student. Perhaps the most significant aspect of the Maths program is the use of Maths Buddies (Year 6/7 students) who work for fifteen minutes daily with the students. This has not only made a massive difference to the maths outcomes for each student involved, but has also enhanced the relationship between my students and the older students who may in the past have bullied or ridiculed my less able students. My students are eager to be chosen and are completely engaged in their learning while working on the buddy program, specifically designed by Maureen for each individual student in my class.

Examples of modifying tasks include minimising reading instructions by using visual cues. Making representations of number using language and symbols to link learning to the real world while creating meaningful experiences using concrete materials.

A firm favourite has been an activity we adapted from Developing mathematics with Unifix’ by Dr Paul Swan and Geoff White creating ‘carriages in the train shed’. Initially this activity was far too complex for our students so we adapted the game. The adapted task was to make two, three and four carriage trains and record the number of carriages in each train. This consolidated students’ counting of objects while developing an understanding of the number in each collection. The more advanced students then arranged the carriages in ascending/descending order and discussed who had more/less and how many more would they need to have the same as another student.

Using a whole school approach to numeracy has promoted a significant and positive change in teaching and learning across both sites. The benefits and expectations developed through the program have created outcomes that were both expected and unexpected, which has fundamentally resulted in successful outcomes for all students.

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Developing a Neuro-Cognitive Profile of Mathematical Learning Disabilities

Teachers can access an extensive research base to understand how children develop language abilities. Advances in knowledge of cognitive processes such as phonological and orthographic awareness are just some of the cognitive processes that assist teachers to learn to help children with reading and spelling difficulties. There have also been significant advances in cognitive neuroscience and psychology over the last decade to understand mathematical development within the brain. The research identifies not only which cognitive functions assist in normal mathematical development, but also identify 'markers' of potential mathematical difficulties within children.

The cohort of students with mathematical learning disabilities is a lot larger than many people realise. Mathematical learning disabilities such as Developmental Dyscalculia, and Maths Anxiety logically fall into this range. However neuroscience researchers also include chromosomal disorders like Fragile X Syndrome and disabilities like Foetal Alcohol Syndrome as indicators of potential mathematical learning difficulties. Neural regions essential for mathematical development have either been malformed or eliminated in people with these conditions. While the prevalence of dyscalculia is around 5% of the population, if all disorders and disabilities with a potential mathematical deficit are included, this range can spiral up to around 12% of the population.

In neuroscience research circles, Developmental Dyscalculia is often used in the same vein as other disabilities like Fragile X Syndrome, Non-verbal Learning Disability and Development Right Hemisphere Syndrome where significant maths deficits are observed. Evaluating all of these mathematical deficits may assist in developing an over-arching neuropsychological profile for the area.

Behavioural Neuro-genetics – A New Trend in Neuroscience

Behavioural Neuro-genetics looks at similar disorders from the alteration or deletion of the same gene site. In a recent study, some researchers hypothesised that there was a molecular link between Fragile X Syndrome, William Syndrome and Velo-Cardio-Facial Syndrome (VCFS) as a result of dendritic organisation affecting the dorsal visual processing stream. The protein FMRP, disrupted in Fragile X, is also altered in the other disorders. The researchers believe that FMRP may be necessary in regulating protein translation at postsynaptic regions necessary for learning and memory (Walter et al, 2009). The continuation of this research is important as all three disorders have a significant visual-spatial maths deficit.

It is possible for educators to see the above work similarly to disorders along the Autism spectrum, whereby the general implications for learning such as the impact of high level anxiety are considered when constructing programs or implementing intervention strategies. The area of Mathematical Learning Disabilities (MLD) identifies for psychologists and teachers a group of disabilities that may have similar or different mathematical deficits, and that dyscalculia is only one of them.

With the use of fMRI imaging, researchers like von Aster and Shalev have been able to start mapping areas of the brain that appear to do specific mathematical functions:
- Bi-parietal – subitising, approximation, comparison
- Left Prefrontal – verbal counting, counting strategies, fact retrieval
- Bi-occipital – written calculations, odd/even

If a parent or colleague states that a student has poor fact retrieval it might be prudent to see if counting strategies are also an issue, as all functions come from a similar part of the brain. This corroborated information may provide a family with significant support in seeking a psychological assessment for their child.

On the other hand, students with identified mathematical difficulties may show strengths in other areas of maths. For example, if a student demonstrates strengths in comparison and subitising, it may be judicious to check if approximation and arithmetic thinking supports this suggestion, as they also come from the same neural region. Consequently, knowledge of neural mathematical structure and function provides not only information about difficulties for teachers but may also help them to build upon any intrinsic strength a student may have.

Recently published research presents the idea that the brain slowly reorganises itself from an early age to be able to perform mathematics into adulthood (Ansari, 2009). This concept has significant ramifications for teachers and parents in helping to nurture normal mathematical development in children, as there are neural-behavioural markers and processes that can be observed.

The language of mathematics is just as symbolic as the language of reading.

The special issue of *Journal of Experimental Child Psychology* (2009) provides some recent developmental studies of numerical cognition. One significant finding was that infants as young as nine months exhibited a similar behaviour to that in adults in distinguishing between a small amount and a large amount of objects (McCrink & Wynn, 2009). Operational momentum is the ability to organise large number operands (initially in addition and subtraction). For example, it is a lot easier to add 7+2 rather than 2+7. Consequently, teachers should be reaffirming to students to modify sums like 4+9 to 9+4 as it is a more 'innate' (and obviously easier) process.

Subitising is another process that is becoming seen as an important ‘marker’ of mathematical development. After a period of time, the brain can instantaneously recognise a numeric amount without counting. Interestingly, subitising can occur with toddlers using amounts of up to three. Subitising uses the same network of occipital and parietal areas of the brain that counting uses (Desoete et al, 2009). Counting is a process that supersedes subitising as children group the amount that they can ‘see’ and then add on. If children cannot recognise amounts at an early age this could be a marker for an impending learning difficulty, if there is not adequate intervention.

These developmental ‘markers’ are very useful in the early intervention and education of children, but need to be used with care. Every child can develop at a different rate, and may complete key developmental stages at different times. However what is described below, demonstrates what is commonly seen as the ‘typical’ pathway of mathematical development.

Developmentally we start as visual-spatial learners in terms of mathematics. Children tend to use an inbuilt visuo-spatial sketchpad to work out quantity and proportion. Concrete representations such as fingers and objects allow children to manipulate quantities and proportions, which is then consolidated subsequently to the visuo-spatial working memory.

Although this stage is highly active and manipulative, it is quite slow and laborious in terms of fact retrieval and work (cognitive load) on the child. The visuo-spatial sketchpad allows us to perceive and understand number sense. However developing verbal counting strategies and using verbal labels for quantitative symbols is a far more efficient process. This is where a shift to the phonological loop (specific left areas of the brain) develops. Fact retrieval becomes more important and verbal counting strategies become more sophisticated. De Smedt (et al, 2009) believes that this shift actually starts around early school age.

This shift is a monumental stage for children as new processes activate different areas of the brain. Children start to rely less on the parietal region and move more to the angular gyrus (AG) as they commit facts to a verbal memory (Dehaene & Cohen 2007).

As children start to access the AG and specific left areas of the brain, they are progressing from manipulation and approximation to providing accuracy and articulation in calculation. However, this does not mean that they lose the ability to approximate but instead start to develop higher mathematical functioning, and use more areas of the brain to perform mathematics.

An understanding of mathematical pre-skills and stages will enhance educators’ ability to better design educational interventions. For example, children tend to learn multiplication by accessing and automatising the verbal memory of the AG (Ischebeck et al, 2009). Educators could use this information two ways. The AG uses language to store information in the verbal memory. Using a sound or song cue may be a fun way in automatising a times-table.

If a student however, has a learning difficulty in using the verbal memory the teacher could then use visual cues to help access the visuo-spatial memory. For example, demonstrating the ‘Add one ten, take off one unit’ pattern in the 9x tables would help the student to visualise – 09, 18, 27, 36 etc.

In a recent study, music-exposure improved spatial learning as well as memory capabilities in other species (Meng et al, 2009). The AG and parietal lobe are greatly stimulated when learning music. Incorporating more music/maths elements into primary maths like rhythmic, pitch and time patterns may improve spatial learning and the development of verbal memory. The parietal lobe is critically involved in learning to read music, as well as knowing where things are in space.

The developed use of fingers in counting, magnitude and memory has become a highly recommended tool by many neuroscientists. Many recent studies have shown that finger gnosis (the inability to perceive magnitude on your hands) is a good predictor of dyscalculia (Conson et al, 2009). A devised 8 week finger training program led to improved numeric skills like subitising and ordinality in children (Gracia-Bafalluy & Noel, 2008).
This research is further supported by a recent study that found when calculation was activated in the IPS (intra-parietal sulcus), a systematic front-to-back arrangement of activation associated with grasping, pointing, attention, eye movement and language activations were also observed (Nieder & Dehaene, 2009).

Maths has traditionally been viewed as an academic activity seated at desks with a lot of symbolic writing. Neuroscience however is suggesting more of an interactive environment based on space, time, direction and magnitude. In other words, if a child cannot perceive their place/space in relation to others and objects, they may have a low conceptualisation of numerate ideas. Children for example, can physically extend their limbs to make shapes before they make them to a smaller magnitude with concrete manipulatives, and then draw them to a smaller magnitude on paper. This gross motor to fine motor skilling is only one way to help develop greater mathematical perception.

Constructing a neuro-cognitive profile of MLD helps provide teachers with a spectrum of mathematical disabilities that can be grouped in terms of mathematical deficit. The neuro-cognitive profile would also outline a mathematical learning pathway, thus outlining markers of ‘typical’ development. Although no one child would have the same developmental learning curve, a child would need to go through all typical mathematical stages to succeed in maths during adulthood.

A greater alliance between neuroscience and education would assist educators and psychologists to better see warning signs of mathematical difficulty and subsequently provide swift and effective help to those children that need it.

References


Simon Fuller
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Simon presented a workshop at the 2010 Special Education Expo entitled ‘Developing a neurocognitive profile of dyscalculia for educators’. This workshop was recorded and will shortly be available for download at http://web.seru.sa.edu.au/Workshops.htm.
Prospect Centre is a Transition centre for senior secondary students preparing for post-school. SACE and VET courses undertaken provide students with the opportunity to develop a range of transferable life and work skills. Explicit numeracy teaching is always followed by guided practical experience until each student becomes confident in their understanding and ability to manage the particular skill. Students are assessed by observation, demonstrated set tasks, practical projects, oral question and answer, work sheets and quizzes.

### Daily Routines

Students practise daily work behaviours thus developing work readiness skills which are assessed each term and reported to schools and parents.

- Every day students are required to ‘sign-in’ as they arrive at the Centre. The sign-in register requires their time of arrival to be documented next to their name. Students must also check the day / date is correct.
- Time management throughout the day is the responsibility of each student. There are two break times - a morning break of 20 minutes and lunch break of 35 minutes. Students are permitted to go ‘off site’ if necessary to purchase food. They are expected to be organised and ready to commence work immediately after these times. Any unexplained lateness is recorded. Many students require consistent practise in this important time management and work preparation skill.
- Students travel to and from Prospect Centre by bus and train. This requires a high level of knowledge of bus timetables, bus stops, bus numbers and ticket purchasing. On-line practise provides students with access to the Metro guide where they demonstrate their knowledge of bus/train timetables. The students also plan outings and excursions within individual programs using the Metro Guide to locate relevant bus routes and times.

### STAGE 1 HEALTH

Numeracy skills which are essential for everyday life such as reading a digital clock and interpreting a bus timetable are reinforced. In this course, students experience numeracy in a large variety of situations. In the SACE Stage 1 Health course there is a major emphasis on physical activity and students have a number of opportunities to measure their physical attributes, estimate distance and results, time their sporting performances and score in a variety of activities. Students undertake a cost benefit analysis on each physical activity and they are required to make a judgement on whether it is value for money. Cost is a big determinant in their choice when negotiating which activities will be undertaken.

### WORK SKILLS PREPARATION

Students in our Work Education group learn what a workplace is like by participating in six days of Work Experience at HandsOn SA, Kent Town and Oakden. Independent travel is encouraged and punctuality emphasised. Students use the bus timetable to determine which bus route to use and work out the time to arrive at their destination and return to Adelaide. After transport training, students meet in the city and travel to Oakden without their teacher.

Students are given a variety of assembly and packaging tasks requested by HandsOn SA’s customers. A certain level of numeracy is required to achieve an accurate result. Counting the number of items of a product is necessary for some of the tasks. For instance, cable ties for electrical work are counted and bundled in lots of 100. To accomplish this task workers use a range of strategies to accurately bundle the required amount.

Some students selected nine plumbing parts, self-checking each bag of parts against the sample given during training. Other jobs entailed counting and bagging 36 antennae parts bundling pamphlets in to 20 or 50 amounts and packaging fish food with the correct weight.

Numeracy tasks test the concentration of some students with a disability. With demonstration and patient training they can achieve required outcomes, some across a range of tasks.

### Practising Numeracy in Community Settings.

The Hyde Street Program provides students with weekly opportunities to buy their own food and drinks in the city and on outings. This means they need to be able to manage their personal budget as well as purchase wisely. Students are encouraged to be independent in terms of their finances. This teaching is reinforced weekly and requires plenty of individual practise.
Students are encouraged to be independent travellers from home which means they learn to organise their time from the start of the day until they arrive home. They learn to read bus timetables and take responsibility for their own time management during the day’s activities. They are assessed on their punctuality throughout the day and become aware of the importance of managing time. Each student pays money for the day on arrival at Hyde St. This experience provides practise in money handling and reinforces the need to check any change given.

The Adelaide railway station also provides a wonderful practical experience for students. They are often quizzed about arrival/departure times and the platform numbers where the trains depart. Students survey the relative prices of healthy food items as this forms an important part of the program. Those students who purchase lunch in the city are strongly encouraged to get best value nutritionally for their money.

Students in their second year in the program are involved in group decision making processes. Their program has a weekly budget from which they operate. Students make informed choices about activity costs and group priorities are established.

Numeracy in Hospitality
Numeracy plays an integral part of the Certificate 1 Hospitality Course. Students shop daily for ingredients for the practical session and compare prices of similar ingredients to identify the ‘best buy’. They check specials prices, estimate prices of individual items and the cost of the total shopping list.

Measuring cups, spoons, scales and jugs are extensively used during practical sessions. Students are taught the importance of measuring accurately and practise using all measuring equipment correctly. Students are also required to monitor their cooking time and appropriate oven temperature settings.

Numeracy in Child Studies
Numeracy skills are developed in the Child Studies course in a variety of ways. Students are required as part of an assessment task related to nutrition and children, to cook a meal suitable for a child of a particular age group of their choice. They are required to apply measurement techniques to their practical task and budget and shop for the activity.

As part of the section on development they plot the growth rate of babies/children’s weight and height on a graph, and learn about the concept of percentiles in relationship to their growth. Their Individual Investigation assessment involves finding out about the ‘Baby Bonus’ and investigating how much it costs to set up for and raise a baby in today’s society. Visits are made to various stores stocking baby goods eg, Toys R Us, Baby Bunting, Department stores, Target, Recycle stores etc. Students are required to cost the items they feel are necessary and compile a list of what they would require, making decisions in relation to the amount of money they would have available and what they consider to be the most important items and the ‘best buys’

Measuring Up to Numeracy
In our Integrated Learning Stage 1 (Wood Workshop) course students need to apply some basic measurement skills to the tasks of designing, cutting out and assembling woodwork projects. The convention of all measurements being in millimetres requires each student to develop, where possible, the ability to accurately measure with a ruler or tape measure or with an accuracy of one millimetre.

Through a series of graded tasks where students begin by measuring small items of less than 100 mm and progressively moving on to larger measurements of 1000mm or more most students have been able to achieve a satisfactory level of skill. This skill is rehearsed frequently to reinforce the students’ learning. A critical factor for success lies in selecting a ruler or tape measure that is only numbered in millimetres without the potentially confusing addition of centimetres.

In our Integrated Learning Stage 1 (Construction Projects) course students measure distances ranging from less than 100mm (in timber construction) to greater than 10 metres (in setting out a site or similar large scale construction). Additionally they need to develop skills in the accurate measurement of volumes (such as in mixing concrete) and the calculation of areas with the use of a calculator (usually to an accuracy of 1 square metre).

As the tasks described above are usually undertaken by a team it provides opportunities for group and individual instruction and also for the more capable and experienced students to mentor those with less developed skills. With practice, most students have shown that they can develop the skills needed to measure distances and quantities to the levels of accuracy needed in the building trades.

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10 MATHEMATICAL POINTS TO CONSIDER

1. Always have an analogue clock alongside a digital clock in your classroom

2. Barrier games are an essential tool for concept development (refer to Barrier Games article in this SERUpdate for more information).

3. Every student needs access to a 0- 99 number chart AND a 1- 100 chart (back to back laminated)

4. A useful place to find out what a student does know is NAPLAN individual results.

5. A useful place to source common misunderstandings students have is the NAPLAN state wide analysis.

6. The four proficiency strands in the Australian Curriculum Mathematics are Understanding, Fluency, Problem Solving and Reasoning. The proficiency strands are the verbs of the Australian Curriculum Mathematics, while the content strands are the nouns!

7. The sequence for teaching and learning measurement is
   1. Identifying the attribute (language experiences, manipulate objects, what can be done to an object without changing the quantity of the attribute present)
   2. Comparing and ordering (compare two first, then seriate three or more examples)
   3. Introduce non standard units
   4. Use standard units
   5. Applications

8. Class teachers need to encourage an environment in which time is given to ponder and unpack the problem. Students need to understand that it is not necessary to always know the answer immediately during a “zone of confusion”.

9. One of the main aims of school mathematics is to create mental objects in the mind’s eye of children. These visualisations need to be manipulated with understanding and confidence. Making mental objects of quantities is called subitising.

10. Understanding fractions must start with the realisation that the original one (whole) needs to be partitioned into equal-sized parts. Students need lots of practice in recognising, folding, cutting, ripping, drawing equal parts of a whole.
What are Barrier Games?

Barrier games are activities based on giving and receiving instructions and require children to interact and use language to complete a task.

Each player needs to pay attention, be patient and be very clear in his/her descriptions or questions asked so that the two pictures match exactly at the end of the game. If the pictures do not match, it indicates that either instructions were not given clearly or that the listener did not listen attentively or understand the concept/s used.

Barrier games are easy to produce using a wide variety of formats and materials.

Barrier Games involve two students working together. They either have a small screen between them or sit back to back. One student provides instructions and the other follows the instructions to draw, create, make or match.

BARRIER GAMES AND MATHS

Barrier games can be a fun way for students/children to develop, understand and practise the language of Mathematics.

There are many basic mathematical concepts that children need to learn both for mathematics and other areas of the school curriculum. Many instructions, for example, that teachers give require understanding of these concepts e.g.

“Write your name **under** the picture that you have drawn.”

“Line up at the door **outside** the Assembly Room.”

Mathematical concepts particularly relating to concepts of Size, Shape, Position (spatial), Quantity and can be practiced whilst playing Barrier Games.

<table>
<thead>
<tr>
<th>SIZE</th>
<th>POSITION</th>
<th>QUANTITY</th>
<th>SHAPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Big/large</td>
<td>Above</td>
<td>All</td>
<td>Circle</td>
</tr>
<tr>
<td>Small/little</td>
<td>Below</td>
<td>Some</td>
<td>Triangle</td>
</tr>
<tr>
<td>Long</td>
<td>Behind</td>
<td>A few</td>
<td>Square</td>
</tr>
<tr>
<td>Short</td>
<td>In front of</td>
<td>None</td>
<td>Rectangle</td>
</tr>
<tr>
<td>Tall</td>
<td>Next to</td>
<td>Full</td>
<td>Hexagon</td>
</tr>
<tr>
<td>Thick</td>
<td>Between</td>
<td>Empty</td>
<td>Pentagon</td>
</tr>
<tr>
<td>Thin</td>
<td>Third</td>
<td>Less</td>
<td>Oval</td>
</tr>
<tr>
<td>Wide</td>
<td>Under</td>
<td>More</td>
<td>Octagon</td>
</tr>
</tbody>
</table>

These concepts can be used when giving instructions about where to place objects as well as describing the objects to be placed.

For example:

Instruction: Put the **biggest** pig **next to** the third door of the barn.

   Place the **triangular** bone near the dog.

Question: Do you mean the **large black and white dog** or the **small brown one**?

Instruction: Place 4 red apples **in** the basket
TYPES OF BARRIER GAMES

simple sequence or pattern making
matching and ordering
coloring in
assembling
constructing
locating – placing objects on a picture or map
mapping – describing and drawing a route between two locations
positioning objects in grids
spotting the difference
dressing dolls and toys

USEFUL MATERIALS TO USE FOR BARRIERS GAMES

picture outlines
maps
blocks
beads
construction materials
counters
magazines
masks
toys
wrapping paper

BARRIER GAMES AVAILABLE FROM SERU

61.0336.01 Barrier Games for Better Communication
61.0489.01 Barrier game: Mr Face
61.0490.01 Barrier game: Simple sequence/Pattern Making (cotton reels)
61.0491.01 Barrier game: Simple sequence/Pattern Making 2
61.0492.01 Barrier game: Matching Pairs
61.0493.01 Barrier game: Felt Play
61.0506.01 Barrier game: Simple Sequence/Pattern Making
61.0507.01 Barrier game: Location
61.0508.01 Barrier game: Over the Shoulder game 2
61.0528.01 Open Barrier game: Where Are They Hiding?
61.0529.01 Open Barrier game: Who Is Driving The…?
61.0642.01 Mr Potato Head barrier game
61.0764.01 My Barrier Games Pack
61.0877.01 Barrier game: My Horses
61.0877.02 Barrier game: Construction
61.0877.03 Barrier game: Maisy Goes to the Farm
61.0877.04 Barrier game; Farm
61.0897.01 Silly City Barrier Game
61.0960.01 Thomas the Tank Engine Barrier Game
RESOURCES RELATED TO THE TOPIC

**The Maths Game: Using Instructional Games To Teach Mathematics, Booker, G 2000. 37.0046.01**
This book shows how the use of games can enhance children’s learning of many mathematical concepts and processes. It contains ideas to assist teachers to develop their own games for classroom use.

**Teaching Maths To Pupils With different Learning Styles, Clausen-May, T. 2005. 37.0058.01**
This resource is suitable for primary and secondary students and examines different ways of teaching maths in order to motivate learners with different learning styles.

**How Do I Teach This Kid? Visual Work Tasks For Beginning Learners on the Autism Spectrum, Henry, K. 2005. 19.0204.01**
This practical book provides ideas for using visual strategies to teach learners with autism. It describes over 80 different work tasks to teach independent work. The activities address skills in six different areas; including mathematics.

**Switch On To Mathematics Lower Primary: Activities in Word, PowerPoint and Excel, Hennessy, Mark. 2009. 64.1497.01**
This resource consists of blackline masters and a CD ROM. The CD contains open ended activities which focus on a particular area of mathematics while developing ICT skills.

**The Ultimate Money Skills Book, Bryar, M. 2001. 64.1282.01**
This is the first book in the series and can be used by teachers in both Primary and Secondary schools. The materials are presented in different units providing practise in the basic skills of money handling, working out money needed, change expected budgeting, saving and banking. Each level has ten sets of practise examples.

**Fractions Game, 2008. 64.1488.01**
This 2-6 player game is designed to assist the development of the ability to convert graphic representations of fractions to simple fractions, decimals fractions and percentages.

**Multi-Coloured Pull Along Train, 2010. 83.1644.01**
This train consists of one engine and two carriages with upright poles on each. Coloured blocks can be stacked to forms patterns. Suitable for pre-school and early years students.

**Math Lotto : A Problem Solving Game, 1997. 64.1370.01**
This problem solving, self checking game for two to six players, provides an introduction to addition, subtraction and multiplication for ages 5-8.

**Math Snap It Up! 2007. 64.1359.01**
This card game, for primary years students, is designed to reinforce multiplication skills using factors 1-10.

**What Teachers Need To Know About Numeracy, Westwood, Peter. 2008 34.0381.01**
This title is one in the series “What Teachers Need To Know About…” The numeracy title explores some of the issues that have emerged over recent years in the area of numeracy teaching. It addresses the degree of balance needed between traditional skills instruction, problem solving and the investigative skills approach.

**Florist, 2010. 82.0612.01**
This game encourages the recognition of colours and shapes using a set sequence. There are six cards that have 12 patterns for different flowers. These flowers can be reproduced on a magnetic board using 37 individual flower parts. Alternately, children could make up their own patterns. Suitable for pre-school and early years students.

**Junior Shapes Pack, 2010. 64.1418.01**
The materials in this pack are intended for students who are learning to recognise and name a range of regular and irregular 2d shapes.

**Criss Cross : A Challenging Word And Number Game, 2005. 85.0561.01**
This word and number game is for 2 players from ages three to adult. In the game, the numbers dealt on the board are the answers. Players must use two of their cards to form a sum that gives one of those answers. The two cards may be added, subtracted, divided or multiplied together to obtain an answer.

**Problem Solving Pack, 2010. 64.1417.01**
The two books and materials in this pack, encouraging problem solving skills, are aimed at students in the primary and middle years of schooling.

**Six Maths Board Games, 2004. 64.1333.01**
This pack of six maths board games is designed for learners in years 3-4. The games cover addition, subtraction, multiplication, division, place value and time.
### ARTICLES RELATED TO THE TOPIC

#### Math Games For Adolescents
Shaftel, J; Pass, L; Schnabel, S  
Teaching Exceptional Children  
Vol 37 No 3, Jan / Feb 2005  
SERU 0854

#### Teach Mathematics: Strategies to Reach All Students
Furner, J; Yahya, N; Duffy, M L  
Intervention In School And Clinic  
Vol 41 No 1, September 2005  
SERU 1044

#### Looking Beyond the Performance of Grave Underachievers In Mathematics
Dettori, G; Ott, M  
Intervention In School And Clinic  
Vol 41 No 4, March 2006  
SERU 1225

#### Learning To Read In Mathematics Classrooms
Meaney, Tasmin; Flett, Kirsten  
Australian Mathematics Teacher, The  
Vol 62 No 2, 2006  
SERU 1237

#### Helping Students with Disabilities Understand what Mathematics Means
Miller, Susan; Hudson, Pamela  
Teaching Exceptional Children  
Vol 39 No 2, September / October 2006  
SERU 1285

#### Teaching Students with Learning Difficulties in Mathematics
Bayetto, Anne  
S P E L D Newsletter  
Spring 2006  
SERU 1320

#### Dyslexia and Maths
Mitchell, Anne; Arkell Helen  
S P E L D Newsletter  
Spring 2006  
SERU 1325

#### Mathematics Accommodations for all Students
Fahsl, Alison  
Intervention In School And Clinic  
Vol 42 No 4, March 2007  
SERU 1410

#### Implementing C R A with Secondary Students with Learning Disabilities in Mathematics
Witzel, B; Riccomini, P J; Schneider, E  
Intervention In School And Clinic  
Vol 43 No 5, 2008  
SERU 1594

Voon Yu, Suet; Murik, Joe  
Special Education Perspectives  
Vol 17 No 1, 2008  
SERU 1604

#### Tools Or Crutches? Apparatus as a Sense-Making Aid in Mathematics Teaching with Children with Moderate Learning Difficulties
Moscardini, Lio  
Support For Learning  
Vol 24 No 1, February 2009  
SERU 1714

#### Using Naplan Items to Develop Students’ Thinking Skills and Build Confidence
Anderson, Judy  
Australian Mathematics Teacher, The  
Vol 65 No 4, 2009  
SERU 1785
Universal Design for Learning (UDL) provides a set of principles for designing relevant and accessible curriculum. UDL is about curriculum that is more flexible and customisable so that individuals can learn in ways that work best for them.

TIMEUDLmath (http://sites.google.com/site/timeudlmath/) is a website that will provide educators with UDL resources and strategies that can be applied in the area of mathematics. The following software resources and descriptions are included:

**Equation Editor in MS Word (2007 and 2010)**
Students with fine motor difficulties may want to try the Equation Editor that is built into Microsoft Word to type mathematical expressions and equations. The new Equation Editor has a much improved user interface that is much easier to use. The Equation Editor is an ideal tool for students with dysgraphia, allowing them to write math equations on the computer.

**Geometer’s Sketchpad**
The Sketchpad is a dynamic construction, demonstration, and exploration tool that adds a powerful dimension to the study of mathematics. The software program can be used to build and investigate mathematical models, objects, figures, diagrams, and graphs. With Sketchpad™, students can be given a tangible, visual way to explore and understand core concepts—from numbers and operations, algebraic thinking, and geometry and measurement in elementary and middle school to algebra, geometry, trigonometry, precalculus, and calculus in high school and college. Concepts that students frequently find difficult become very clear when they see visual representations on the screen and interact with them using Sketchpad.

**MathPad Plus: Fractions and Decimals** offers the same functionality as MathPad—then adds an array of new features! Students can do addition, subtraction, multiplication and division using fractions and decimals. Teachers can enter problems from worksheets or textbooks so students with learning disabilities can work on the same problems as their peers.

SERU has MathPad and MathPad Plus installed on its demonstration computer for visitors to review.

**Jigworks by Crick Software**
http://www.cricksoft.com/uk/products/jigworks/

This flexible tool helps create multimodal jigsaws and inset puzzles. It is ideal for mathematics concepts such as matching, sequencing, shape, number and classification. Sets of related activities can be created for children to work through independently. Ready made activities can be downloaded from the Learning Grids website. However, it only takes a few minutes to create jigsaw activities using any digital picture. Puzzles can be set to have from 4 to 64 pieces. Sounds can be added when you start or complete the jigsaw and to individual pieces. Pieces can be moved without holding the mouse button down. Like all Crick products, Jigworks is fully switch accessible. Suitable for early years and older learners with special needs.

SERU has Jigworks installed on its demonstration computer for visitors to review. Workshops are also offered.
**TechBits**

**iPods/iPads**

These emerging technologies enable inclusive learning programs that follow UDL principles. Their portability supports anywhere-anytime learning and connection to online virtual learning environments that provide scaffolded interaction with multimodal learning tasks. The notion of direct access through touch screen technology is not new to special education. Touch windows that could be added to BBC-B and Apple 2E computers (fitted over the monitor) were used extensively in special education settings in the 1980s to address the physical and cognitive needs of students with disabilities and learning difficulties. This technology has evolved and is now the input method for mainstream devices such as iPhones/iPods/iPads.

A list of iPhone, iPad and iPod touch Apps for Special Education has been collated by Eric Sailer. Jane Farrall (Speech Pathologist, Spectronics) has localised this list for Australia. Her blog entry is available on the Spectronics website ([http://www.spectronicsinoz.com/blog/](http://www.spectronicsinoz.com/blog/)). A range of learning areas are covered including Apps for Communication, Organisation, Reading, Writing, Music, Art, Assistive Technology and Maths. The following Maths Apps with brief descriptions are included.

### Digital Pens

<table>
<thead>
<tr>
<th>123 Animals Counting</th>
<th>Touch 40 different animals with sounds to see and hear numbers counted.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anthimaroo</td>
<td>With time and scores in various levels, the game format makes counting fun.</td>
</tr>
<tr>
<td>Cloud Math</td>
<td>Practice adding, subtracting, multiplying, and dividing with a timer, levels of difficulty, and solution choices.</td>
</tr>
<tr>
<td>Cute Math</td>
<td>Seven cute activities for counting, adding, and subtracting with manipulatives, solution choices, and verbal praise.</td>
</tr>
<tr>
<td>Freddy Fraction</td>
<td>Use Freddy, an alien, to determine the equivalence among fractions, decimals, and percents.</td>
</tr>
<tr>
<td>Graphing Calculator</td>
<td>Scientific calculator and high resolution function plotter to trace multiple equations on the same graph.</td>
</tr>
<tr>
<td>KidCalc Calculator for Children</td>
<td>Activities for number recognition, counting, and math operations using flash cards, puzzles, and games.</td>
</tr>
<tr>
<td>Kids Math Fun~ Kindergarten</td>
<td>With choices and data collection, practice addition and subtraction of two single digit numbers.</td>
</tr>
<tr>
<td>Math Drills</td>
<td>Drills for adding, subtracting, multiplying, and dividing with number lines, hints and facts.</td>
</tr>
<tr>
<td>Math Magic</td>
<td>Adding, subtracting, multiplying, and dividing with visual supports, solution choices, reinforcers, and rewards.</td>
</tr>
</tbody>
</table>

**Pulse Smartpens**

Pulse Smartpens provide teachers with a tool to create pencasts much like podcasts. An audio recording of explanations can be captured whilst writing notes and drawing diagrams on the special Pulse Pen paper. The recording can then be uploaded to the Livescribe desktop software when the pen is connected to a computer. The Flash movie created from this upload process displays a video of the recorded pen strokes.

The recorded audio plays back in sync with this video to provide students with a multimodal replay of the mathematical concept or process.

The Livescribe Desktop software can also be used to upload a pencast to the Livescribe Online Community Space. Teachers can choose to share it as a public resource or send a link of this online resource to their students.

Pencasts can also be embedded on to a website or blog. A dedicated tool at [http://jamessocol.com/pencast/](http://jamessocol.com/pencast/) can be used to create the embed code for a wiki.

Examples of pencasts, including ones with a mathematical focus, can be viewed at Livescribe web site. [http://bit.ly/oPAnL](http://bit.ly/oPAnL)

The author of this article explains how math disabilities are identified and how parents can work with teachers to help their children.

ONLINE ACTIVITIES

http://www.kidsites.com/sites-edu/math.htm
A range of maths games and activities for ages 13+

http://www.mathplayground.com/
Math Playground, is a website for primary and middle school students / children where they can practise their maths skills and play a logic games.

http://www.mathforum.com
This American online resource is designed to improve math learning, teaching, and communication. Produced by teachers, mathematicians, researchers, students, and parents it offers problems and puzzles; online mentoring; research; team problem solving; collaborations; and professional development.

http://www.mathleague.com
This site features a set of interactive arithmetic lessons - Kindergarten to Year 8. Practise is available on each topic through a wide range of lessons, interactive practise and games. It offers the four operations, decimals, equations, estimation, fractions, geometry, graphs, measurement, patterns, ratio, percent, place value and money (US).

www.figurethis.org
Figure This! demonstrates challenging middle school mathematics and emphasizes the importance of high-quality math education for all students that can be carried out in school or at home.

Maths Online is an online maths tutoring program based on Australian state curricula for Years 7 - 12. The program features hundreds of fully animated and narrated maths lessons with over 15,000 exam-style questions to test a student’s mastery of maths.

www.mathcats.com
This interactive math site provides a range of math activities suitable for primary age learners.

www.mathleague.com
The Math League provides a range of challenging mathematics materials to students. League specialties include math contests, books, and computer software designed to stimulate interest and confidence in mathematics for students from mid-primary through to high school.

http://www.amathsdictionaryforkids.com/
This animated, interactive dictionary site for students explains over 600 common math terms and words in simple language.

www.funbrain.com/numbers.html
An extensive list of online converters and calculators to assist with items such as fractions, prime numbers, quadratic equations and conversions in temperature, length, area and volume.

This website provides research links and practical suggestions for incorporating virtual manipulatives into mathematics instruction. The Resources section has extensive links to interactive sites including The National Library of Virtual Manipulatives, Illuminations, Arcytech, Shodor, MathTools and other quality virtual manipulatives.

http://www.ct4me.net/math_manipulatives.htm
The Maths Manipulatives site begins with a short virtual manipulatives essay which addresses a definition of a virtual manipulative, the role they play in learning and cautionary statements about using and overusing manipulatives and calculators. There is also an extensive list of links to interactive online resources.

http://www.techtrekers.com/sim.htm
This site has a very extensive listing of interactive math simulation applets. Many can be downloaded for offline use. Simulations in the sciences are also listed.

www.coolmath4kids.com/
A range of maths games and activities for ages 13+

http://www.abc.net.au/countusin/default.htm
Count Us In: A range of 15 free activities dealing with counting, patterns, sorting, time, volume and height is provided.

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SERU Ning

The SERU Ning website has been operating since July. It enables members to join or create interest groups, participate in forums, share ideas and upload resources. There are currently 54 members and five groups have been established. One is a special education teachers network that has been running for a number of years in the North East district. It will now trial the use of the Ning online community to supplement the face to face meetings that occur each term.

The SERU Ning environment will provide:

- Professional learning opportunities to discuss, share and collaborate on issues concerning students with disabilities and learning difficulties
- Professional learning support for communities involved in SERU and other DECS projects
- A gateway to blended eLearning events and hosting of online conferences.

The SERU Ning is also an opportunity for all DECS staff to create and manage an interest group or existing network in their district or cluster of schools. Please feel free to contact an administrator of the site to discuss how you can be supported in planning and establishing your own online group. Please note that the SERU Ning is for DECS personnel only. You cannot create a group for your class and enrol your students. Visit the Ning web site (http://www.ning.com/) to investigate plans suited to classroom use.

Who can join?
All DECS staff are eligible for membership. Specialist contributors may be invited for some professional collaboration.

How do I join?
Go to http://specialeducationresourceunit.ning.com and Sign Up using a valid DECS email address. If you have difficulties, send an email (from your valid DECS address) to admin@seru.sa.edu.au and request a Ning Invitation.
NEW RESOURCES

This book addresses some of the specific issues around dating faced by teens with AS. Written in a question and answer format, the book offers practical advice on dating challenges. Each topic is followed by discussion questions. Special notes that define vocabulary and concepts of today’s dating world are also included.

The activities in this book can be used to facilitate improved speech intelligibility and to encourage phonemic awareness in students up to Years 3/4. It is also suitable for older students experiencing difficulties with reading and spelling.

Dalwood Spelling Test, Knight, D. & Baker, J. et al. 2008. 55.0136.01.
This standardised test of spelling achievement for students from kindergarten to year 10. It has been designed to give classroom teachers a fast and reliable means to identify students with spelling weaknesses and to evaluate the progress of students over the school year.

Hygiene and Related Behaviours For Children and Adolescents with Autism, Mahler K. 2009. 66-1430-01.
This resource is a comprehensive curriculum for teaching social understanding and hygiene and self care for adolescents with high functioning Autism and Asperger’s Syndrome.

This resource is for teenagers with ASD and their families. It addresses ideas, processes and strategies for housing options, post secondary education, employment and recreation/leisure activities.

This brightly coloured jigsaw puzzle depicts 27 vehicles that are used for many different purposes.

This illustrated guide presents the major developmental stages in a child’s life from birth to 16 years. The DVD gives further insight into each stage of development.

Each of the seven chapters addresses an issue relating to ASD’s eg sensory, social, behavioural and educational. Various strategies and considerations are discussed.

All of the items in this pack (train, peg knitting dolly and knitting mushroom) encourage the development of fine motor and eye hand co-ordination skills.

Multilit Word Attack Skills Extension Program, 63.2792.03
This program follows on from the Multilit Word Attack Skills (WAS) in the Multilit Reading Tutor Program (rev 2007). It shares many feature of the WAS and has been designed to help struggling readers learn skills and strategies required to read multi syllabic words that make up most of the text students will encounter in the middle grades (years 4-8).

Mini Jigsaw Pack, 2010. 81.1646.01
This set of 6 mini jigsaws consists of an aeroplane, car, dinosaur, dolphin, train and tugboat. Each puzzle has 3-4 pieces and encourages visual discrimination and fine motor skills.

This portable carry pack with adjustable strap and velcro fastener contains 9 tactile fiddle toys.

This book links current evidence from cognitive neuroscience research with the implications for learning. The author offers advice on how neuroscience can help with teaching and includes practical classroom examples and real life case studies.

Think Organise, Write: Turn Thinking into Writing Using graphic Organisers, Quill, A & Townsend, A. 2009. 67-0554-01.
In this book the authors show students how to progress from recording ideas using a graphic organiser, to composing a written response according to the ideas collected via a graphic organiser.

This set is made up of 3 families each consisting of 8 wooden figures each representing Western, Asian and African American cultures.
**NEW RESOURCES**

**Mix and Match Vehicles, 2010. 82.613.01**  
This game is played with 32 tyre shaped cards. Three different games are suggested, two of which involve matching and one involves matching and descriptive language.

**We Can Work It Out: Conflict Resolution For Children. Polland, B. 2000. 66-1432-01.**  
The author offers a three step framework that helps those involved in conflict stay focused on a productive resolution. Examples of common conflicts and solutions are provided.

**My Friend Has Autism, Toureville, A, 2010. 60.1024.01.**  
In this picture book, Nick tells of his friendship with Zac and shares some of his unique characteristics. Fact boxes are interspersed throughout the text to give further insight into some of these characteristics.

**Owning It: Stories About Teens With Disabilities, 2008. 66-1433-01.**  
This book relates the experiences of ten teenagers dealing with all the common stresses but with the added challenges of having a disability.

**Some Kids Just Can’t Sit Still, Goldstein, S. 2009. 60-1028-01.**  
This story is written for children with ADHD and explains it’s characteristics. It describes strategies to help make their daily lives easier and that ADHD is not an illness but a condition. Students in the primary years would find this book informative.

**Tasks Galore For The Real World, Eckenrode, L. 2004. 19-0246-04.**  
This is the second in a series of task books for people with autism spectrum disorders and other visual learners. It focuses on concepts needed to manage life with greater independence and on skills that can open vocational opportunities.

**Dad And Me In The Morning, Lakin, P. 1994. 60-1027-01.**  
This book tells the story of a young boy and his father who steal out of the house before light, to witness the magic of dawn. Along the way they communicate in a variety of ways, including signing.

**Fine Motor Skills Pack, 2010. 83.1640.01**  
The three resources in this pack encourage the development of fine motor skills. It includes threading activities and maze puzzle boards for fine motor manipulation.

**Some Kids Use Wheelchairs, Schaeffer, L. 2008 60-1026-01.**  
This title is one in the series “Understanding Differences”. Using photographs, it describes why some children use wheelchairs and what a child who uses one might do in the course of a day.

**Some Kids Wear Leg Braces, Schaeffer, L. 2008. 60-1042-01.**  
This title is one in the series “Understanding Differences”. It explains why some children need to wear leg braces and how braces assist them in their everyday life.

**Phonological Awareness In Words and Sentences (PAWS), 2000. 63-3268-01.**  
This resource provides educators with materials to stimulate the development of phonological awareness in students aged between 5 and 11. Activities help students to identify syllables in words, add syllables to produce meaningful words, and use contextual information to identify words within sentences.

**Life Skills Activities for Secondary Students with Special Needs, Mannix, D. 2009. 66.1431.01**  
This resource provides teachers and parents with activities, discussion questions and evaluation suggestions to help adolescents with special needs acquire the basic skills needed to achieve independence and success.

**Kids With Special Needs: Information and Activities To Promote Awareness and Understanding, Getskow, V. 1996. 66-1436-01**  
This resource is designed to increase awareness and understanding about a range of disabilities. The extensive simulation games and activities enable participants to gain a better insight into the issues facing children with a communication, physical or intellectual disability.

**Frisbees, 2010. 84.0449.01**  
These 20cm soft rubber Frisbees are suitable for indoor or outdoor use and are non age specific.

SAVE THE DATE......

January TechFest 2011
Following the success of this year’s program, the January TechFest will once again be on offer for 2011. Initial planning is currently underway for the 7 day program which will commence the week beginning Monday January 17th 2011.

The following workshops are being considered for inclusion in the TechFest program:
- Clicker 5 Advanced
- Basic Boardmaker 6
- Digital Notetaking with the Pulse Smartpen
- AccessApps
- Introduction to Proloquo2Go
- MS Word Wizardry
- Introduction to Dragon Dictate
- Bookbuilding with Clicker 5
- Boardmaker Plus
- Digital Puppetry with Crazy Talk
- Read and Write Gold
- Reading Comprehension and Assistive Technologies
- PowerPoint Extreme
- Introduction to WriteOnLine

Descriptors for these workshops can be found at http://web.seru.sa.edu.au/Workshops.htm.

The program will be finalised by mid Term 4. During this planning period there is an opportunity for interested participants to negotiate a tailored workshop to be delivered to their school staff. Please contact Jim Sprialis to negotiate a tailored workshop.

Term 4 SERUpdate
The theme for next term’s SERUpdate is ‘Setting Up for Success’. Contributors for this edition may like to consider the following guiding questions when formulating an article:
- How do you prepare your classroom for a successful start to a school year?
- How do you create a supportive and challenging environment for student learning?
- How do you engineer the classroom to increase independence in classroom participation?
- What can a successful transition program look like?
- How do you plan for engagement with parents and other community members?

Would you like to contribute an article?
SERUpdate relies heavily on the willingness of educators to contribute articles. Feedback from readers confirms that contributions from sites are a valuable way of keeping informed with what is happening at other schools. Contributing an article has also proved to be a valuable exercise in assisting school based contributors document their site plan initiatives. They also appreciated SERU’s provision of TRT release for this reflection and recording process.

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