THE MATHEMATICAL ASSOCIATION OF VICTORIA

THE COMMON DENOMINATOR 1/15

EXPLORING SYMMETRY

Open ended play in the early childhood setting led to an interesting exploration of symmetry.

INSIDE

It was once considered that there was no advantage to exposing young children to mathematics as they were believed incapable of comprehending this sort of thinking.

However when taking the time to observe children in the early years we can see that children as young as three are already demonstrating mathematical thinking through their play and interactions such as talking, imaginative play, art and constructing. Researchers Sarama and Clements (2009) believe that children's mathematical competencies may even be innate or develop in the first years of life. As a result, Gifford (2005) suggests that it is the role of teachers to help children to learn in a way that leads them to make connections in their learning and are actively moving forward.

Working in an early childhood room with children aged three to five years old has provided me with such insight into how all children naturally explore and observe mathematical concepts constantly throughout the day.

Continued on page 4

THE COMMON DENOMINATOR
The MAV's magazine published for its members.

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FROM THE PRESIDENT

Associate Professor Marj Horne - Faculty of Education,
Australian Catholic University

Welcome to 2015! It's going to be a big year. The VCAA study design will be released in 2015 for immediate implementation. The MAV will support teachers and schools through this period. Our door is always open so please don't hesitate to get in contact with us if you and your school need professional development, advice or support.

On that note, please check that you have renewed your 2015 MAV membership. Membership is the backbone of our organisation. Renewing your membership is quick and easy (see the page opposite for details on how to renew). If you are unsure if your membership is up-to-date, get in contact with us and we will check for you.

Be sure to read the review on *Made by Maths*, the new MAV app on page 16. I encourage you to download and try it out.

I'm proud to announce that the app won the Australian Professional Teachers' Association Innovative Association Award. Congratulations to all involved. If you haven't yet tried the app, search for Made by Maths on the App Store or Google Play. It is a terrific resource and will come in very handy for those of you who wish to include mathematics in your excursions.

MAV Councillor and longstanding MAV member, June Penney, has received the 2014 Outstanding Professional Service Award from the Council for Professional Teaching Associations of Victoria. June has provided an affirmation of the value of mathematics in society and a practical, positive insight for thousands of students into thinking and working like a mathematician. Congratulations June.

Last but not least, MAV Games Day registrations are now open!

PROFESSIONAL LEARNING 2015

Mathematics Education Consultants can design professional learning programs for you and your colleagues that meet your school's goals. Workshops that meet the needs of your teachers and their students can be developed. This may entail coaching, modeled mathematics teaching, whole staff meetings, a cluster of schools within a region, professional learning teams.

MAV Education consultants can visit your school weekly and guide you through each step of the way. This is a brilliant way to achieve rapid improvement in mathematics teaching and learning across your school.

We can explore:

- organising a differentiated classroom
- resourcing your AusVELS curriculum
- effective use of technology and apps
- focus on specific content areas (ie teaching fractions, geometry etc)
- practical activities for building the AC proficiencies
- AusVELS and reporting
- Teach Maths for Understanding
- mathematics and the inquiry classroom
- building teachers' mathematics teaching capacity
- using student data to achieve sustainable improvement
- engagement in the classroom
- assessment for learning
- how students learn mathematics
- errors and misconceptions in mathematics learning

The MAV's Mathematics Active Schools program is rapidly gaining momentum. If your school is effectively engaging students mathematically, consider applying to become a Mathematics Active School. It is no additional work for the school and is a terrific way to publicly recognise the positive work schools are achieving in this area.

If you'd like to discuss MAV's Mathematics Active Schools program or your schools mathematical learning needs, contact Jennifer Bowden, jbowden@mav.vic.edu.au or telephone (03) 9380 2399.

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EXPLORING SYMMETRY

Kirsten Goldsmith - Kinder teacher, Smith Street Children's Centre and Kindergarten

However when questioned about such concepts, the children did not have any comprehension of what constitutes mathematics, nor did they readily recall mathematical language. Therefore it is the role of the early childhood educator to use these teachable moments to not only extend the child's play but to provide a foundation for their understandings in which they can continue to build upon in their future learning.

One clear example of this has been an exploration of symmetry that took place for several weeks within my kindergarten room sparked by the introduction of Morphun blocks.

Not only were the children engaged by the bright colours and a new resource in the room but all the children - ranging from ages three to five years of age - were intrigued by the stack and slide possibilities of these blocks and the square, circle and triangle options.

As there was such a varied age group interested, initial conversation ranged from differentiating shapes to discussing how to order the shapes to make various configurations. Hours were initially spent examining instructions, counting the blocks in the picture and then recreating the image.

Children were clearly using mathematical functions naturally. The children were not only demonstrating their understanding of the correlation between number and quantity but they were developing the ability to sort shape and colour as well as ordering and following patterns which are the basis of mathematical conception.

Over time, the children became less interested in the instructions and more interested in what they could create themselves. Some children just made seemingly random constructions whereas others began noticing the patterns they could produce. It was clear that they were making patterns, and could identify what block or shape needed to come next, however it wasn't until prompted by an educator that they articulated that it was a pattern.

It is essential for an educator to not just lead the conversation but to encourage the child to talk about what they see, their thinking behind it and why it is significant.

As the children continued to play with these blocks their patterns began to become more complicated with hours being dedicated to the construction of complex works.

With no adult interference, several boys had been involved in making extremely intricate designs through colours and block positions.

They produced perfectly symmetrical patterns independently however when questioned 'do you know what symmetry is?', children could not explain. One such design became the centre of a targeted group exploration. I asked the children to look carefully at the design and to tell me what they noticed about it. The responses consisted of 'they have used only triangle blocks and one square', 'they have made a pattern' and the response that became our definition of symmetry, 'both sides are equal'.

Kirsten discusses symmetry with kindergarten children using everyday objects.

When asked to explain what they meant by 'both sides are equal' a 5 year old gave a description any adult would be proud of. His response was 'If I cut it in half and put it together then they would be the same'. Now is that a response from a child too young to comprehend mathematical concepts? No! This opened up the path for a huge exploration into symmetry and what symmetry does and doesn't look like.

We began by examined an apple, a paw paw ointment tube, a boat (front-on and side-on) and a rectangular piece of paper as well as ripped piece of paper. Using only the words of this young boy, the children all correctly identified what these items had or didn't have in common. The group were initially conflicted over the paw paw ointment however once listening to the reasoning of another boy the group were convinced. He explained 'If we cut the container in half it would be even. But it has writing on it. The writing wouldn't be the same on both sides so it can't be equal.'

It was at this point that we introduced the word *symmetry* to the children using the definition of the first young boy, 'if you cut it in half it would be equal on both sides'. The children continued their day by pointing at items around the room and yard and determining if they were symmetrical or not and participating in in-depth conversations negotiating some of the less obvious shapes.

Since this exploration the children have been using the concept of symmetry and applying it to their Morphun block constructions, play dough, lunches and they have even been observed discussing whether the designs on their clothing are symmetrical. The children had grasped the concept of symmetry well before it was formally introduced to them.

As an educator it is essential to not underestimate the comprehension of children but instead to determine what they have already discovered and build upon that. In most cases, I'm positive you will be surprised. As an early childhood educator, our role is not to necessarily teach new concepts, but provide the language and tools in order to make sense of children's already curious minds.

REFERENCES

Gifford, S. (2005). Teaching Mathematics 3-5: *Developing Learning in the Foundation Stage*. Berkshire, GRB: McGraw-Hill Education.

Samara, J., & Clements, D. (2009). *Early childhood mathematics education research: learning trajectories for young children*. (pp. 3-25). New York: London: Routledge

Early child centres are able to join MAV for free in 2015 provided they are happy to assist the MAV in providing feedback throughout the year.

Please pass this information onto your early childhood colleagues. To join, phone 9380 2399.

A sample pack of Morphun blocks will be sent to early childhood members (while stocks last) so perhaps you can get some inspiration from this article and start a discussion on symmetry too! MAVshop stocks Morphun blocks (see back page for pricing).

ENGAGING PARENTS IN MATHS

Anne-Marie O'Hagan

PARENT ENGAGEMENT

There is a growing body of research to suggest that parent engagement in the educational development of their children significantly improves academic outcomes. However, maths is a subject area that many parents and teachers do not feel confident in supporting their children's learning. Building a bridge between parent participation and the classroom is vital to give our children the best learning opportunities.

Research has shown that the more parents and children talk to each other, the better students achieve. Apart from talking, parents can be instrumental in their child's learning by being a good role model. There are three demonstrated behaviours that are particularly useful for successful learning:

- self regulation, that is, the ability to regulate emotions and remain resilient
- empathy, being able to imagine things from your child's perspective
- and persistence.

The more we talk maths and share our enjoyment of the experience the better chance children have to build a positive attitude towards maths learning.

PARENT-SCHOOL PARTNERSHIPS

Federal Education Minister Christopher Pyne has said that he wants parents to be more involved in their children's education and in schools, but what does this look like? Parents can help their child by having regular and meaningful conversations with them, by setting high expectations and by demonstrating a genuine interest in and support of learning at home and at school. (Epstein & Salinas 2004; El Nokali, Bachman & Votruba-Drzal 2010). When considering any parent-school partnership based learning it is important to consider the following principles.

GUIDING PRINCIPLES

- Use a standards or research-based framework to guide development of activities
- Base the activities on a developmental sequence for children's maths skills that include a range of concepts
- Plan play-based mathematical activities that are engaging and low pressure to ensure parents' and children's enjoyment of these experiences
- Encourage parents to allow their children choose the activities they engage in
- Differentiate activities to be more or less challenging for children
- Write activities with an encouraging tone, avoiding department of education jargon
- Activities need to be clear and easy to follow.

CREATING CHANGE

The Ardoch Count 4 Kids Challenge stemmed from a desire to strengthen parent involvement in their child's learning. This 30-day math-a-thon challenged parents to spend 5-10 minutes a day talking to their child about math, whether it be what they are learning at school, or looking at some of the suggested activities online together whilst raising funds for a great cause.

LISTENING TO PARENTS

Moving forward the Ardoch Count 4 Kids Challenge hopes to create parent-school partnerships in 2015 by engaging students and parents in meaningful learning. The feedback we received from parents this year was very positive. Parents enjoyed spending time talking to their child about maths, but felt that activities were either too challenging or not challenging enough.

Some parents wanted them to be age-based to give them an indication of how their child was performing against their peers. As a result there will be suggestions for parents to differentiate the learning activities that will be aligned to the AusVELS standards to give parents and teachers an indication of which activities will be appropriate for their children. The Ardoch Count 4 Kids Challenge provides the perfect opportunity to set up a month long parent-helper program in school. The challenge will provide support for parents who want to help their child with maths but don't know where to begin.

There is no uniform solution to strengthening parent-school partnerships.

However we can all agree that parents play an important role in helping children learn about math. They are their children's first teachers and we would be wise to utilise them in a meaningful way.

AUTHOR

Anne-Marie O'Hagan is a primary school teacher, currently working in private practice whilst on family leave. Anne-Marie appreciates the role of parent attitudes and involvement in their child's learning and wants to create change by engaging more parents in their child's education.

REFERENCES

El Nokali, N.E., H.J. Bachman, & E. Votruba-Drzal. 2010. *Parent Involvement and Children's Academic and Social Development in Elementary School*. Child Development 81 (3): 988–1005. www.ncbi.nlm.nih.gov/pmc/articles/PMC2973328/.

Epstein, J.L., & K.C. Salinas. 2004. *Partnering With Families and Communities*. Educational Leadership 61 (8): 12–18.

Lucas, B. 2010, *The Impact of Parent Engagement on Learner Success*, Research into Practice GEMS Education, No 1 Spring 2010. www.gemseducation.com/uploads/image/_MEDIA_MANAGER/GEMS_Documents/The-Impact-of-Parental-Engagement-on-Learner-Success613583.pdf

To find out how you can get involved in the Ardoch Count 4 Kids Challenge in 2015, check out www.count4kids.com.au

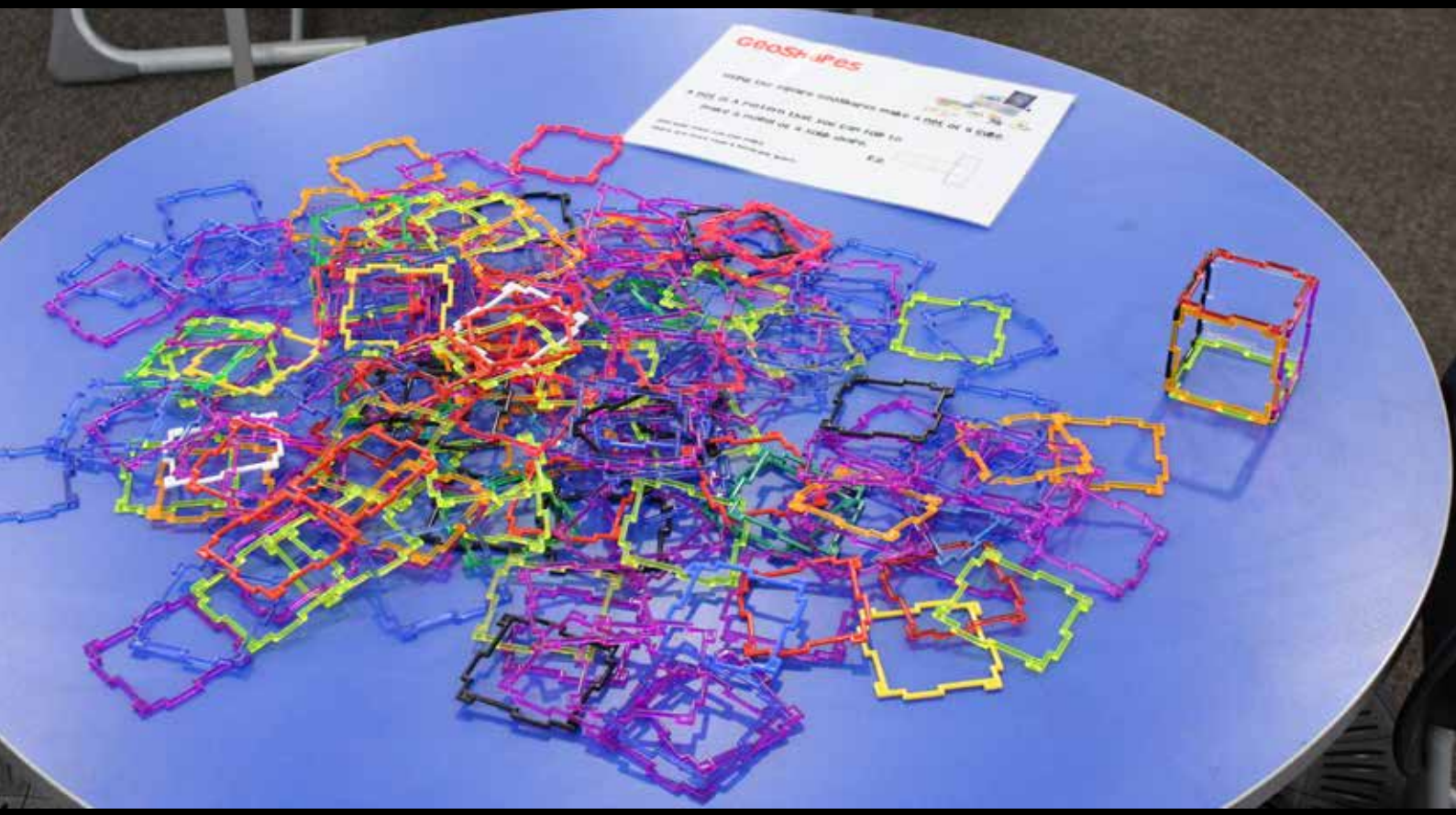
The MAV's Family Maths Nights are another great way to promote family involvement with mathematics through a fun and shared experience. They help to create a sense of community and build a strong family-school partnership.

MAV's Mathematical Education Consultants can tailor a Family Maths Nights specifically for your school. The article on page 9 describes how schools run Family Maths Nights.

If you are interested in learning more about hosting a Family Maths Night at your school, telephone 9380 2399 or contact Ellen Corovic (primary), ecorovic@mav.vic.edu.au or Helen Haralambous (secondary), hharalambous@mav.vic.edu.au (secondary).

YEAR OF MATHS

Chantel Jose - St Kilda Park Primary School



A Geoshapes station provides students and parents with lots of hands-on maths fun at a Family Maths Night.

This year St Kilda Park Primary School have been immersed in a *Year of Maths*. Our teacher professional development has been centred around the teaching of mathematics.

We have written a new mathematics policy, changed mathematics lessons to begin at 9am and set guidelines around how maths lessons should look. We have also aimed to promote the fantastic work our students and teachers do with the school community. We did this by increasing mathematics information in school newsletter articles, Konnective updates as well as running a Family Maths Night.

As we had never run a Family Maths Night before, we contacted the MAV. Our Maths Professional Learning Team worked with Mathematics Education Consultant Jennifer Bowden to set up five different spaces with a range of maths activities for the event.

We had:

- two rooms focussed on number, one for F-2 and another for Years 3-6
- a chance and data room
- a shape area
- our ICT co-ordinator worked with us to set up a technology room showcasing a range of websites, app and a direction/programming activity using the bee-bots.

We also set up a range of maths related books in our school library.

The students met at 6pm and had a quick briefing while the parents went to our hall to listen to a presentation from Jennifer.

She gave examples of the activities we do at school and things that parents could do at home to support their children's mathematical understanding.

The parents then met their children and moved across the five rooms trying out the activities. The children had a passport that they needed to have signed off by an adult once they had completed an activity in each room. The event finished at 7.30pm.

We also had playing cards, six and nine sided dice and counters available for sale so the parents could do some of the activities at home. The nine sided dice were a hit!

The MAV provided order forms so parents could order some of the other resources, such as PLANKS and Morphun blocks.

We had around 100 parents and students attend the event and received some great feedback!

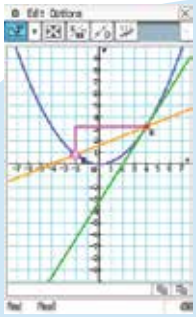
Thanks to the MAV and Jennifer for their support and hopefully we will be able to successfully run our own event next year.

Family Maths Nights are an effective and simple way to engage parents and students with mathematics.

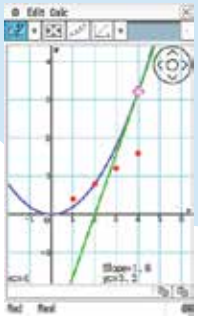
Contact Ellen Corovic, ecorovic@mav.vic.edu.au.

ClassPad II
A new operating system has arrived

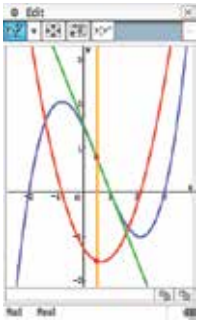
OS Ver 2.0 includes these exciting new features, and much more:



Interact with secants and chords in the new Interactive Differential Calculus application.

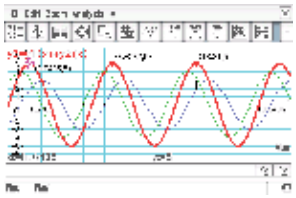


Plot the values of the tangent's slope and see the idea of a derivative function forming.

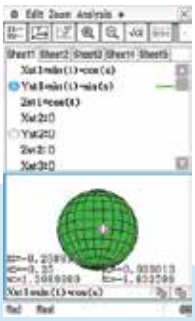


Explore the connections between a function and its derivative function.

Now with sliders & pinch zoom, making interaction with graphs simpler than ever before



Graphs can now be viewed horizontally.



3D Graphing, with wire mesh and surface colouring

Physium presents the periodic table in a colourful and engaging manner.

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MATHEMATICA AND THE AUSTRALIAN CURRICULUM

Carmen Popescu-Rose, Director, Mathematics for Excellence. www.wolfram.com/training/instructors/popescu-rose.html.

The purpose of this article is to present some lesson ideas using the Mathematica functionality in teaching and exploring mathematical concepts as outlined in the Australian Curriculum at Year 11 level for Essential Mathematics and General Mathematics. Mathematical Methods and Specialist Mathematics will be explored in the next edition of *Common Denominator*.

YEAR 11 – ESSENTIAL MATHEMATICS - UNIT 2, TOPIC 4: TIME AND MOTION.

- REPRESENT TIME USING 12-HOUR AND 24-HOUR CLOCKS (ACMEM077)
- CALCULATE TIME INTERVALS, SUCH AS TIME BETWEEN, TIME AHEAD, TIME BEHIND (ACMEM078)

Representing time using the 12-hour and 24-hour clocks is not a difficult concept; however, calculating time intervals between, ahead and behind could be challenging for many students. Mathematica functionality could be used in order to introduce these concepts in both static and dynamic forms.

The command DateString[] produces a static display of the current local day, date and time while the command Dynamic[{DateString[],Clock [{1,1},1]}] produces the dynamic output of the current local day, date and time.

In both outputs the time is displayed in hours, minutes and seconds in a 24-hour format (see figure 1). A static or dynamic analog clock can also be displayed by either using the command ClockGauge[] or the command Dynamic[{ClockGauge[], Clock[{1, 1}, 1]}], (see figure 2).

```
In[1]:= DateString[]
Out[1]= Mon 1 Sep 2014 11:33:37
```

Figure 1a. *DateString output*

```
In[1]:= Dynamic[{DateString[], Clock[{1, 1}, 1]}]
Out[1]= {Sun 31 Aug 2014 16:05:00, 1.}
```

Figure 1b. *Dynamic DateString output*

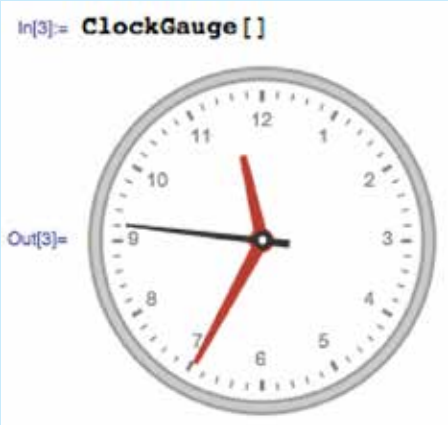

Figure 2a. *Static analog clock*

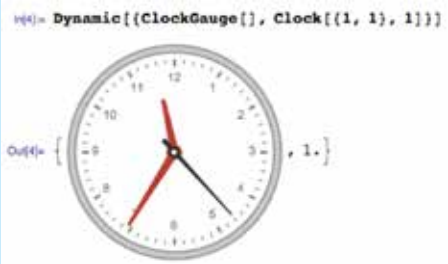

Figure 2b. *Dynamic analog clock*

A similar output is produced by the command DateObject[]. This command uses the time set by default on the computer in use and it can also be used to display the GMT (Greenwich Mean Time) wanted.

For example, Melbourne, Canberra, Sydney, Brisbane and Cairns are in the GMT+10 timezone so the command used is either DateObject[]for the local time or DateObject[TimeZone->+10] for the +10 time zone.

Figure 3a. *DateObject output*

Figure 3b. *DateObject for time zone+10 output*

Time zones could be further investigated by embedding a link to the time zones map from timeanddate.com so that students can access it straight away and become accustomed with the various time zones.

This can be achieved in Mathematica by using the command Hyperlink['Name','URL'].

Figure 4. *Input and output for embedding a hyperlink to timeanddate.com in Mathematica*

To become familiar with calculating time differences students could use the command TimeObject[{hours,min}] - TimeObject[{hours,min}] and make connections between how the answer and ways of calculating these differences by hand.

```
In[8]:= TimeObject[{11, 20}] - TimeObject[{10, 30}]
Out[8]= 50 min
```

Figure 5. *Input and output for calculating time differences*

All the commands used in Fig. 1 – 5 can be easily accessed from the Mathematica Help menu and easily changed to the requirements of the task at hand.

From the help menu (search: Date and Time Labels and Clocks) students could produce a list of dynamic or static analog clocks displaying times around the world or around Australia. Students could use these clocks to further investigate the concepts of time ahead and time behind. The concept of DST (daylight saving time) should also be incorporated into this investigation.

Figure 5. *A list of five anolog clocks displaying corresponding times in five capital cities in Australia*

This investigation can be adapted to the requirements of the lesson and the needs of the group of students involved.

MATHEMATICA AND THE AUSTRALIAN CURRICULUM (CONT.)

YEAR 11 – GENERAL MATHEMATICS – UNIT 1 TOPIC 3: SHAPE AND MEASUREMENT

- OBTAIN A SCALE FACTOR AND USE IT TO SOLVE SCALING PROBLEMS INVOLVING THE CALCULATION OF THE AREAS OF SIMILAR FIGURES (ACMGM024)
- OBTAIN A SCALE FACTOR AND USE IT TO SOLVE SCALING PROBLEMS INVOLVING THE CALCULATION OF SURFACE AREAS AND VOLUMES OF SIMILAR SOLIDS. (ACMGM025)

The use of images and diagrams to support the learning and understanding of mathematical concepts has been treated widely in mathematical research. Visualising the concepts of similar shapes and scale factors could enhance students' learning. Mathematica can be used for this purpose when discussing scale factors, areas of similar shapes and volumes of similar objects.

Using a simple command like Graphics[Triangle[]] produces a right-angled isosceles triangle with side lengths of 1, 1 and $\sqrt{2}$ units as shown in figure 7.

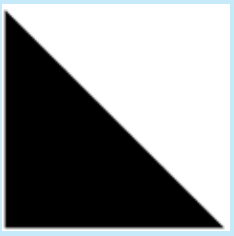

Figure 7

The command Graphics[{{Gray, Triangle[]}, Scale[{Pink, Triangle[]}, .5]}] produces two right-angled isosceles triangles. The first triangle is the $\{1, 1, \sqrt{2}\}$ triangle while the second triangle is the original triangle reduced by a scale factor of $\frac{1}{2}$. See figure 8.

Figure 8

One of the very useful features of Mathematica is that the graphics produced become interactive and the user can change the graphics as they desire. Students can now manipulate the graphics in order to draw conclusions regarding the ratio between the areas of the two triangles.

Let L be the length of the two equal sides of the original triangle, l be the length of the two equal sides of the reduced triangle and k the scale factor $\frac{l}{L} = \frac{1}{2}$. The reduced triangle can be selected and dragged to one corner (bottom right corner in this case) of the original triangle as shown in figure 9. As all the sides have been reduced by the same scale factor, the two triangles are similar and the reduced triangle fits perfectly in this corner.

Figure 9. *Reduced triangle superimposed over the bottom right corner of the original triangle.*

Another Mathematica functionality which can now be used, is copying the reduced triangle as many times as necessary, rotate and translate these copies on top of the larger triangle in order to determine the number of reduced triangles that can fit over the original triangle.

Figure 10. *Three steps in constructing the tangram of the original triangle.*

The next step is calculating the area of the two triangles. This can be either done by hand or by using the Mathematica command Area[Triangle[]]. This area will be the area of the original triangle. On a Cartesian plane, this triangle has coordinates {(0.0), (1,0), (0,1)}. To calculate the area of the reduced triangle, the students can be instructed to use the command Area[Triangle[{{0,0},{ $\frac{1}{2}$,0}, {0, $\frac{1}{2}$ }]] where the sides of the original triangle have been reduced by a factor of $\frac{1}{2}$. To obtain answers with decimal values either use 0.5 instead of $\frac{1}{2}$ or type '//N' at the end of the command.

```
In[9]:= Area[Triangle[]]
Out[9]= 1/2

In[10]:= Area[Triangle[{{0, 0}, {1/2, 0}, {0, 1/2}}]]
Out[10]= 1/8

In[11]:= Area[Triangle[]] // N
Out[11]= 0.5

In[12]:= Area[Triangle[{{0, 0}, {1/2, 0}, {0, 1/2}}]] // N
Out[12]= 0.125
```

Figure 11. *Inputs and outputs for calculating the areas of the two triangles in (top) fraction form and (bottom) decimal form.*

To calculate the ratios between the sides and the areas use List[{Ratios[{1,$\frac{1}{2}$ }], Ratios[{8,2}]}]. This command displays both ratios in a list of fractions figure12 (top) or decimals figure 12 (bottom).

```
In[13]:= List[{Ratios[{1, 1/2}], Ratios[{8, 2}]}]
Out[13]= {{{1/2}, {1/4}}}

In[14]:= List[{Ratios[{1, 1/2}], Ratios[{8, 2}]}] // N
Out[14]= {{{0.5}, {0.25}}}
```

Figure 12. *Inputs and outputs for calculating the ratios in (top) fraction form and (bottom) decimal form.*

This investigation could also be repeated using an enlargement factor k = 3 using a different shape such as a square of side length 1 using the command Graphics[{Scale[{Darker[Blue], Rectangle[]}, 3], {Green,Rectangle[]}}]. In Mathematica Rectangle[] produces a square of side length 1 unit.

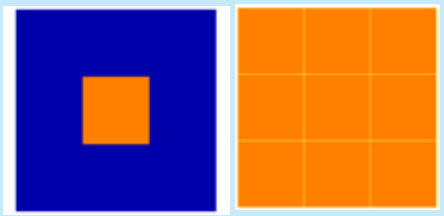

Figure 13. *Two squares: (left) original and its enlargement by a factor of 3, (right) the enlarged square covered by 9 original squares.*

To calculate the areas of the two squares use the commands Area[Rectangle[] for the original square with corners at {(0, 0), (1, 0), (1, 1), (0, 1)} and Area[Rectangle[{(0, 0),(3, 3)}] for the enlarged square.
The enlarged square is given by the corner coordinates (0, 0) and (3, 3).

This means that the square displayed has a side length of 3 units and the corners at {(0, 0), (3, 0), (3, 3), (0, 3)}.

```
In[15]:= Area[Rectangle[]]
Out[15]= 1

In[16]:= Area[Rectangle[{0, 0}, {3, 3}]]
Out[16]= 9
```

Figure 14. *Inputs and outputs for calculating the areas of the two squares.*

The ratios for the sides and the areas can be displayed in a grid or as a list:

```
In[17]:= List[{Ratios[{1, 3}], Ratios[{1, 9}]}]
Out[17]= {{{3}, {9}}}
```

Figure 15. *Inputs and outputs for calculating the ratios between the two areas.*

The same procedure can be used to calculate the volumes of a cube of side length one unit and enlarged cube by a factor of 3.

To construct the two volumes use the command Graphics3D[{Scale[{Darker[Blue], Opacity[0.3], Cuboid[]}, 3],{Green, Cuboid[]}}].

This command produces the cubes shown in figure 16.

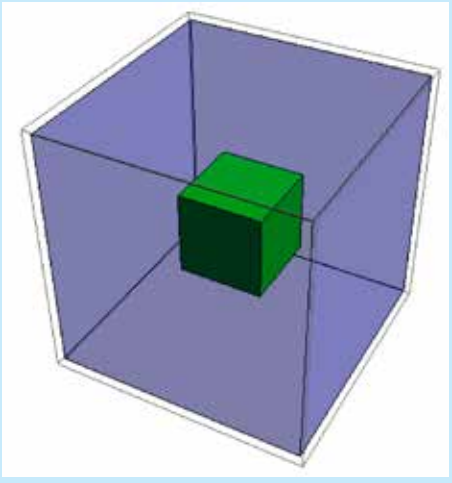

Figure 16. *The output for producing two cubes of side lengths 1 and 3 respectively.*

Figure 17. *Three sets of cubes at different stages of filling the enlarged cubed with the original cubes.*

To calculate the volumes of the two cubes use the commands Volume[Cuboid[] for the original cube with corners at {(0, 0, 0), (1, 0, 0), (1, 1, 0), (0, 1, 0), (0, 0, 1), (1, 1, 0), (1, 1, 1), (0, 1, 1)} and Volume[Cuboid[{(0, 0, 0),(3, 3, 3)}] for the enlarged cube.

The enlarged square is given by the corner coordinates (0, 0, 0) and (3, 3, 3). This means that the cube displayed has a side length of 3 units and the corners at {(0, 0, 0), (3, 0, 0), (3, 3, 0), (0, 3, 0), (0, 0, 3), (3, 3, 0), (3, 3, 3), (0, 3, 3)}.

Students are not required to know the coordinates of all corners of the cubes; this is left to the teacher's discretion.

```
In[18]:= Volume[Cuboid[]]
Out[18]= 1

In[19]:= Volume[Cuboid[{0, 0, 0}, {3, 3, 3}]]
Out[19]= 27
```

Figure 18. *Inputs and outputs for calculating the volume of the two cubes.*

To calculate the ratios between the sides and the volumes use List[{Ratios[{1,3}], Ratios[{1,27}]}].

```
In[20]:= List[{Ratios[{1, 3}], Ratios[{1, 27}]}]
Out[20]= {{{3}, {27}}}
```

Figure 19. *Inputs and outputs for calculating the ratios between the two volumes.*

This investigation can be adapted to the requirements of the lesson and the needs of the group of students involved.

CONCLUSION

Mathematical concepts can be taught in various ways and it comes down to the teacher's creativity and imagination to inspire their students in the learning of Mathematics. One might ask: 'Why use Mathematica to introduce this topic (or any other topic as a matter of fact)?' The answer that comes to mind is 'Because the student can take home a notebook full of information, interactive activities, examples and solutions to questions, and hints. They can open it when completing homework or when studying for an assessment task and ... it's all there at their fingertips.'

REFERENCES

Australian CURRICULUM, Australian Curriculum, Assessment and Reporting Authority (ACARA), Senior Secondary, Mathematics, Essential Mathematics www.australiancurriculum.edu.au/SeniorSecondary/Overview

Mathematica (Version 9) [Computer software], Wolfram, www.wolfram.com/mathematica

www.timeanddate.com/time/map/

The Definition of the Derivative from the Wolfram Demonstrations Project http://demonstrations.wolfram.com/TheDefinitionOfTheDerivative/ Contributed by Jim Swift.

Note: For larger versions of these diagrams, contact the MAV. Smaller versions of the figures appear here due to space constraints.

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POTATO GAMES

Andrew Noordhoff , Year 3 teacher - Jells Park Primary School

Students take part in a potato and spoon race at Jells Park Primary School.

In Term 4 2014, Year 3 and 4 students at Jells Park Primary School embarked on a six week maths unit entitled *The Potato Pentathlon*. The idea was crafted by the Year 3 and 4 teachers on a planning day with a focus on participating in more real life maths beyond the classroom, to further engage students in mathematics.

The unit tied in perfectly with our integrated topic of the Commonwealth Games and also became part of our literacy sessions.

The students were asked to bring a potato to school in the third week of Term 4 and then began the first event titled the *Pre-event warm-up: Paying your weigh*, which involved students weighing their potato and then showing ways to pay for their potato according to a price set by their teacher (e.g. 1 gram = 3 cents).

Over successive weeks, each class had selected one of the remaining five main events, they included:

- high jump
- potato and spoon race
- the long roll
- potato archery
- weighing in.

Each week a designated event was held with specific follow up task. One of the great aspects of the unit was that the follow up maths could be modified according to the student's ability, which allowed the teachers to extend and simplify according to the students understanding of the mathematical concepts each week.

Some of the mathematical concepts covered included:

- different methods to pay for an item
- working out change
- the four operations
- measuring height
- percentages
- fractions
- graphing
- measuring distance
- estimation
- data trends
- probability.

The students were highly engaged in the unit and we only had a few potato casualties!

It was great to get outside and compete in a range of fun events and then come back to the classroom and investigate the maths embedded in each activity.

Do you have a great maths unit to share? *Common Denominator* is a great place to publish activities and units of work that engage your students.

If you'd like to contribute an article, please contact Jennifer Bowden, jbowden@mav.vic.edu.au.

You don't have to be a brilliant writer, you just need to be able to communicate your ideas - we'll look after the rest.

MADE BY MATHS - A MAV APP

Ellen Corovic - MAV and Therese Clebney - Pascoe Vale Girls School

Pascoe Vale Girls College students in the Melbourne CBD using the MAV's Made by Maths *app.*

The *Made By Maths* app showcases mathematics in an engaging and meaningful way. It has been designed to house a number of walks for use by students and teachers on school excursions.

Currently the app has a free stop, Federation Square, as well as the first full walk Swanston Street (available through in-app purchasing for $0.99). Both of these walks are largely based on geometry and is suitable for Australian Curriculum levels 7 -10. Additional walks will be included throughout 2015 and beyond.

Made By Maths is available on all Android and Apple smartphones and tablets. It provides real world learning as users embark on a journey discovering mathematics in our society.

Made By Maths is available to download from Google Play for Android users and from the App Store for Apple devices.

Download on the App Store

GET IT ON Google play

FEATURES OF MADE BY MATHS

- videos, texts and graphics to support understanding
- earn trophies by completing 'Things To Do'
- all work completed in the app can be synced/saved to the MAV server for teachers to review student work.

USING THE MADE BY MATHS APP

Firstly, individuals can down load the app and discover the hidden mathematical treasures of Swanston Street at their own pace for their own pleasure.

The app can be used as a learning activity for students. There are several in-built functions to support school groups. These features include the ability for students to upload their data (images and text collected through in-app functions) to the MAV's server for teachers to obtain at a later time. To make use of this teachers need to set up an account and retrieve a code at http://madebymaths.mav.vic.edu.au (prior to the excursion).

TRIALS AND FIXES

During 2014, the MAV undertook an extensive feedback and review process. As part of this, several schools participated in school trials. Pascoe Vale Girls College was one of the trial schools and below is a reflection from teacher Therese Clebney.

Following the trials a SWOT analysis was undertaken (strengths, weaknesses, opportunities and threats). This analysis provided the basis for changes to the beta version of the app and supporting website.

The MAV would like to thank the teachers, students and schools involved in trialling the *Made By Maths* app.

> 'Like most maths teachers we are all looking for different ways to present to the students how maths is used in the real world: get them enthusiastic about something, use some technology other than the computer or calculator, or even go on an excursion! So I decided to get involved in the *Made by Maths* app trial.

I am teaching two Year 8 General Maths classes – mixed ability, with the 'advanced' students skimmed off.

After testing the waters with the school's admin, I decided to ask the students if they would like to go out on an excursion and trial a maths app. Let's not be silly here – of course they agreed – anything to get out of school for the day (or in our case a half day). It was planned to take them out in the last week of Term 3; one class Monday, the other Friday. We would start at Melbourne Central and work our way down Swanston St to Federation Square. I had spent one lesson prior to the excursion, explaining to the students how to get the app installed and little about what we were doing.

So, loaded with the app on our phones, tablets or iPods, we headed into the city arriving at Melbourne Central. Keep in mind we were trialling the app on behalf of MAV and part of this involved testing the resource to provide feedback to MAV. It was here that we found a lot of students hadn't downloaded the entire app – or that it hadn't download correctly. But thanks to the wireless connection at Melbourne Central, we were able to rectify the issue and get started on some maths. Our first task was to view the pictures and clips on the Melbourne Central Cone and answer some questions. With Ellen Corovic from MAV working with us we made our way slowly to Fed Square.

After working through this first part of the app, we split into two groups. I took my group up to RMIT, viewing at the Observation Point, Swanston St, on the way. From there it was Architectural Fragment, Roman Numerals and Giant Chess Board, a little of the Melbourne Town Hall, the windows above the doors to St Paul's and looking at the trefoils and quatrefoils and onto Federation Square.

At this stage, the students were a little weary and losing enthusiasm. Even changing the number of tasks for our second trip the students were quite exhausted on reaching Fed Square and struggled to complete some of the tasks there.

WHAT DID WE FIND?

- the maths in most cases was a little high for the students in my classes
- the students were willing to give the activities a go, but we had probably decided to do too much, even with changes made
- students were clicking their way through the options without thinking about what the task wanted
- too many tasks involved taking pictures or making a short video - some students were uncomfortable with this
- the app would be good for Year 9 and above. The others who trialled it with Year 9 students found this and had different issues from Year 8 students
- we found that parts of the app were incorrect, as an example: at one destination there was no correct answer option in the multiple choice selection *(note: this is now fixed)*
- some aspects needed a little extra explanation for the students to follow easily.

Assessment is easy as well. No pieces of paper getting tatty, smudged or wet. As the students complete tasks they get trophies and these change from silver to gold. After the excursion students sync their work through the app. The teacher can then retrieve the class data and view each group's work that was completed, including videos, pictures and answers to questions. So easy to see and use.

SUMMARY

Ellen and I discussed the excursion and the feedback from our two outings. Would I do it again? YES!

I'd recommend picking and choosing which parts of the app to complete, don't think you can do it all. Review the geometric aspects before going out and be completely familiar with the app. Even after reassessing how we would tackle the second day, we went out and changed our expectations, again, while on the excursion. We were better prepared.

Parts of this review this sounds a little negative, but our overall experience was positive. We learnt maths and history of Melbourne and had fun on the way. I asked my students if they would they like to do it again, they said they would – they enjoyed the opportunity to do something a lot different from normal class work and do work 'without writing it down'.

I would like to thank Ellen for her assistance on our first attempt and the numeracy coach from school, who assisted me, Pam Saxon. Their help and assistance was invaluable in making this trial successful.'

MADE BY MATHS WORKSHOPS

The MAV are offering workshops to assist teachers understanding of the full benefits of the *Made by Maths* app.

Workshop one

Thursday 19 February
4pm – 5.30pm
MAV, 61 Blyth Street, Brunswick

- overview of the app
- teacher support materials
- excursion advice

Workshop two

Held during the Term 1 holidays, this workshop will includes time for participants to trial the walk.

Wednesday 1 April
9am – 1pm
CBD location (meeting spot TBC)

- overview of the app
- teacher support materials
- excursion advice
- take part in the Swanston Street walk

Register at www.mav.vic.edu.au

The MAV app is available for download, search *Made by Maths* on the App Store or Google Play.

We'd love to hear your experience of using the app. Email Ellen Corovic, ecorovic@mav.vic.edu.au.

SOPHIE'S PRIZE - BOOK REVIEW

Dr Sharyn Livy - Faculty of Education, Monash University

The Mathematical Association of Victoria's bookshop has grown, providing a range of titles that can be read with different age groups to generate mathematical activities in primary classrooms.

Children's literature can provide a rich environment where mathematical ideas can be explored by:

- making connections to student lives
- promoting opportunities for problem solving and mathematical reasoning
- integrating of mathematical content

One of our newest picture books, *Sophie's Prize*, written by Jennie Marson and illustrated by Lexie Watt, can be read for the enjoyment of the story and illustrations or used to encourage mathematical thinking within a realistic situation. It is most suited to early primary years.

Sophie is the main character and thinks that she is the richest girl in Australia when she wins $100 in an art competition. The story provides an opportunity to discuss how Sophie should spend her money.

Knowing how to manage personal finances is a feature of everyday life. Introducing students to financial literacy in the early years will assist students as they consider their needs and wants into the future.

STUDENT REFLECTION

Zeke enjoyed reading the book, 'It's good because it tells people how to use their money. I give it seven out of ten.'

Zeke asked his brother Finn to comment, 'Good book because it teaches you about money and knowing how much it is worth. Plus thinking about what to do with it. I think it would be a good book for Preps to Year 1.'

AFTER READING SOPHIE'S PRIZE

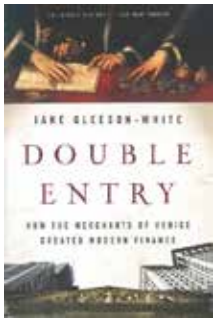
- discuss with students what they could buy with $10, $20, $50 or $100
- bring catalogues into the classroom and students can decide how best to spend the money by making a poster
- older students might prepare a meal or party budget using catalogues
- plan the cost of a family day to the art gallery or somewhere else
- draw a map of your family outing
- create a timetable of how you will spend the day.

Email your ideas or student work samples so that we can share these with other teachers. Email Sharyn.Livy@monash.edu.au.

Sophie's Prize is available from the MAVshop, www.mav.vic.edu.au/shop. Member price: $16.61.

MAVSHOP

MAV MEMBERS RECEIVE A 20% DISCOUNT ON ALL STOCK

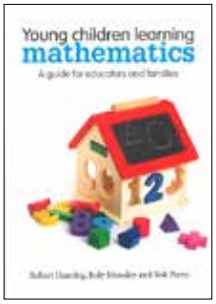


DOUBLE ENTRY

ALL

The MAV have started to stock a few titles that would be of interest to mathematics educators at a recreational level. *Double Entry* is a fascinating exploration of how a simple system used to measure and record wealth spawned a cultural revolution. Our world is governed by the numbers generated by the accounts of nations and corporations. We depend on these numbers to direct our governments, organisations, economies, societies. But where did they come from-and how did they become so powerful? Prepare to have your idea of accounting changed forever.

$22.83 (MEMBER)
$28.54 (NON MEMBER)

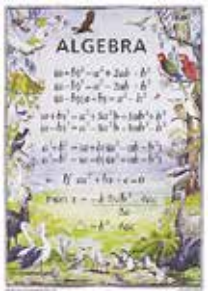


YOUNG CHILDREN LEARNING MATHEMATICS

EC

This book is a guide for educators and families explores the possibilities and potential for early childhood educators, parents and carers to stimulate young children's mathematical thinking. It answers questions about early childhood mathematics, discusses the experiences, activities and conversations that could lead to mathematics learning, and provides simple, easy-to-follow guidelines on introducing and building on the mathematical concepts underpinning play and activity in young children aged from birth to five.

$36.35 (MEMBER)
$45.44 (NON MEMBER)



ALGEBRA MATHS POSTER

7-10

This attractive wall poster is one of a set of 12 informative laminated maths posters (49cm x 68cm). Other posters include area, calculus, coordinate geometry, differentiation, index laws, integration, logarithms, probability, trigonometry, the unit circle and volume. A great addition to your mathematics classroom or school corridors.

$16.86 (MEMBER)
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MORPHUN BRICKS JUNIOR 400 BI-BOX

F-4

Morphun award winning bricks developed in the UK and manufactured in Europe in prime colours, transforms the educational value of traditional bricks. The junior 400 pieces set comes with a selection of five instructions for different levels of difficulty, in a Bi Box. Morphun added dozens of ways of joining bricks by creating a triangle brick as well as side joiners, direction changers, short and long axles, and many other features.

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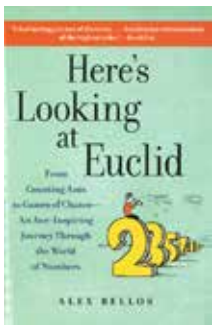

HERE'S LOOKING AT EUCLID

ALL

Too often math gets a bad rap, characterised as dry and difficult. Alex Bellos has traveled all around the globe and has plunged into history to uncover fascinating stories of mathematical achievement, from the breakthroughs of Euclid, to the creations of the Zen master of origami, one of the hottest areas of mathematical work today. Taking us into the wilds of the Amazon, he tells the story of a tribe there who can count only to five and reports on the latest findings about the math instinct-including the revelation that ants can actually count how many steps they've taken.

$19.54 (MEMBER)
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