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Algorithmic thinking across primary years

Jennifer Bowden

Judy Gregg

Abstract

Algorithmic thinking provides opportunities for students to follow and create a well-defined set of instructions to perform a task or solve a problem. We often focus purely on numbers, without linking algebraic problem-solving skills. Promoting algorithmic thinking encourages and increases students' ability to solve problems using different strategies. This workshop will demonstrate lesson from Year 2 to Year 6 that challenge students with the opportunity to explore algorithmic thinking. These lessons have been successfully used in classrooms and will be available online through the MAV website with enabling and extending prompts.

Warm Up - The Arrays Game

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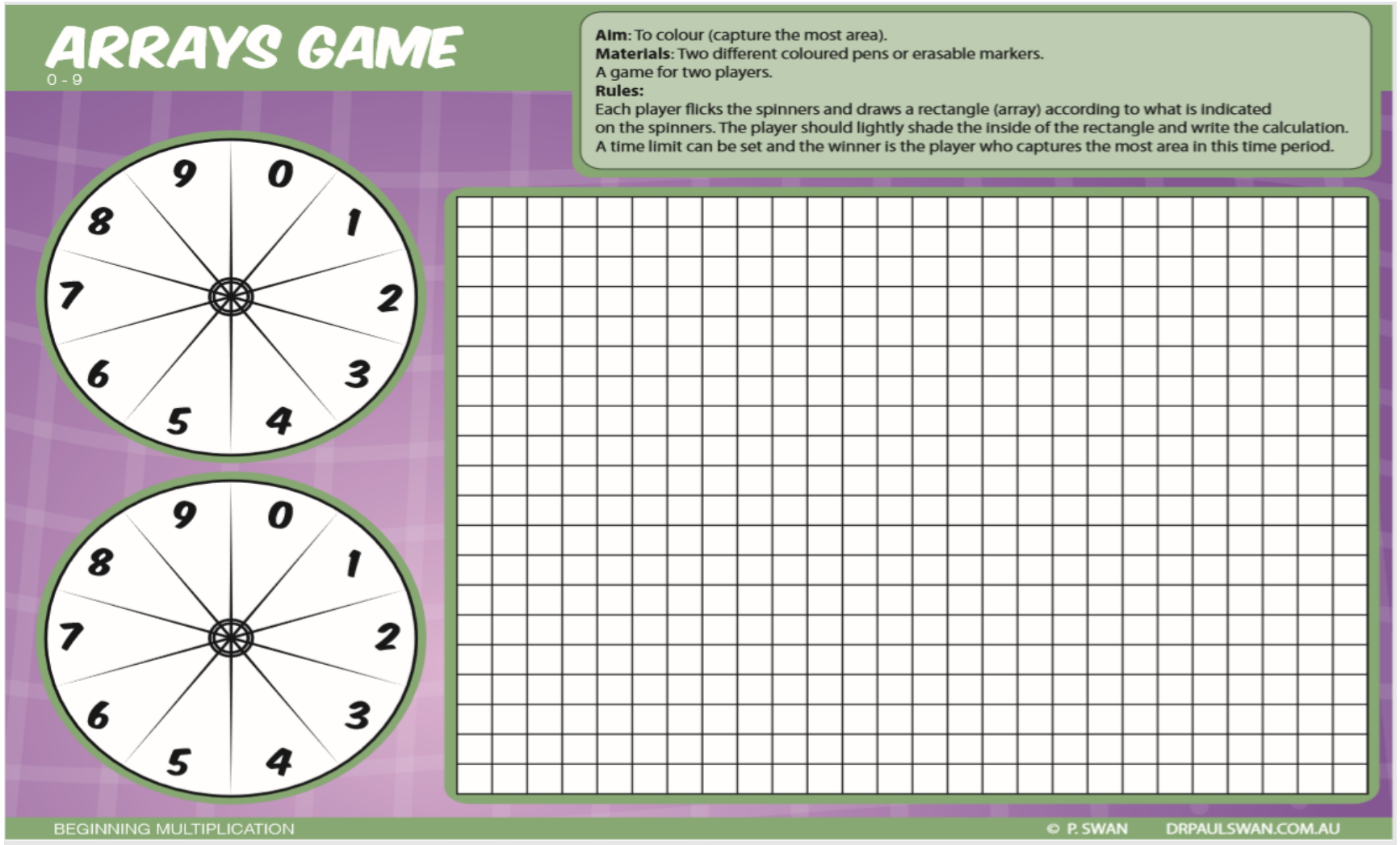

10 lessons for Algorithmic Thinking

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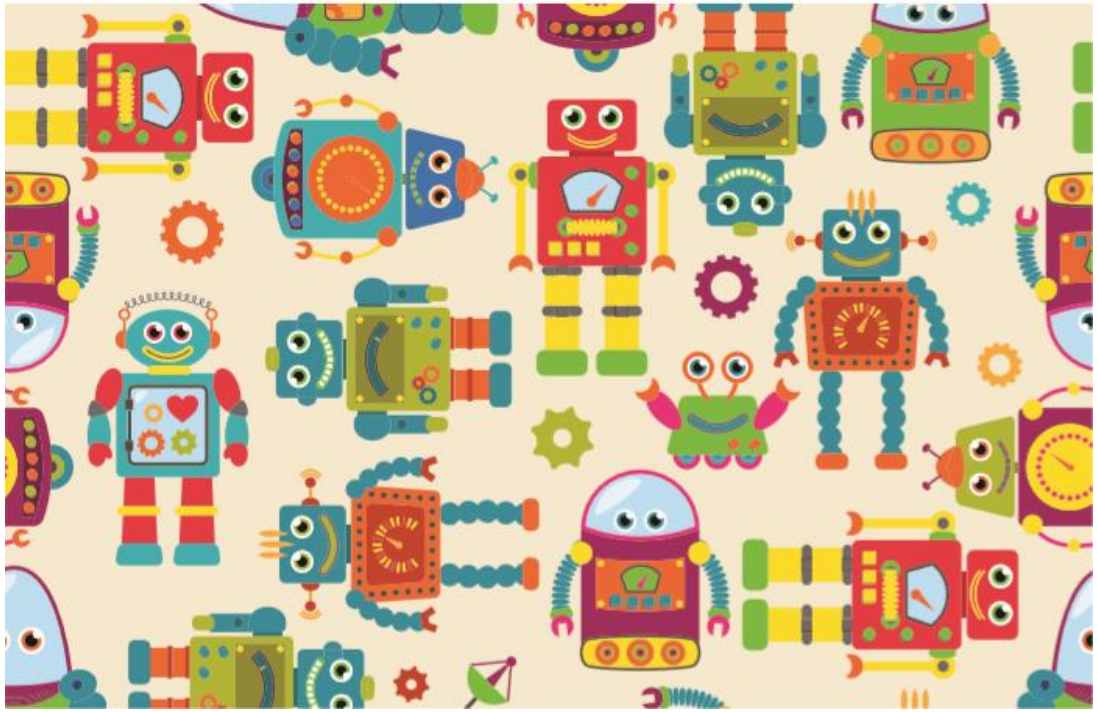
- Yr 2 – Birthday Party Fun
- Yr 2 – Obstacle Course
- Yr 3 – Number Code
- Yr 3 – Number Paths
- Yr 4 – Farmer's Garden
- Yr 4 - Sushi Plates
- Yr 5 - Car Rally
- Yr 5 – Robot Arms
- Yr 6 – Scrutinizing square numbers
- Yr 6 – Tracking triangular numbers



https://www.mav.vic.edu.au/files/2018/primary-resources/algorithmic-thinking/AT_Year_5_-_Robot_Arms_-_complete_file.pdf

Lesson Features

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- Victorian Curriculum Links
- Mathematical language
- Materials and resources required
- Warm Up
- Launch
- Explore
- Summary
- Enabling prompts
- Extending prompts
- Questions to encourage deeper thinking
- Assessment opportunities

https://www.mav.vic.edu.au/files/2018/primary-resources/algorithmic-thinking/AT_Year_4_-_Sushi_plates_-_complete_file.pdf

What is algorithmic thinking?

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- **What is the relationship between algorithmic thinking and coding?** Algorithmic thinking is less about coding or any specific technology than it is about a **systematic method for solving problems**. Coding is part of the story, but so is the use of flow diagrams, spreadsheets, calculators, dynamic geometry software and even pencil and paper.

- **What is algorithmic thinking as it applies to maths?** An algorithm is a step-by-step process that is used to solve a problem, so you could say algorithmic thinking is about coming up with **step-by-step processes to solve mathematical problems**. Essentially it means solving problems by thinking in the way a computer operates.

https://www.cambridge.edu.au/education/news/2016-08-04/Interpreting-algorithmics-in-the-Victorian-Curriculum/

Victorian Curriculum Algorithms and coding

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- At each level a single new content description related to algorithms and coding in mathematics with two elaborations has been included
- The new content descriptions are located in the *Patterns and algebra* sub-strand of the **Number and Algebra** strand
- They relate to existing mathematical content
- They complement, and are aligned with the Victorian Digital Technologies curriculum (see: http://victoriancurriculum.vcaa.vic.edu.au/technologies/digital-technologies/curriculum/f-10

Algorithms in the VC

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Foundation - Follow a short sequence of instructions (VCMNA077)

Level 1 - Recognise the importance of repetition of a process in solving problems (VCMNA094)

Level 2 - Apply repetition in arithmetic operations, including multiplication as repeated addition and division as repeated subtraction (VCMNA114)

Level 3 - Use a function machine and the inverse machine as a model to apply mathematical rules to numbers or shapes (VCMNA139)

Algorithms in the VC

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Level 4 – Define a simple class of problems and solve them using an effective algorithm that involves a short sequence of steps and decisions (VCMNA164)

Level 5 – Follow a mathematical algorithm involving branching and repetition (iteration) (VCMNA194)

Level 6 - Design algorithms involving branching and iteration to solve specific classes of mathematical problems (VCMNA221)

Yr 4 - The Farmer Garden

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Tell the students that the class will be making their own farmer's garden with four different patches. Each patch will grow something different, but each patch is a different size. They need to figure out the area of each patch.

The garden is set out as follows:

- WHEAT
- CORN
- CARROTS
- PEAS

The wheat is 50 metres across and 30 metres down. The carrot patch is next to the wheat and is 7 metres across and 30 metres down. The corn is below the wheat and is 50 metres across and 6 metres down. Next to the corn are the peas. This patch is 7 metres across and 6 metres down.

Yr 4 The Farmer's Garden

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1. What method/steps would you use to work out the area of each patch?
2. What is area of the whole garden?
3. What are the dimensions of the whole garden?

- WHEAT
- CORN
- CARROTS
- PEAS

(Use your mathematics book or spare paper to record your thinking and solutions.)

Level 4 – Define a simple class of problems and solve them using an effective algorithm that involves a short sequence of steps and decisions (VCMNA164)

Taking it further

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ENABLING PROMPTS

- Write the dimensions for each patch on the diagram.
- Use smaller numbers for each patch instead, such as: 20 x 10, 3 x 10, 20 x 4, 3 x 4.
- Give the students square tiles (counters) to help them model the problem.

EXTENDING PROMPTS

- The garden could have six or nine patches instead (two digit by three digit, or three digit by three digit)
- Ask the students to work out the area of the gardens mentioned above: 28 x 45 m, 63 x 57 m, 39 x 86m, using an efficient method, such as breaking each garden up into smaller patches to work out the total area.

Yr 4 – Sushi Plates

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‘A family eats a meal at a Sushi Train restaurant.
The nine orange plates cost $3.80 and the top purple plate
costs $5.80.
How much did the family spend?’

Enabling and Extending Prompts

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Enabling and extending prompts

What if the orange plates cost $4 and the purple plate cost $6?

How much change would the family get if they paid at a register with a $100 note?

What if the bowls of miso soup cost $2.60. How much would the final bill be?

If the family had $79 to spend what could they buy?

Design a menu for a Sushi Train Restaurant.

Evaluating and Debugging

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- Evaluation is how we look at algorithms and determine how useful they are, how adaptable, how efficient, how correct. There may be many algorithmic solutions to a problem, evaluation asks which one was best and why?
- Evaluation is also concerned with the people who use an algorithm. Did it solve their problem? Was it better on paper than in practice?

- Every ‘programmer’ will make mistakes, so debugging is a normal part of the process
- Not a teachers job to debug
- Encourages independence

Creating your own…

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- If a hungry couple spent $38.30 at a Sushi Train restaurant how much would each colour plate be? The difference in cost between the plates is either $1.00 or 50 cents, one colour is worth $3.30)

Teaching Algorithms in the Primary School Years

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What's important:

- Developing the language of communicating Algorithms (Computational Thinking) is critical at all stages of the curriculum
- No particular language or programming medium is required
- Linked to the digital technologies curriculum but quite distinct purposes
- Algorithms focus on mathematics of number, shape, patterns and algebra
- Student group work is particularly powerful to develop and refine algorithmic thinking
- Display student work, students discuss ideas and formulate understanding as a group, group presentations

Max Stephens, University of Melbourne (2017)

Where can you find us?

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Curriculum and resources

This page connects MAV members to some inspirational ideas developed by some of the 'movers and shakers' that the MAV are proud to be in partnership with.

It is place where you can explore curriculum planning and implementation and teaching and assessment resources.

If you have great resources to add to this page let us know at office@mav.vic.edu.au.

Teaching Ideas and Resources

Hand-picked resources just for you.

10 Lessons for Algorithmic Thinking

Check out these 10 great lessons for the Victorian Curriculum level 2 to 6.

Mathematics tasks centre

The Mathematics Tasks Centre is a world of alternatives to text-based learning.

Maths 300

MAV and AAMT support Maths 300, and we can help you with PL or implementing these great resources

Paul Swan

Dr Paul Swan produces an assortment of games, printables, planning ideas, videos and interactive materials to inspire maths teaching and learning.

Engaging Maths

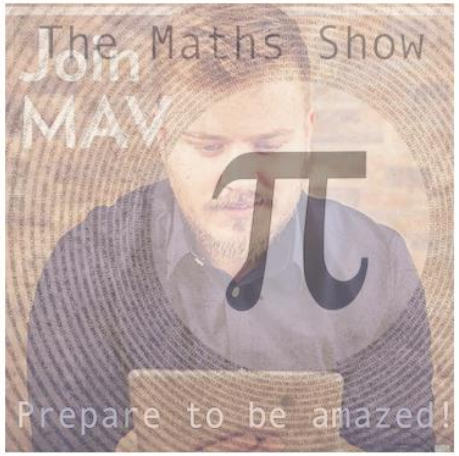
Engaging Maths by Dr. Catherine Attard contains publications, classroom resources and terrific ideas for using digital technologies in maths.

Top Drawer

AAMT Top Drawer Teachers. Rummage through these drawers for expert advice, teaching suggestions, and classroom activities.

PRIMARY RESOURCES

- Authentic Tasks
- Enrichment
- Picture Books
- Mathspiration
- News and research
- Curriculum and resources



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- https://www.mav.vic.edu.au/resources/primary-resources/item/633-10-lessons-for-algorithmic-thinking.html