

# pedagogy corner

with  
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Having a nice mathematical task is one challenge for a teacher – another is making it come alive for students in the classroom. And the pathway to the latter is pedagogy – the range of teaching strategies possessed and activated by the teacher.

There is a delightful mathematical activity known as Spirolaterals. Following some given rules on dotted paper, fascinating and aesthetically pleasing geometric shapes can be created and explored mathematically.

For example, starting at a chosen starting point, the instructions are:

L L L L L  
1 2 3 4 5

These mean that from the start point go left for one space, then left for 2, then left for 3, 4 and 5—always turning left. Following these rules gives the following pattern.

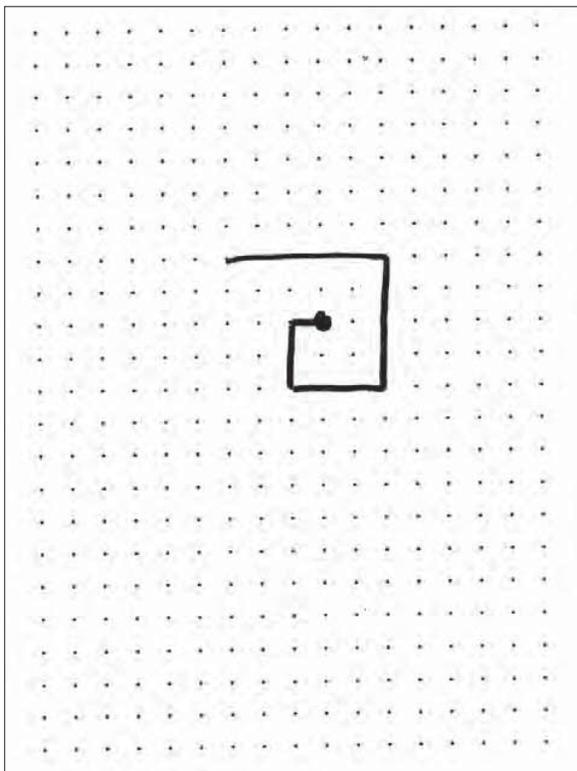


Figure 1. Order 5 sequence.

Then the sequence is repeated and the pattern complete if you arrive back at the starting point.

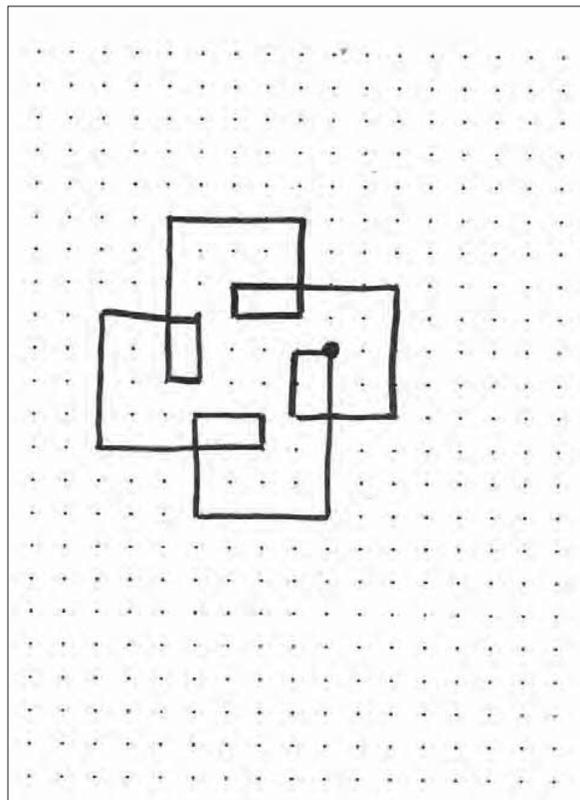


Figure 2. Order 5 sequence repeated.

In this case four repeats of the pattern returns you to the starting point. But what happens to the pattern if the number of left turns is some other number, such as 3, 4, 6, 7, ..  $n$ ? The readers might like to explore these possibilities, perhaps as an individual pursuit. The investigation of these shapes can be very satisfying.

However, the purpose here is to examine pedagogical strategies that could enhance engagement and effective learning at a whole-class level. I have always enjoyed this particular activity after finding it in a mathematics resource book, *Spirolaterals* (Mottershead, 1979). In trying the activity in classrooms, I find about 30% of my students develop the same fascination as I

have—the remainder seeing it somewhat as just another maths task.

Could I deliberately apply a pedagogy perspective or lens to enhance the task and hence build it into an effective classroom lesson?

## A pedagogy perspective

In examining any lesson for effective pedagogy, peering through a pedagogical lens can both justify existing teacher decisions but just as importantly recognise missed opportunities. Active questions that can be ‘asked’ as you peer through such a lens are:

- Have I got an interesting and meaningful context?
- Can I make it concrete?
- Can I make it a genuine problem solving challenge?
- Can I use the outdoors? And involve students physically (kinaesthetics)?
- Can I inject an estimation component?
- Could I use a simulation role play?
- Can I make it personal for the students?
- Could I make it a collaborative group challenge?
- Can I make links, connections to other subject areas e.g., language? And other maths topics?
- Can I exploit the visual aspects?
- Can I embed the learning within a storyshell?
- Can I provide choices to allow student ownership and self-responsibility?
- Can I make the task open-ended and investigative?
- Can I allow for multiple entry and exit points? (Differentiation)
- Can I exploit potential technology benefits?
- Can I aim for genuine understandings? (Fewer rules without meaning.)

The above list has been distilled from several sources and research about classroom teaching, and there is much evidence about the potential benefits to a learning environment.

The following are four such opportunities for the Spirolaterals task drawn from this list.

1. Storyshell
2. Physical (kinaesthetic)
3. Technology support
4. Open-ended and investigative.

## 1. A storyshell

One storyshell that worked well for a teacher with their students goes as follows. It is said with some humour!

“When you leave school, you presumably will get a job—one of the jobs you might get is to be a bus driver around our local area. Can I check if you are qualified ?

i) Do you know your left hand from your right?

ii) Can you count up to 5?

Then you are qualified!”

“Now every time you turn up to work—they give you a bus to drive—today it’s the number 5 bus. And your instructions are: from the depot, go one block left, then turn left for 2, then left for 3, 4 and 5 blocks always turning left. Stop then and pick up passengers—or let them off. Then repeat the sequence until you finish up at the depot!”

### The effect

The story engages students at a personal level and provides a context.

In trying this storyshell strategy I went from 30% engagement to 100% engagement. Why? The power of ‘story’.

## 2. Kinaesthetics

In some classes, we went outside, students placed a marker on the ground, all facing a particular direction and then acted out the instructions. Turn left and go one pace, now turn left for two paces etc.

### The effect

Once again it adds a personal dimension—the students are the bus drivers! It also helps back inside the classroom. The patterns on paper can be quite abstract for some students, but were made more meaningful by the personal physical experience.

## 3. Technology support

A custom designed piece of software (Flavel, 2016) helps in several ways. Firstly, students can check their answers to see they have got the pattern correct. Secondly, from patterns in the data, students create hypotheses for such queries as “Can I predict how many repeats of the pattern will occur for any bus?” The quick feedback from the software provides an efficiency and keeps focus on the big ideas and generalisations behind the pattern.

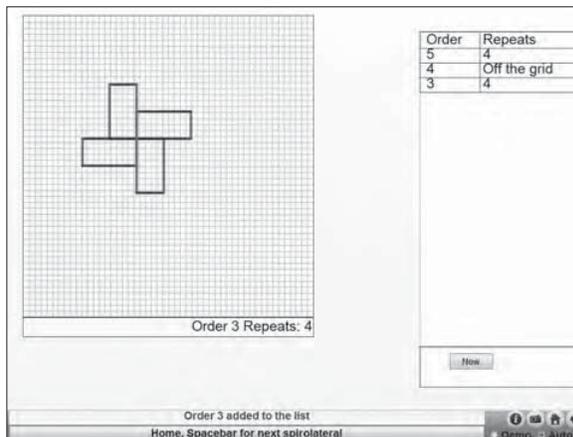


Figure 3. Image from software for the number 5 bus.

The number 4 bus pattern interestingly spirals off forever—hence generating the tile of ‘Spirolaterals’.

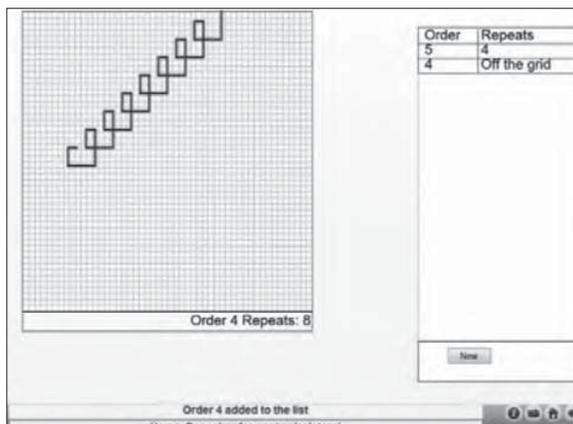


Figure 4. Image from software for the number 4 bus.

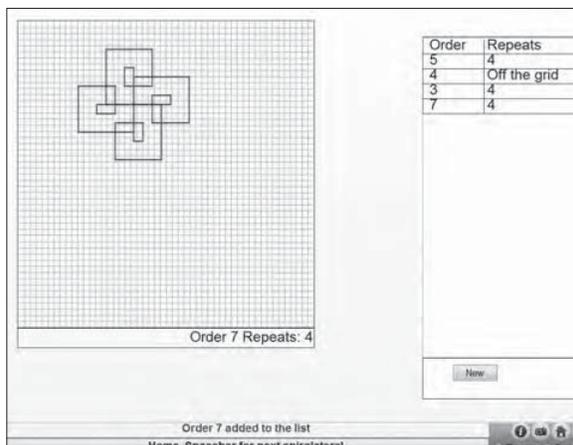


Figure 5. Image from software for the number 7 bus.

Thirdly the software can produce patterns for large numbers which would be entirely impractical without the software. The following pattern is for the number 30 bus.

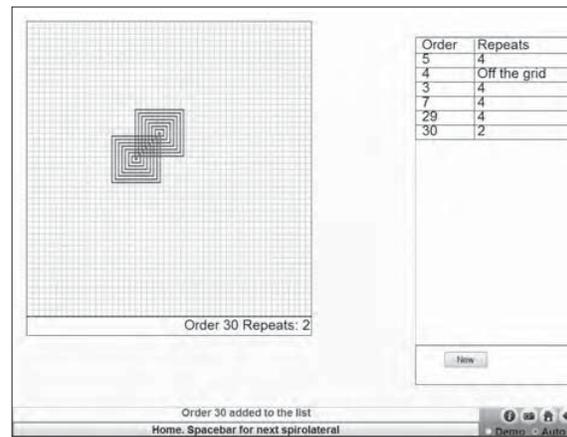


Figure 6. Image from software for the number 30 bus.

### The effect

It gave students a powerful tool for them to employ to eliminate what can become tedious drawing, it generated data quickly and efficiently and most importantly gave students a sense of power and control over the investigation.

## 4. Open-ended investigative

The teacher makes a conscious decision to encourage such questions as:

- What if you turned right sometimes?
- What if the road system was triangular?

### The effect

Pursuing such questions creates and supports a culture of curiosity and deliberately highlights to students the true open-ended nature of mathematics—and how mathematicians go about their task. Different students will be interested in pursuing different paths, hence allowing for multiple entry and multiple exit points, and multiple levels of success

The above Spirolaterals lesson is fully documented including a lesson plan and supportive software within the Maths300 project (Lovitt & Williams, 2015). Perhaps it could now be sensibly renamed as ‘The Bus Driver’s Problem’.

I found an interesting task in a mathematics resource book. By the deliberate addition of selected pedagogical strategies, I now have a very enjoyable and effective whole class lesson.

## References

- Lovitt, C., & Williams, D. (2015). *Maths300*. Melbourne: The Task Centre Collective Pty Ltd. Retrieved from [www.maths300.com](http://www.maths300.com)
- Mottershead, L. (1979). *Spirolaterals*. Melbourne: L & S Publishing Company.
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