SHORT CIRCUIT

Canberra Mathematical Association Inc.

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NEWS AND COMMENT

The 2024 CMA Conference is over but its inspiration may endure for some time. The keynote speakers, Jennifer Way and Catherine Attard addressed the conference theme: Mathematicians - agents of change, differently, but each with useful things to say about teaching and learning.

Throughout the day, individual participants could choose just 4 out of the 28 available workshop sessions. These ranged in flavour from practical to thought-provoking - often a difficult choice.

Here were professional teachers thinking purposefully about what they do in the ever changing environments in which they work.

In this edition of Short Circuit we continue the discussion about pedagogy via Steve Thornton's response to last month's article by Valerie Barker.

Steve reminds us that while urgent concerns are often raised about the 'what' and the 'how' of education, not so much is heard about the 'why'.

Accordingly, Steve examines the Greek idea of the παιδαγωγός from which the English word *pedagogy* derives.

There may be more to come in this vein. Your thoughts are welcome.

Last month we posed a question on the front page about whether the arithmetic sequence 3, 13, 23, 33, 43, ... contains infinitely many prime numbers. In response, CMA life member Mike Newman pointed us to Dirichlet's theorem, which confirms that the answer is 'yes' for arithmetic sequences in which the starting number and the common difference have no common factors.

The result was proved in 1826 by Peter Gustav Lejeune Dirichlet. Dirichlet's proof involves ideas that go quite a way beyond high school maths.

CANBERRA MATHEMATICAL ASSOCIATION

MEMBERSHIP

Memberships run from 1 Jan to 31 Dec. each year. Membership forms may be downloaded from the CMA website: http://www.canberramaths.org.au

The several benefits of Membership of CMA may be found on the website.

NEWSLETTER

The CMA newsletter, Short Circuit, is distributed monthly to everyone on our mailing list, free of charge and regardless of membership status.

That you are receiving Short Circuit does not imply that you are a current CMA member but we do encourage you to join.

Short Circuit welcomes all readers.

Inside:

THE PAIDAGOGOS

From Steve Thornton

How refreshing it was to read Valerie's stimulating piece in the latest *Short Circuit*, "A Rose by Any Other Name…?" It prompted me to reflect on how I might respond to an inquiry into teaching and on some of the writing about education that has influenced me.

I did come across the word pedagogy quite a bit in my teacher education. Yet it was not in the context of pedagogy as the how of teaching or what some might now like to term the science of teaching (closely related to the science of learning, science of reading or even science of maths, which purports to be "a movement focused on using objective evidence about how students learn math to make educational decisions and to inform policy and practice" – see https://www.thescienceofmath.com/). More of this later! Rather, it was with reference to Paolo Freire's *Pedagogy of the Oppressed*. This, along with Ivan Illich's *Deschooling Society*, Postman and Weingartner's *Teaching as a Subversive Activity*, Evertee Reimer's *School is Dead* and the wonderful but troubling *How Children Fail* quoted by Valerie, was required reading in a university environment that was probably just beginning to assert itself as the home of the intellectual left.

Interestingly, Freire's use of the term pedagogy is probably a lot closer to the origin of the term than the way we might use it today, and particularly when it is construed as the science of teaching. In Greek times, a paidagogos was most likely a slave, often one that was too damaged to do useful work such as physical labour. It was the job of the paidagogos to accompany the young son of the nobleman in their daily activities, perhaps shielding them from harm, administering discipline when necessary or teaching the correct social customs. In essence, the paidagogos accompanied the child on their journey. This, I suggest, is closer to what Freire meant by pedagogy in *Pedagogy of the Oppressed* than the way we now use the word pedagogy. For Freire, literacy was emancipation. Pedagogy was about journeying with the poor and disenfranchised, or as we might say the Other, to give them power in an oppressive society.

So, I want to suggest that we might do well to think of pedagogy as journeying rather than teaching. The paidagogos journeying with the child, Freire journeying with the oppressed or the 21st Century maths teacher journeying with their students. This seems to me to cast a very different light on "class, whole-school and system-wide approaches and supports that have been *proven* to *improve learning outcomes* for all students at each stage of learning and development, including:… pedagogical approaches…" as quoted in the terms of reference of the Inquiry (my italics).

I have intentionally italicised four words here: proven, improve, learning and outcomes. Of course, one can hardly argue against improvement, or against learning or against better outcomes and equally one can hardly question advocacy of approaches that are proven to be effective. Each of the terms is so persuasive that they are unquestioned in the current educational climate. Yet, I want to suggest each of these ideas *is* questionable and that each runs counter to the original notion of the paidagogos and to pedagogy as described by Freire, Illich and co.

One of the most influential writers on educational philosophy in the 21st Century is Gert Biesta. Biesta questions the inexorable focus on learning outcomes, coining the term *learnification* to describe the shift in focus away from education in its broadest and most noble sense to a focus on learning. He claims that we have become obsessed with the language of learning, in the process atomising knowledge, reducing education to a set of facts or skills that can be easily measured and diminishing the role of the teacher. The drive to learnification also silences discussion of educational purpose or values, which Biesta argues are much more important questions than questions of what or how.

One phrase used by Biesta that has profoundly influenced my thinking is the title of the third book in a trilogy about education, called *The Beautiful Risk of Education*. His claim is that education is inherently risky. It is a gift that we offer to our students and, if they want, and as I suggest many do, they are free to reject that gift. The *science* of learning, or reading, or maths, is about minimising risk using so-called proven methods. Yet, according to Biesta, if we remove the risk from education, we run the real risk of removing education itself. Rather than being risk averse as so much of modern society is, Biesta argues that we should celebrate the weakness of education and hence become risk-celebratory!

As I was reading for my thesis, I was also profoundly influenced by two English philosophers of education, Nick Peim and Kevin Flint, who wrote a challenging book called *Rethinking the Education Improvement Agenda*. Every school seems to now have a School Improvement Plan, which is regularly revisited and updated. After all, no school is perfect and who can argue against improvement? Peim and Flint's claim, though, is that the focus on measurable improvement is an aspect of what they term the *technological enframing* of society. Technology produces an output that, hopefully, we have told it to produce. It is predictable and measurable. In the technological enframing, the purpose of the education system is technological – it is to advance the competitiveness of the society and students and schools are the tools by which this is achieved. School improvement is then about contributing to the drive for the nation to be more competitive, which is inextricably linked, at least in the political rhetoric, to GDP. To the detriment of society, this also privileges STEM disciplines at the expense of literature, the Arts and the Humanities (am I allowed to question that in this forum?) In the technological enframing, the value of the student lies not in his or her humanity but in the extent to which they contribute to the nation's measure of achievement. Students become part of what Heidegger called *bestand*, or the "standing reserve". That is, in the endless technological drive for efficiency, the earth, its creatures and our fellow human beings are reduced to the status of raw material.

So where does this leave mathematics, the mathematics teacher and the mathematics student? As Valerie so eloquently wrote, education is politically charged and, for better or worse, marked by rapid change. Yet for me, the one constant is the joy of mathematics and the thrill when one of my students, whether a young child at school or an old(er) university education student, also experiences the joy of mathematical discovery or the privilege of being the paidagogos, journeying through mathematics with the children they teach.

Thank you, Valerie!

MAWA VIRTUAL

Join us for the 2024 [Virtual Maths Conference] on Friday, 3rd May.

ICME-15

The [International Congress on Mathematical Education] is the largest international conference on mathematics education in the world.

The 15th International Congress on Mathematical Education (ICME-15) will take place 7-14 July 2024 at International Convention Centre in Sydney, Australia. ICME-15 promises to be an innovative congress that builds on the well-established ICME program, showcasing established and emerging thought leaders from around the world.

ABOUT THE CMA

NEWSLETTER OF THE CANBERRA MATHEMATICAL ASSOCIATION INC. INC

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We're on the Web!
http://www.canberramaths.org.au/

The Canberra Mathematical Association (Inc.) is the representative body of professional educators of mathematics in Canberra, Australia.

It was established by, among others, the late Professor Bernhard Neumann in 1963. It continues to run - as it began - purely on a volunteer basis.

Its aims include

* the promotion of mathematical education to government through lobbying,
* the development, application and dissemination of mathematical knowledge within Canberra through in-service opportunities, and
* facilitating effective cooperation and collaboration between mathematics teachers and their colleagues in Canberra.

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Joe Williams is the website manager.

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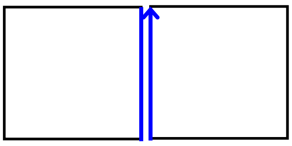
QUESTION

There is an old question that goes back at least as far as the writings of Martin Gardner in Scientific American. Place two identical coins side-by-side and roll one about the other without slipping. How many rotations does the rolling coin make to get back to its starting position?

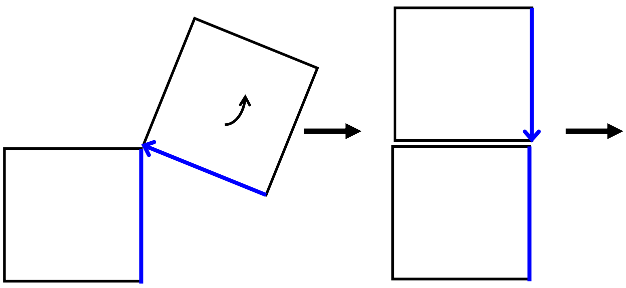
Despite the one-to-one correspondence between the edge-points on the coins, the number of rotations is not one but two.

A way to see what is happening is to replace the coins with squares, which are, of course, equivalent to circles in a topological sense. The following diagrams illustrate the reasoning.

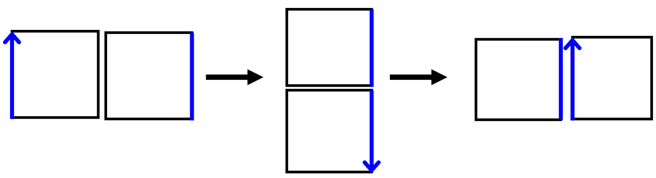
Each square has exactly one coloured edge, with an arrow head on the edge of the rolling square.



The square on the right is rotated around the point where the top corners touch until the next pair of sides is aligned.



The rolling motion is repeated until after four steps the coloured edges are again together.



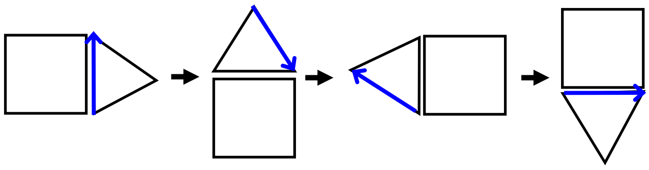
That is, the moving square has measured out the perimeter of the fixed square once. And yet—

The moving coloured edge has turned through 180° four times, and therefore, has undergone two complete rotations around its centre.

Now consider this:

Take a square and an equilateral triangle. The sides of the square and the triangle are equal. Perform a sequence of anticlockwise rotations of the triangle about the corners of the square. Topologically this is the same as two circular coins with radii in the ratio 4:3 where the smaller coin rolls without slipping around the larger.

As before, we would like to know how many full rotations of the triangle will bring it back to its original state.



We might ask:

Through what angle does the triangle turn at each step?

How many 360° rotations does it undergo in each four-step tour around the square?

How many steps are needed to bring the triangle back to both its original position and orientation?

How many 360° rotations does the triangle undergo over the full cycle?

What, if anything, would change if we considered clockwise motions of the square about the triangle instead of anticlockwise motions of the triangle about the square?

Curiosity may lead one to wonder about other regular polygons with unit edges moving in relation to one another in a similar way. If an n-gon rolls around an m-gon, is there a rule that predicts how many 360° rotations of the n-gon should occur?

This is equivalent to a pair of coins whose radii are in the ratio m:n.

We can deduce via some high-school geometry that when an n-gon rolls around an m-gon, the angle through which the n-gon rotates in a single step is $360(m+n)/mn$ degrees.

Thus, in mn steps the n-gon makes $m+n$ rotations of 360° to arrive back in its starting position.

What if, in the case of two coins, the circumferences m and n do not exactly measure one another? That is, the expression m:n is not a ratio but an *irratio*.

The rolling coin comes back to its original position periodically and it must regularly come back to its original orientation, but it can never achieve both its initial position and orientation together.

PT

RESOURCES

Naomi Fitzgerald writes:

We launched our new reSolve website this week, which we are all very excited about!!

We have new *place value* teaching sequences in Year F-2, with some PL embedded; we will be adding to the resources as we write new content.

Go and have a look – resolve.edu.au

The classic reSolve resources are still accessible on this site too.

Resources for mathematics teachers

The Australian Association of Mathematics Teachers (AAMT) is the leading organisation representing mathematics education in Australian schools.

The work of AAMT includes:

- Professional learning for teachers of mathematics
- Advancing mathematics education via collaborative research and national projects
- Running conferences and events for mathematics educators in Australia
- Providing resources for mathematics education via the **AAMT web shop** and **Maths300**
- Publishing peer reviewed journals —**The Australian Mathematics Education Journal (AMEJ)** and **The Australian Primary Mathematics Classroom (APMC)**
- Advocacy for mathematics education in Australia
- Supporting the State-based affiliated mathematics teacher associations.

AT THE CMA CONFERENCE