Teaching geometry using Logo/Python turtle module

(or how to sneak programming into maths class)

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Digital Technologies Curriculum

- Endorsed last year, covers Kindergarten – Year 10

- Different states/territories are in various stages of planning/implementation

- 7-8: Implement and modify programs with **user interfaces** involving **branching**, **iteration** and **functions** in a **general purpose** programming language

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A great starting point, but...

- Curriculum is very crowded

  - "It's important that teachers cover DT content descriptors in conjunction with other learning areas, because that's the only way you'll create any extra time."

- Subjects are siloed

- Schools lack of support and experience

- Some states are further behind and we want to teach more kids now!

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Possible solution - teach it in maths?

- ○ Deep connection between maths and CS

- ○ Lots of connections between the two curricula

- ○ Every child learns maths

- ○ Opportunity for authentic integration

- ○ VIC has added Digital Technologies-like content descriptors into their maths curriculum
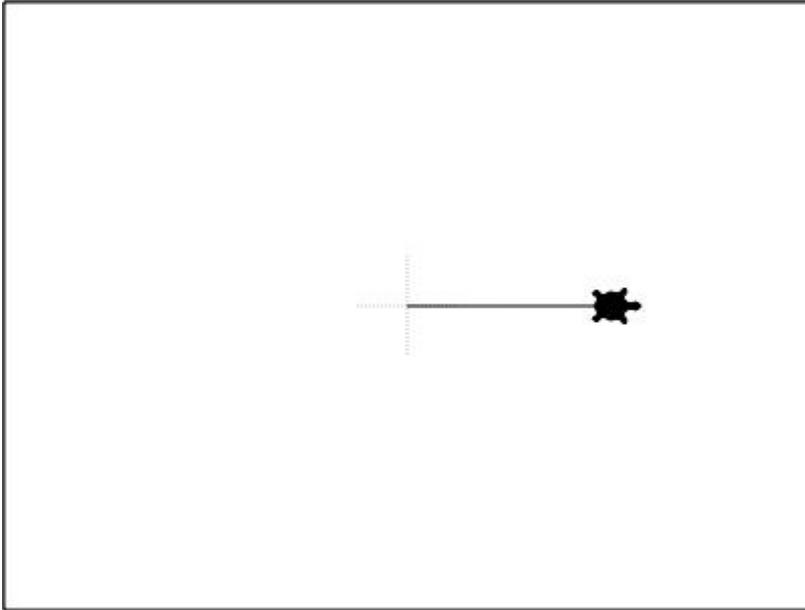
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1 Logo/Python turtle module

A brief history of Logo

- ○ Educational programming language designed in 1967, remembered for turtle graphics

- ○ Originally a physical robot (called a turtle) that drew with a pen on paper

- ○ There have been various implementations over the years , e.g. Python turtle module!

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```
from turtle import *

forward(100)
```

2

Put turtle/geometry problems in existing competition
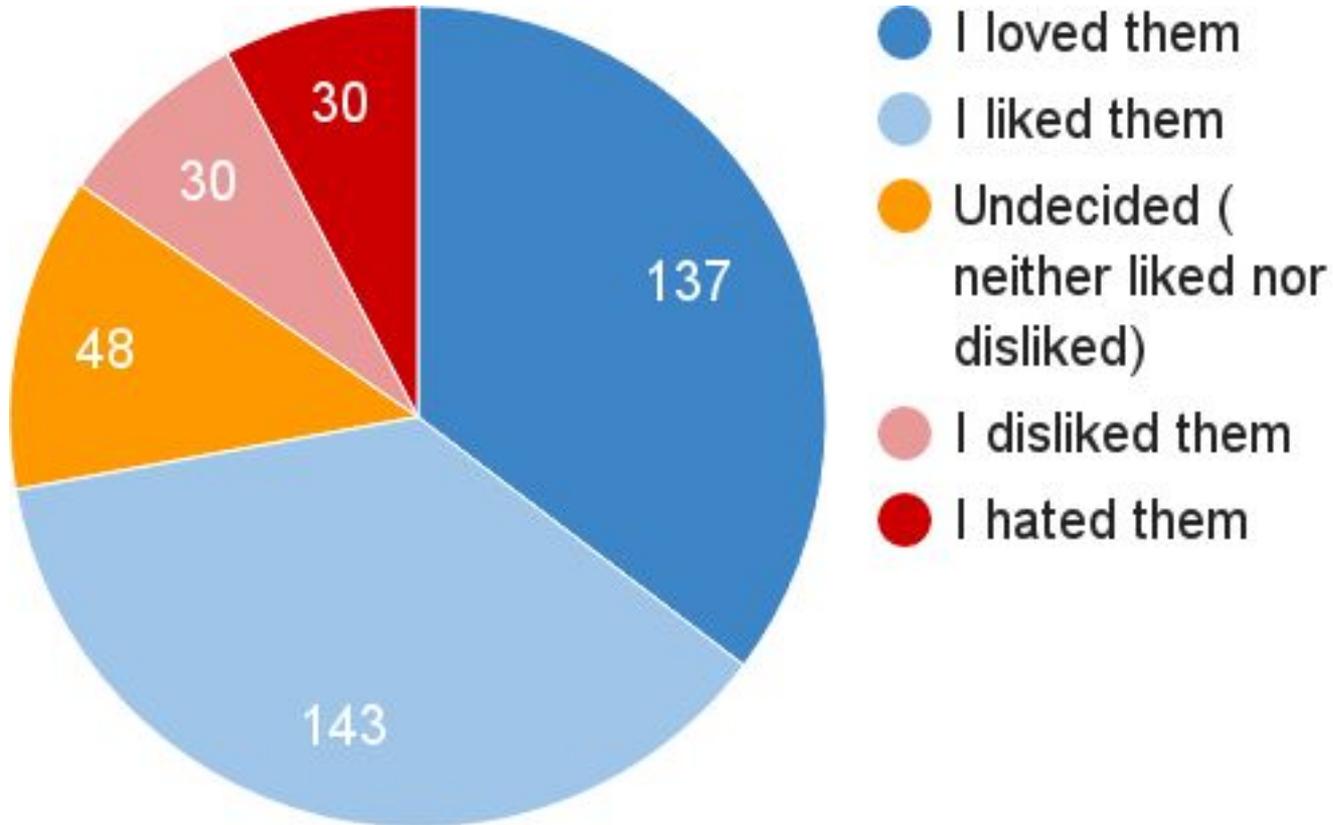
NCSS Challenge 2015
~6000 students, ~500 teachers

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Demo

Geometry/turtle problems in the NCSS Challenge

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What students thought

- *IT WAS AMAZING!!!! I loved programming to make shapes and pictures but don't ask me to redo them because they were very hard to work out how do*

- *It felt nice when I got them right, because I'm weak at maths.*

- *I would much rather write other programs or stab forks in my eyes than do anymore [sic] turtle questions.*
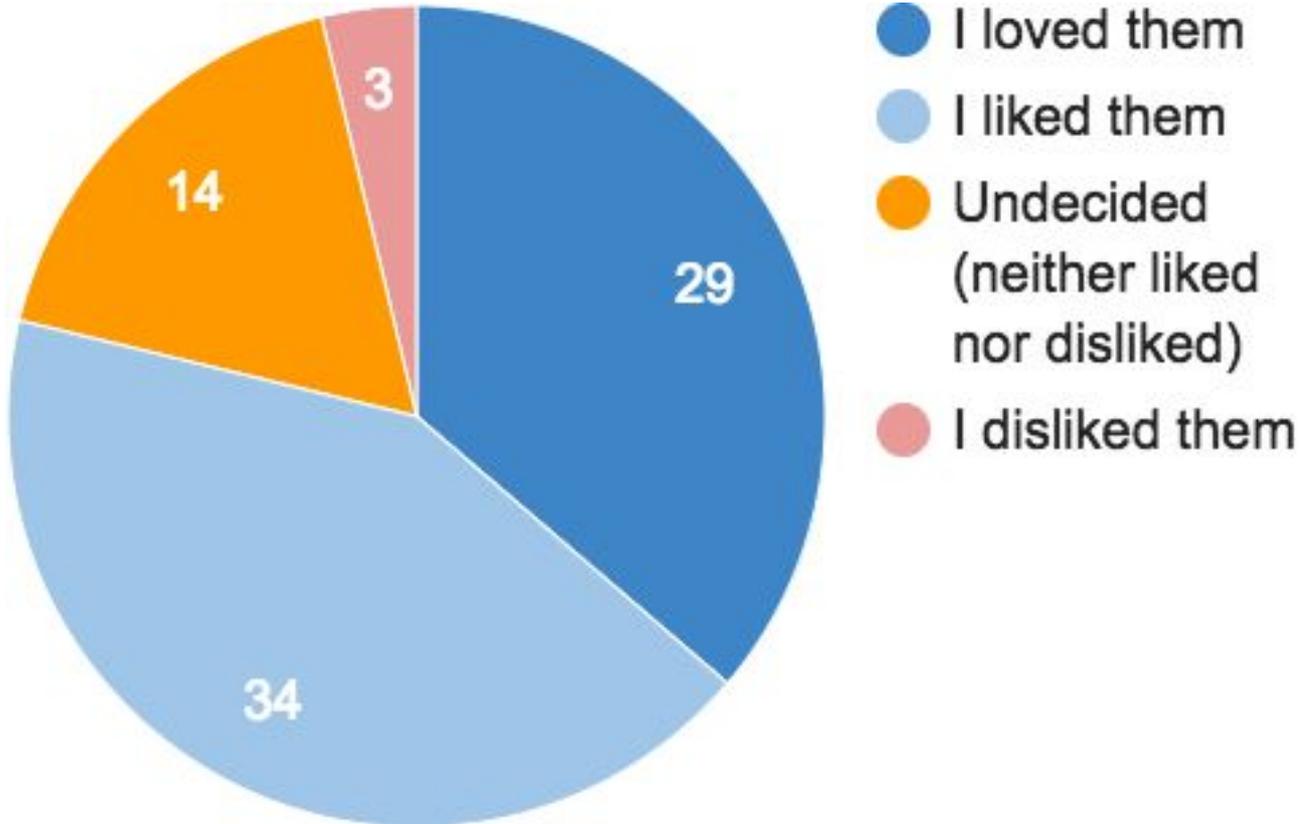
Did you like the turtle questions? (students)

- I loved them — 137
- I liked them — 143
- Undecided (neither liked nor disliked) — 48
- I disliked them — 30
- I hated them — 30

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What teachers thought

- *Engaging and more enjoyable as you could see where an incorrect instruction was drawn out with the turtle - see physical errors, rather than computer language feedback stating errors.* - Rob McLean

- *As much as I liked them, students tended to get hung up on the mathematics of the questions, rather than the programming bits! At the Beginner level, this often caused the students to get disheartened with the programming side of things too.* - Richard Lawler

- *Okay, I personally hated the turtle but that's because I couldn't get my mind around it! It was great for students however and our Head of Maths found some great connections with vectors, angles etc.* - Lou Christie

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Did you like the turtle questions? (teachers)

Pie chart legend:
- I loved them
- I liked them
- Undecided (neither liked nor disliked)
- I disliked them

Values shown on chart: 29, 34, 14, 3

What did we learn?

- Feedback generally positive

- Concerns about maths being too difficult turning students off programming

- Problem: Large range of ages (Years 5-12) works for programming but not maths

- 59 teachers said they'd be interested in working with maths colleagues to trial a turtle/maths course for Year 7 students

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③ Create a Year 7 maths course

groklearning.com/course/maths-yr7

Features of the course based on feedback

- Targeted at Year 7 and tied to their curricula

- More explicit teaching of maths concepts

- Slowed right down - 6 modules so far cover

  - Maths concepts: arithmetic, naming angles, angle calculations, angles on parallel lines

  - DT concepts: user interaction, variables, types, and branching

- More repetition - two problems for each concept

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Trial with a Year 7 cohort

- 91 students across 4 classes

- Enthusiastic Head of Maths

- 4 maths teacher with very little coding experience

- Classes completed 1-3 modules over 3 periods

- A lot of students didn't even get to turtle :(
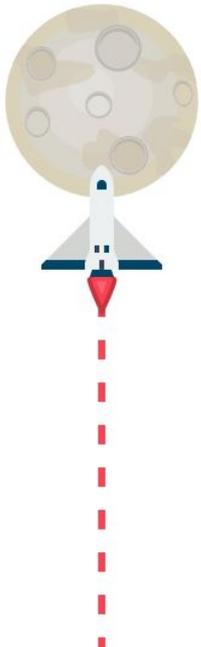
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What did we learn?

- It's hard to do anything interesting without basic programming
  - This will get better as students learn programming from a younger age

- Maths teachers concerned about having enough time to teach maths curriculum

- Getting the balance right is hard...

- But we'll keep trying!

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What's happening now

- ○ Released course on the website last week

- ○ More trials with maths students

- ○ At schools with engaged teachers

- ○ Work to shift the balance towards maths and further slow down and embed programming concepts

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Conclusion

- Teaching Digital Technologies needs integration

- Logo is an engaging and time-tested way to connect programming and maths

- Python standard library includes turtle module

- We're in a tough transitional phase, trying to find the right balance of maths, programming and fun!

- Working with teachers has been invaluable

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ANY QUESTIONS?

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