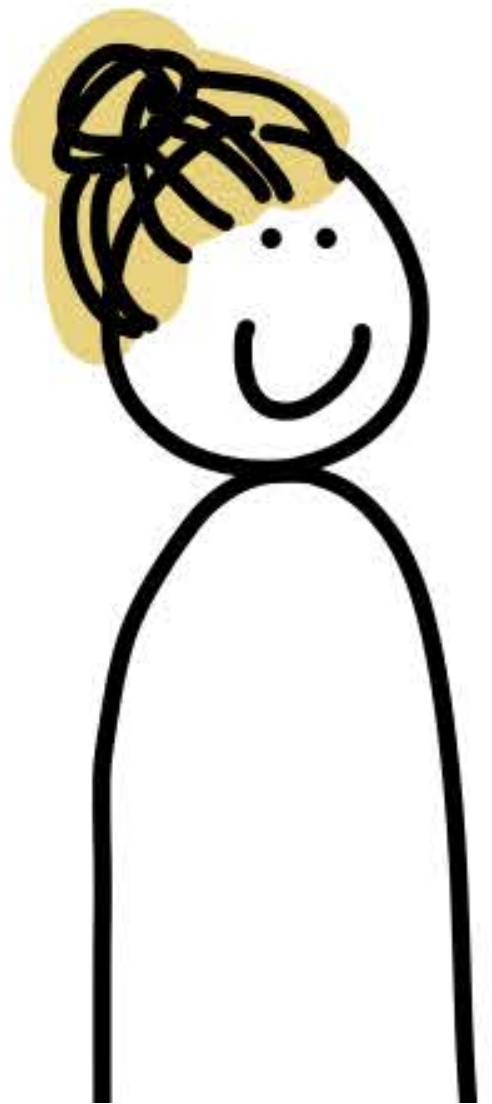
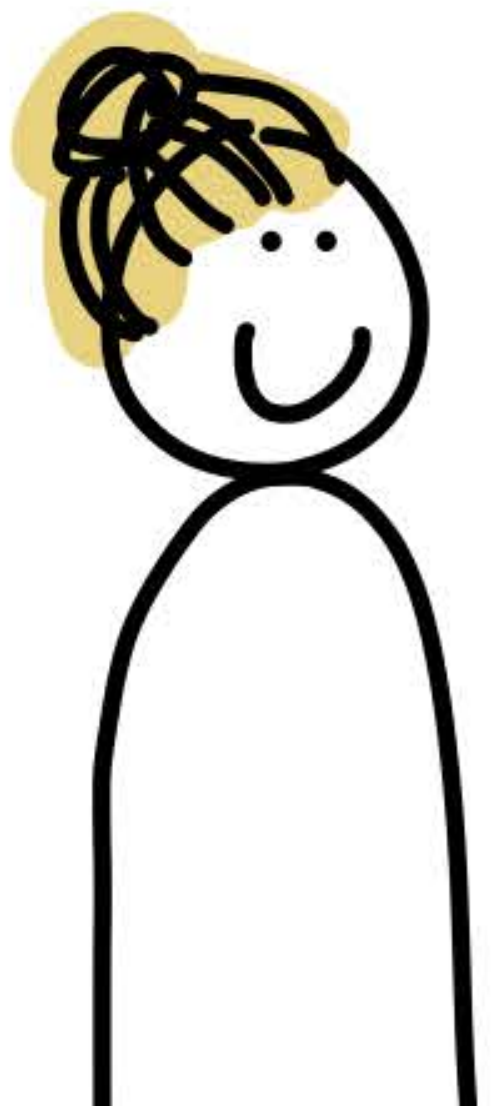


Explicit Direct Instruction in Programming Education



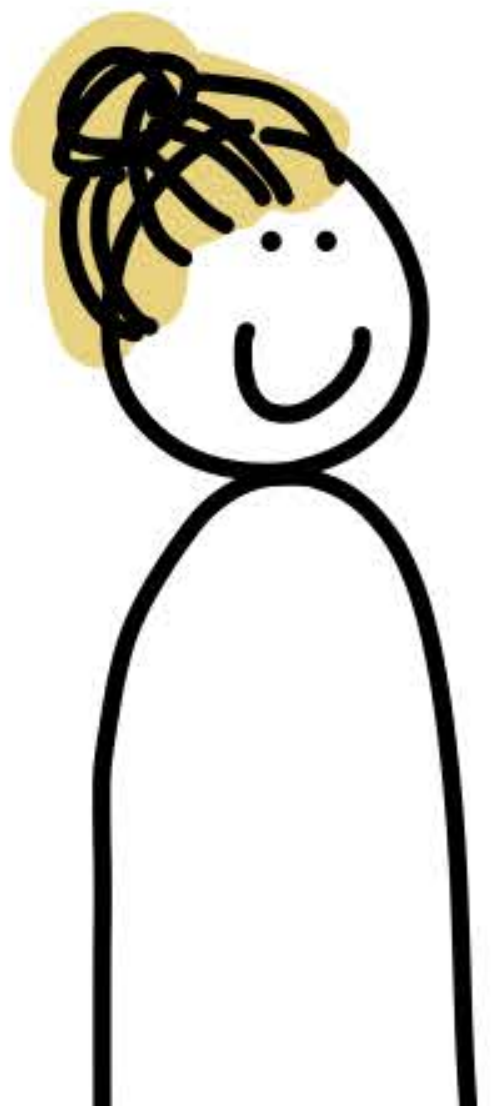
@Felienne

How to teach programming (and other things)



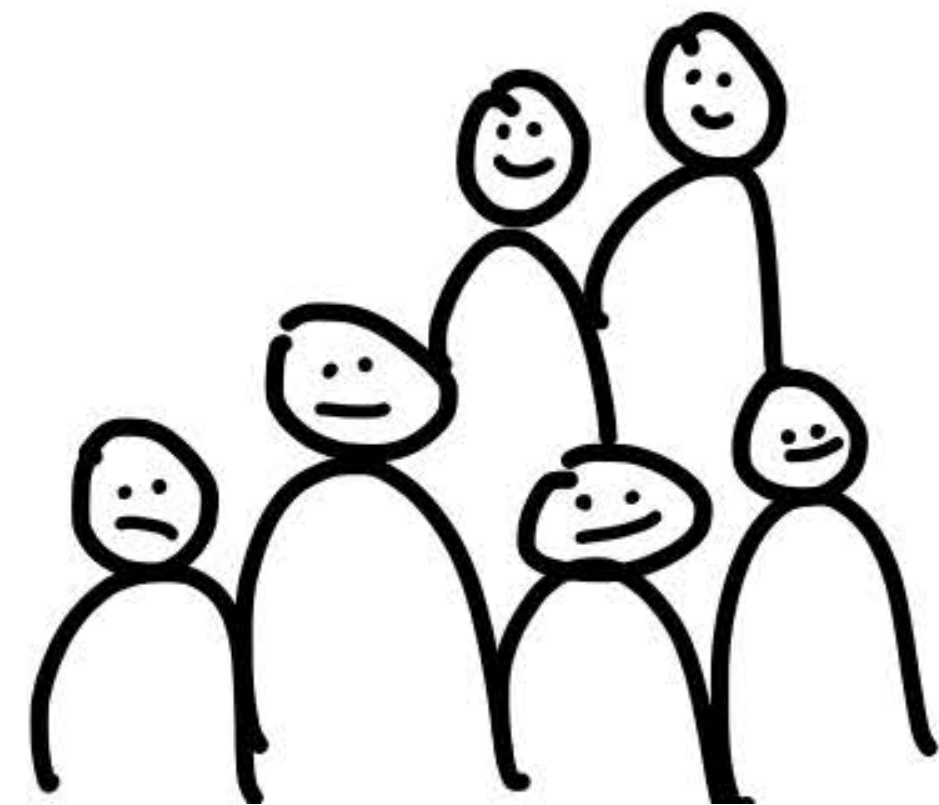
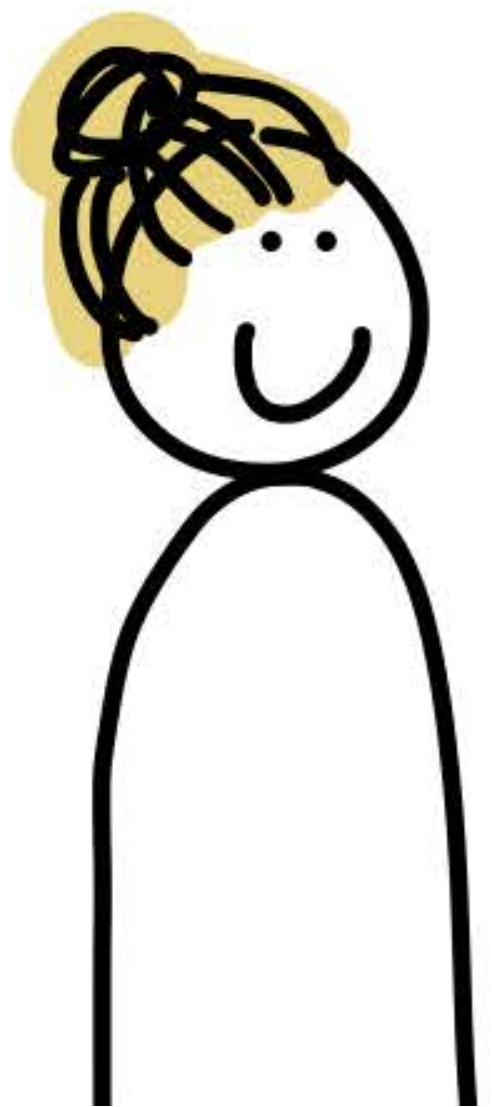
@Felienne

How to teach programming (and other things)

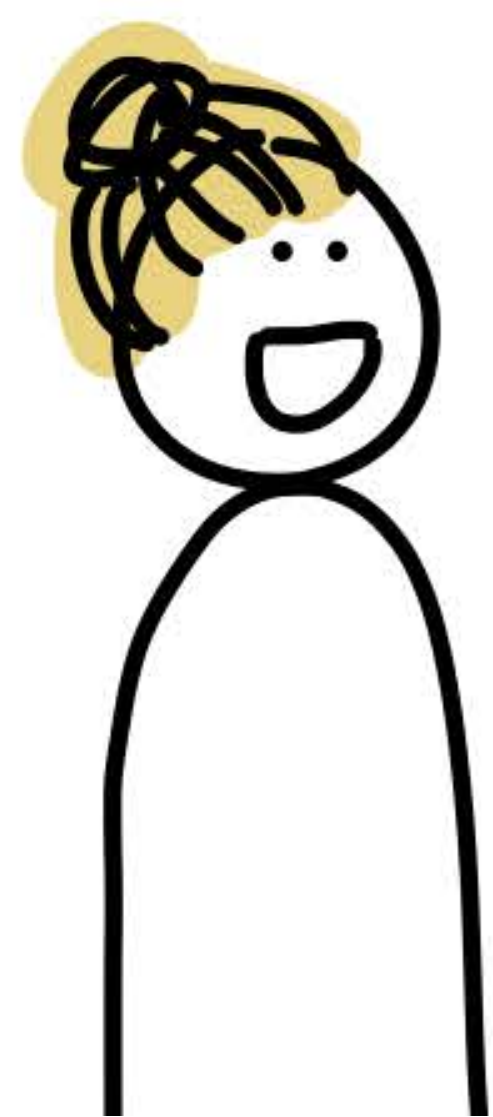


@Felienne

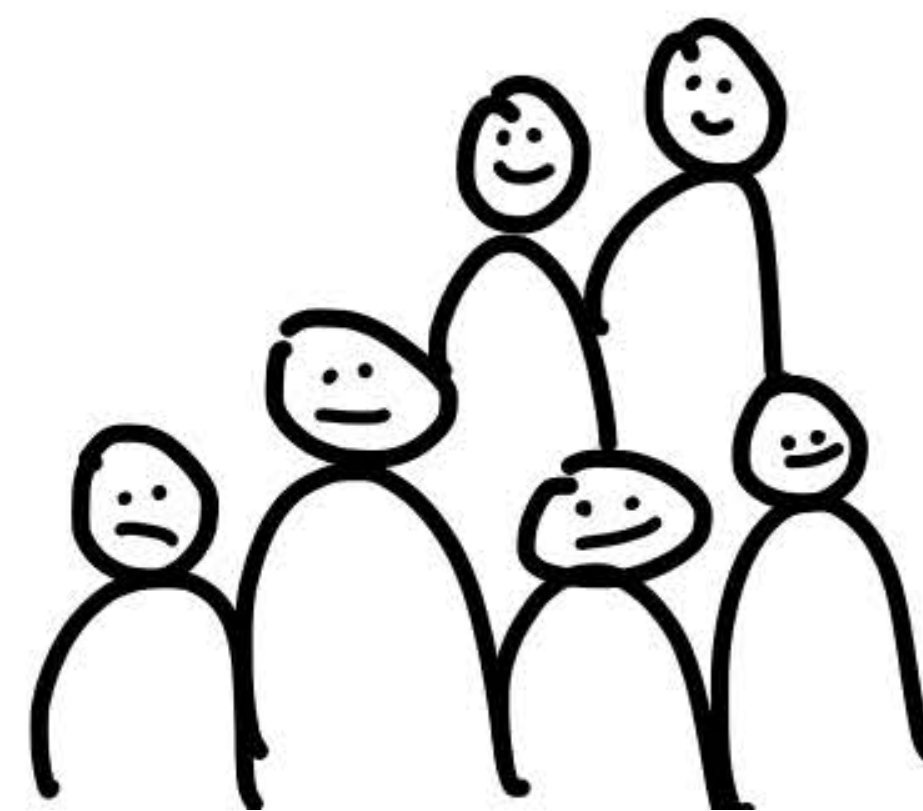
We'd love to
learn programming



Yeah!

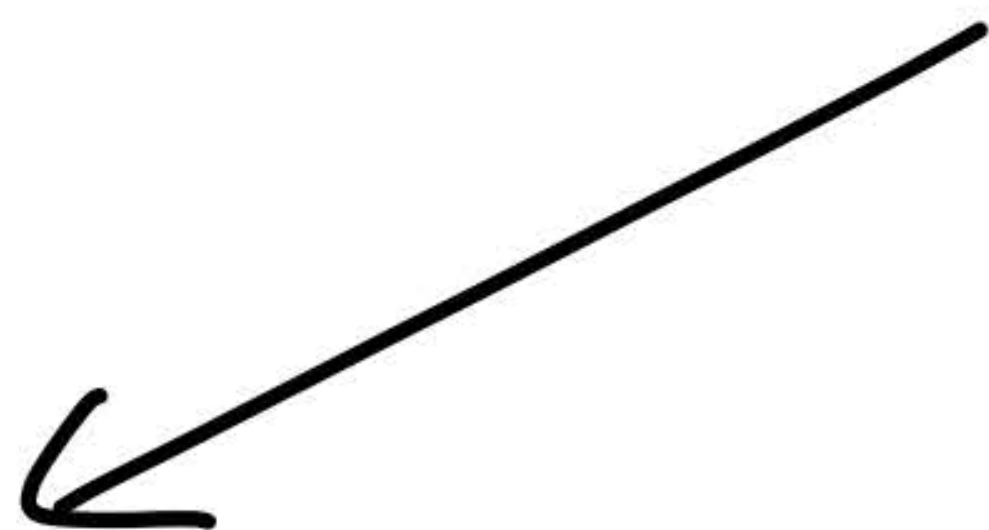
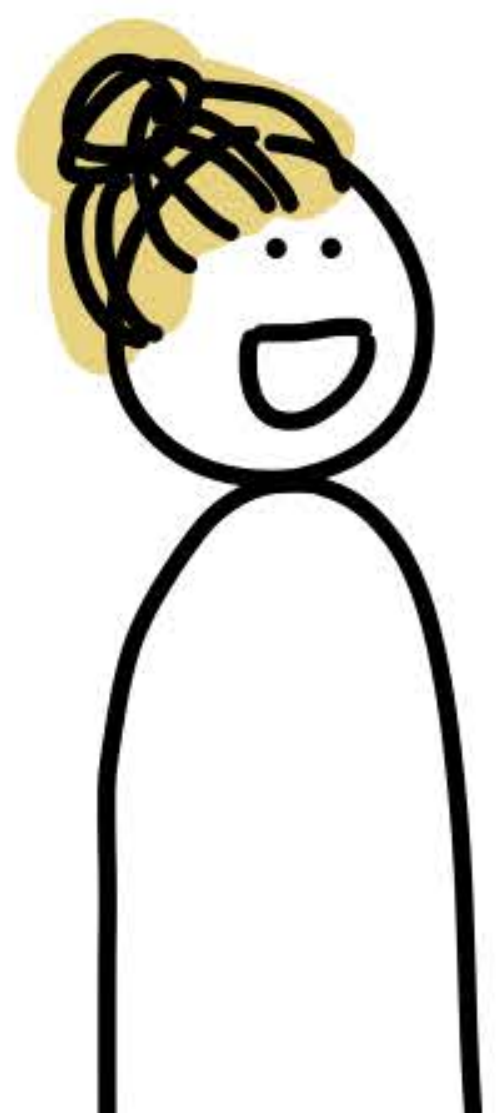


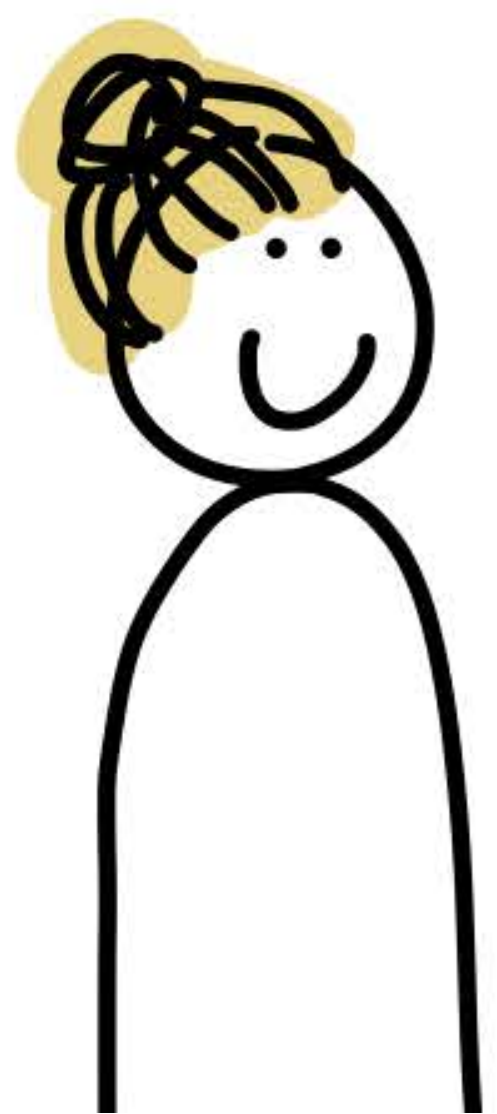
We'd love to
learn programming



Yeah!

Doesn't know anything
about teaching

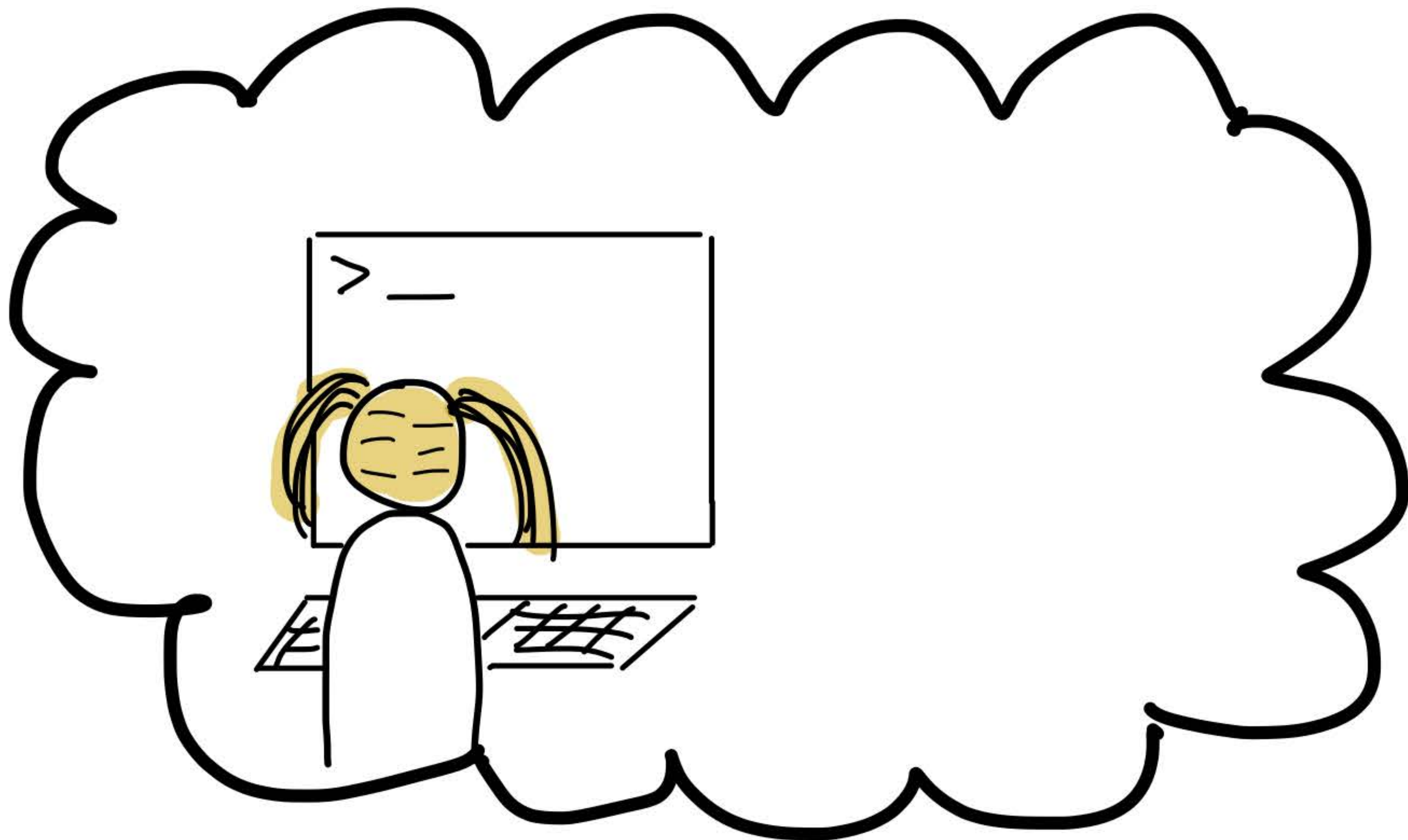


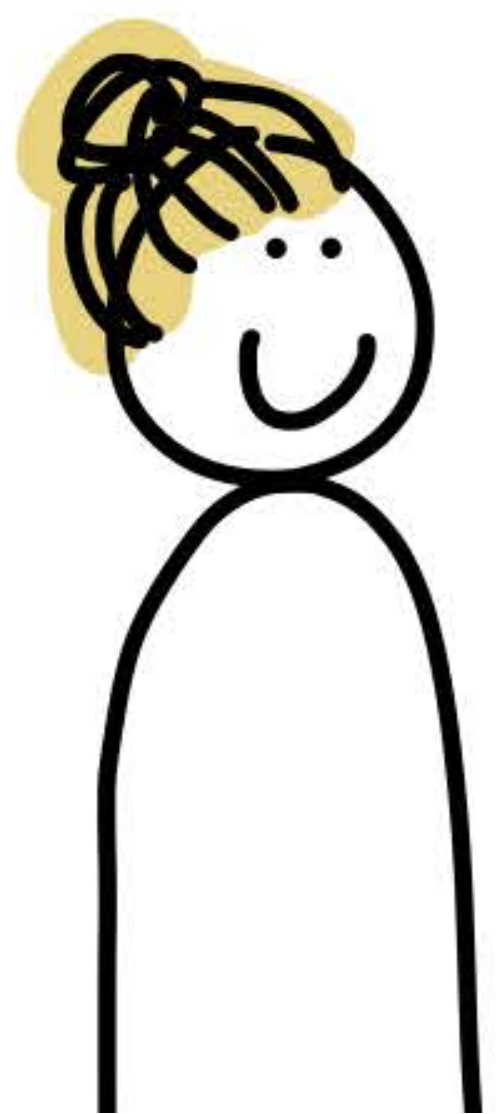


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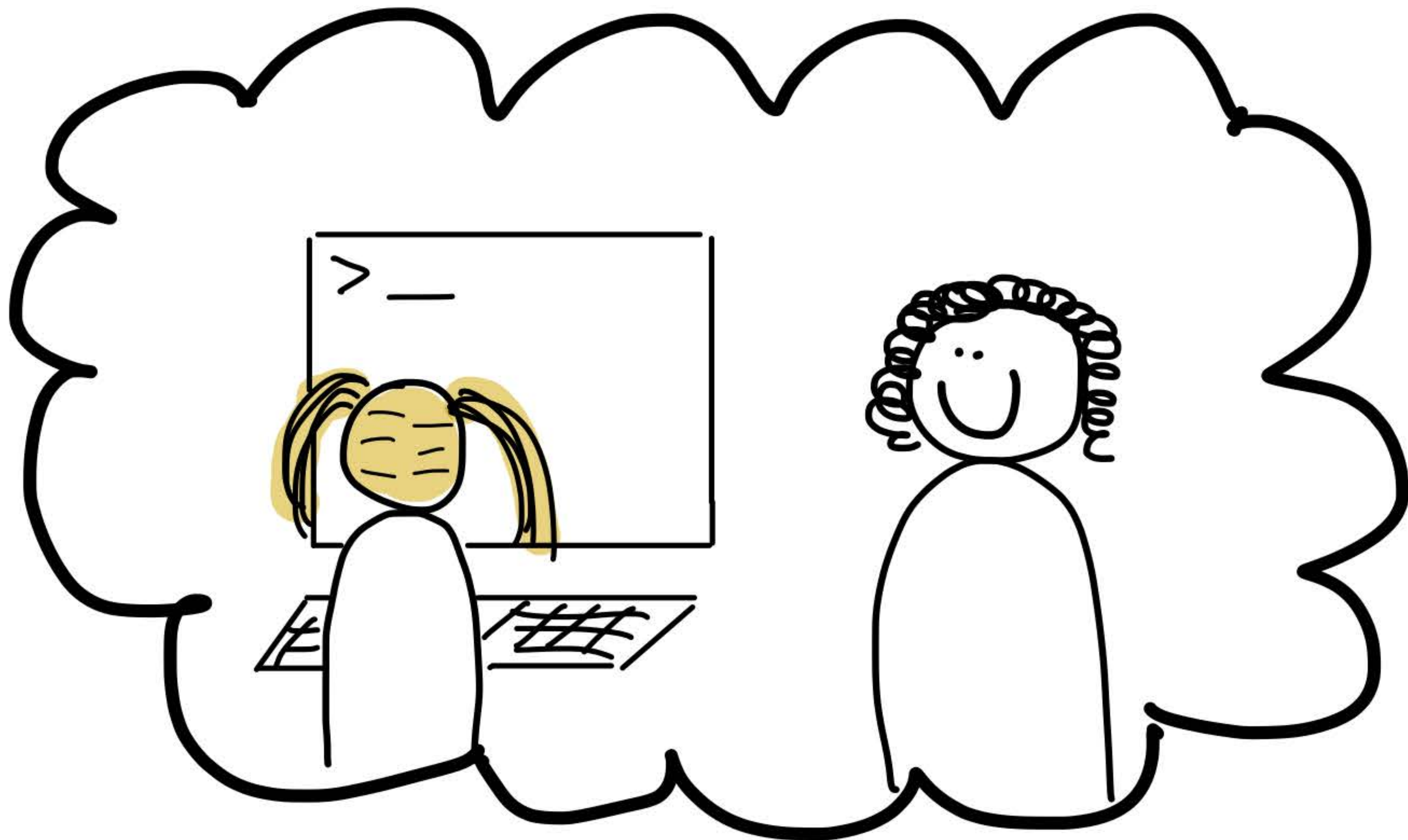


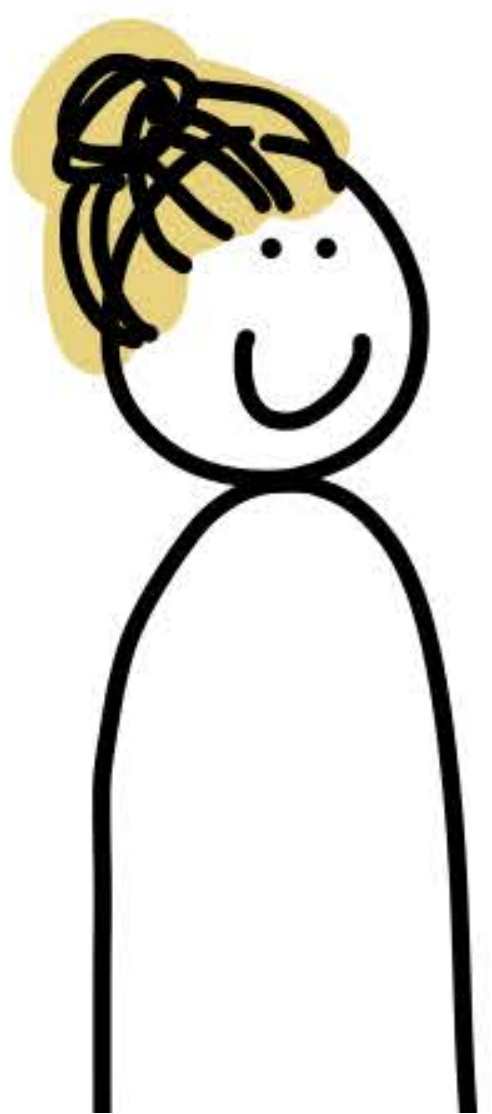


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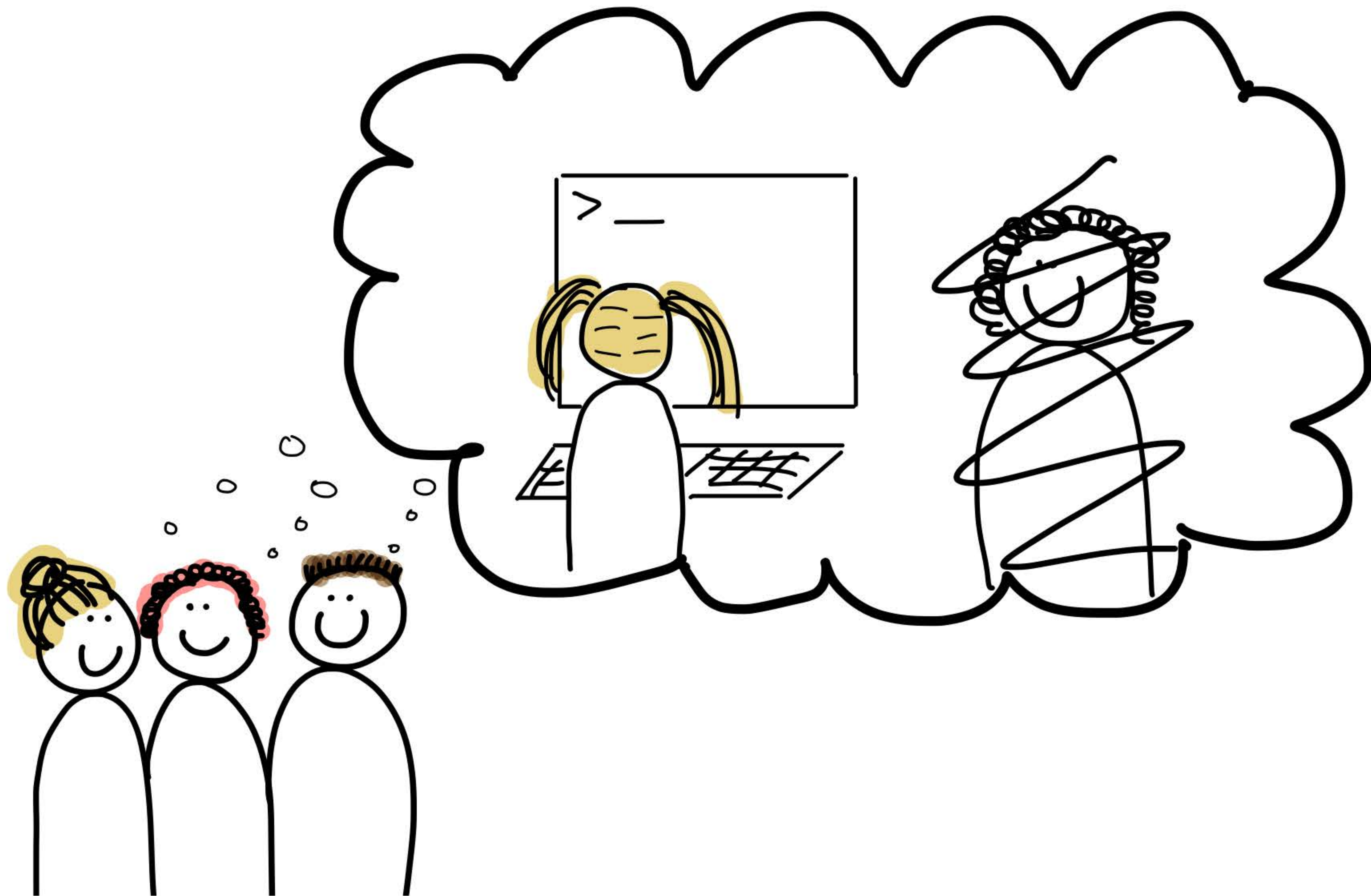


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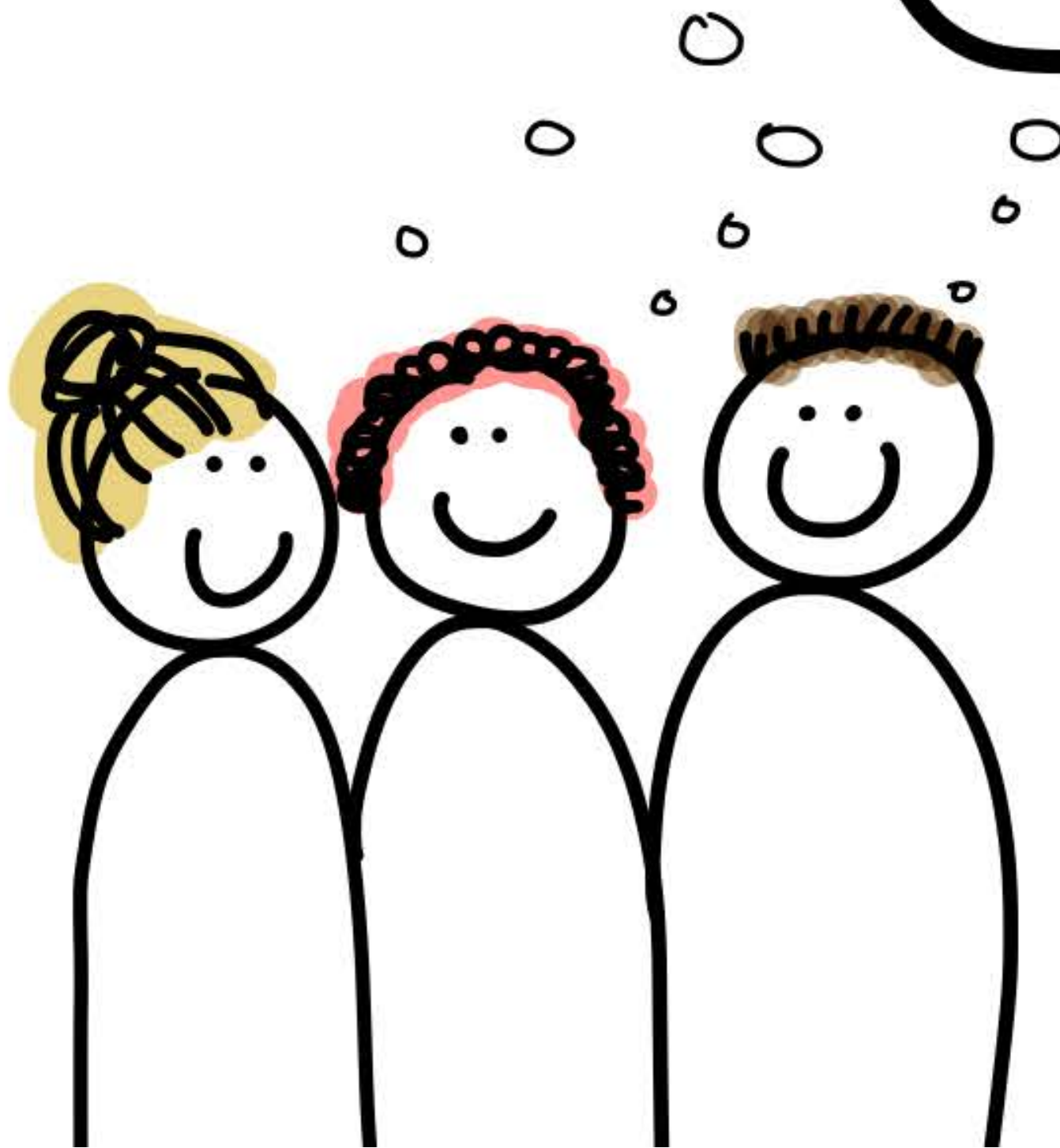
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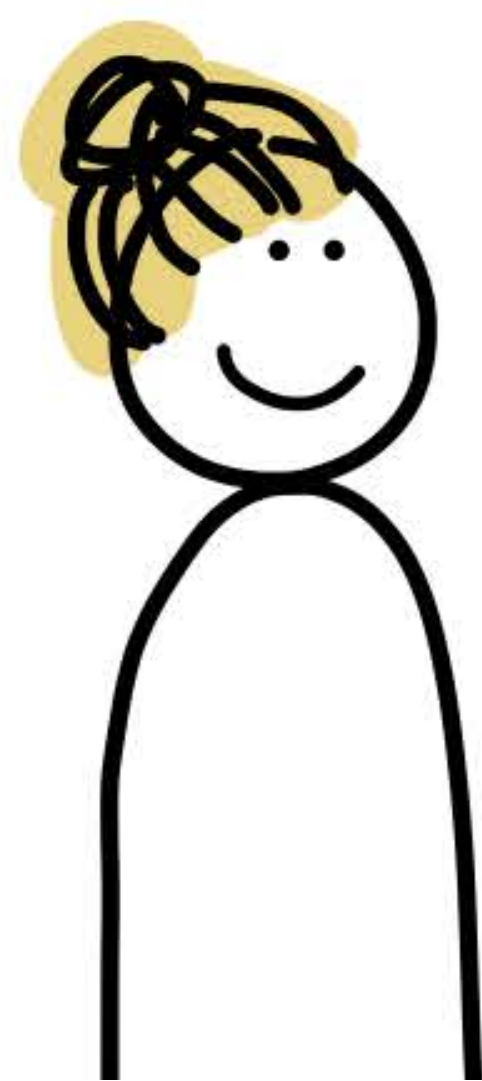
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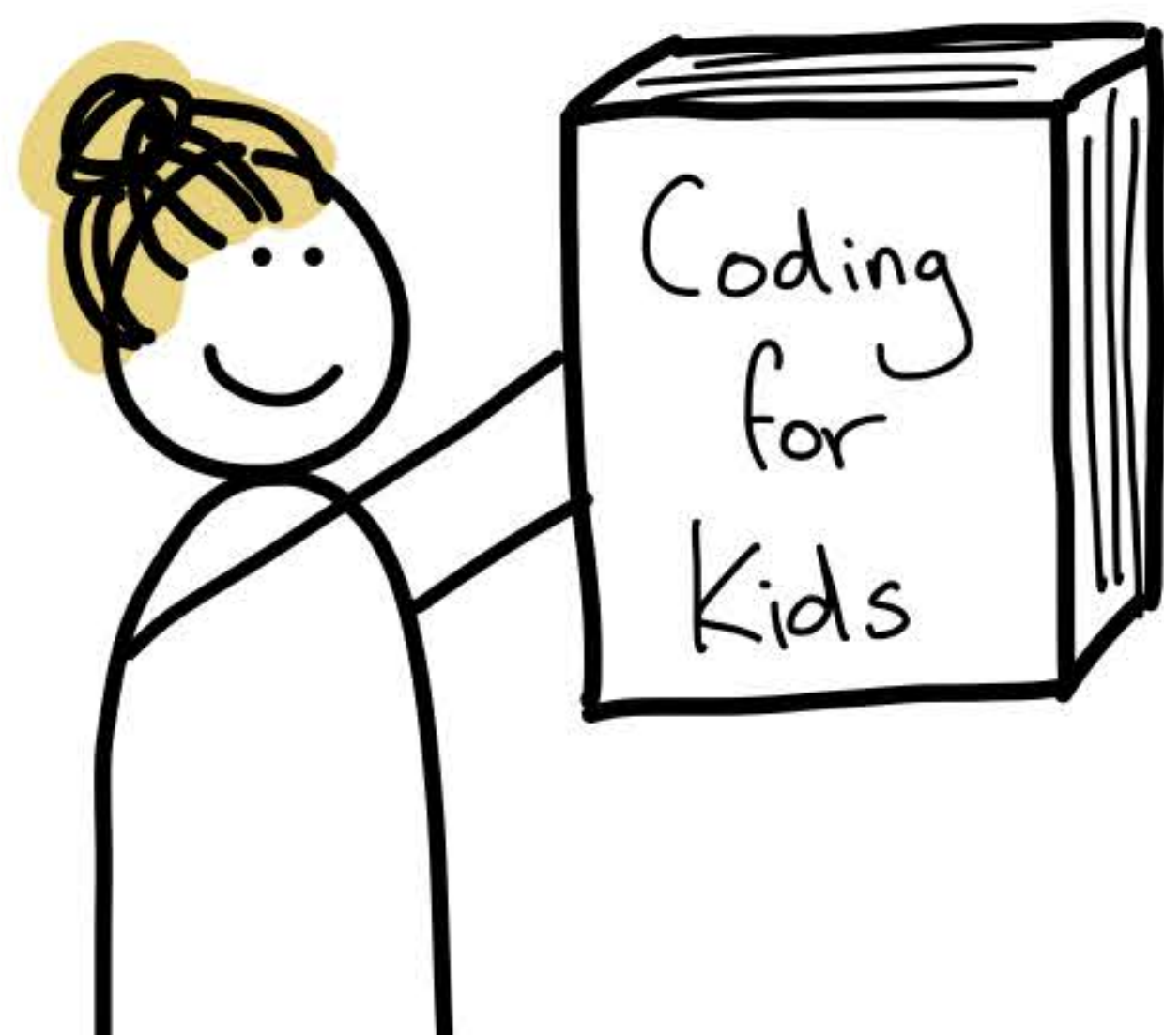


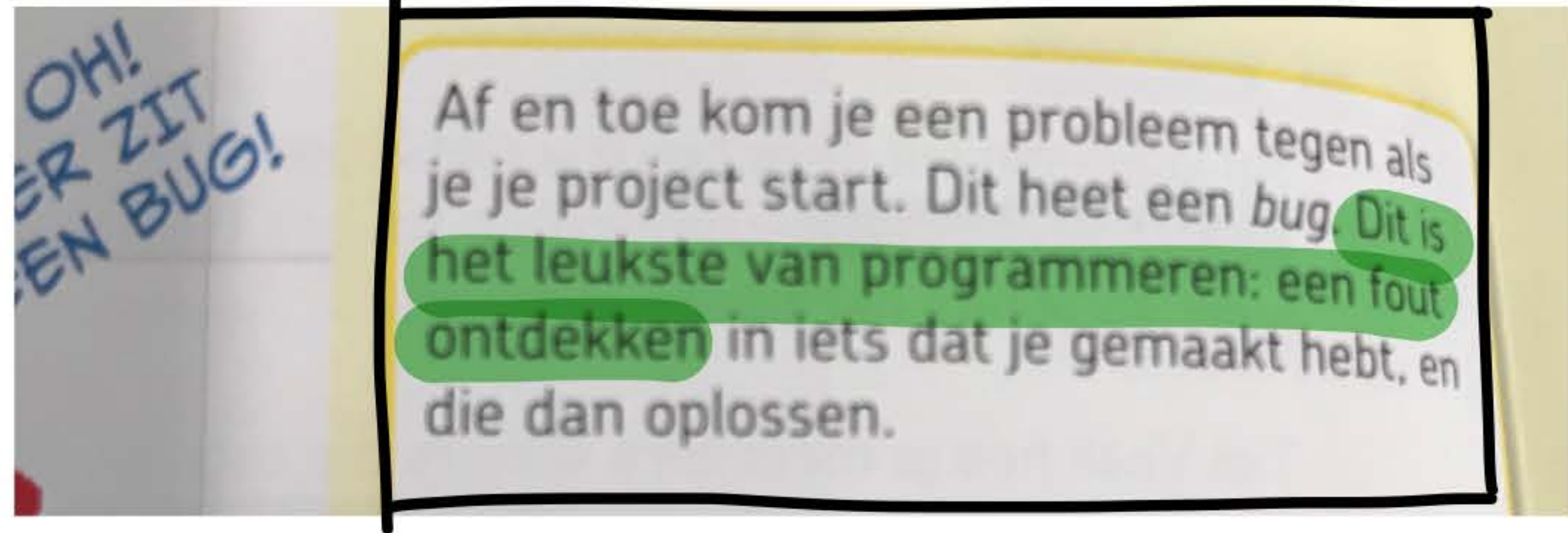


Just let
them explore!

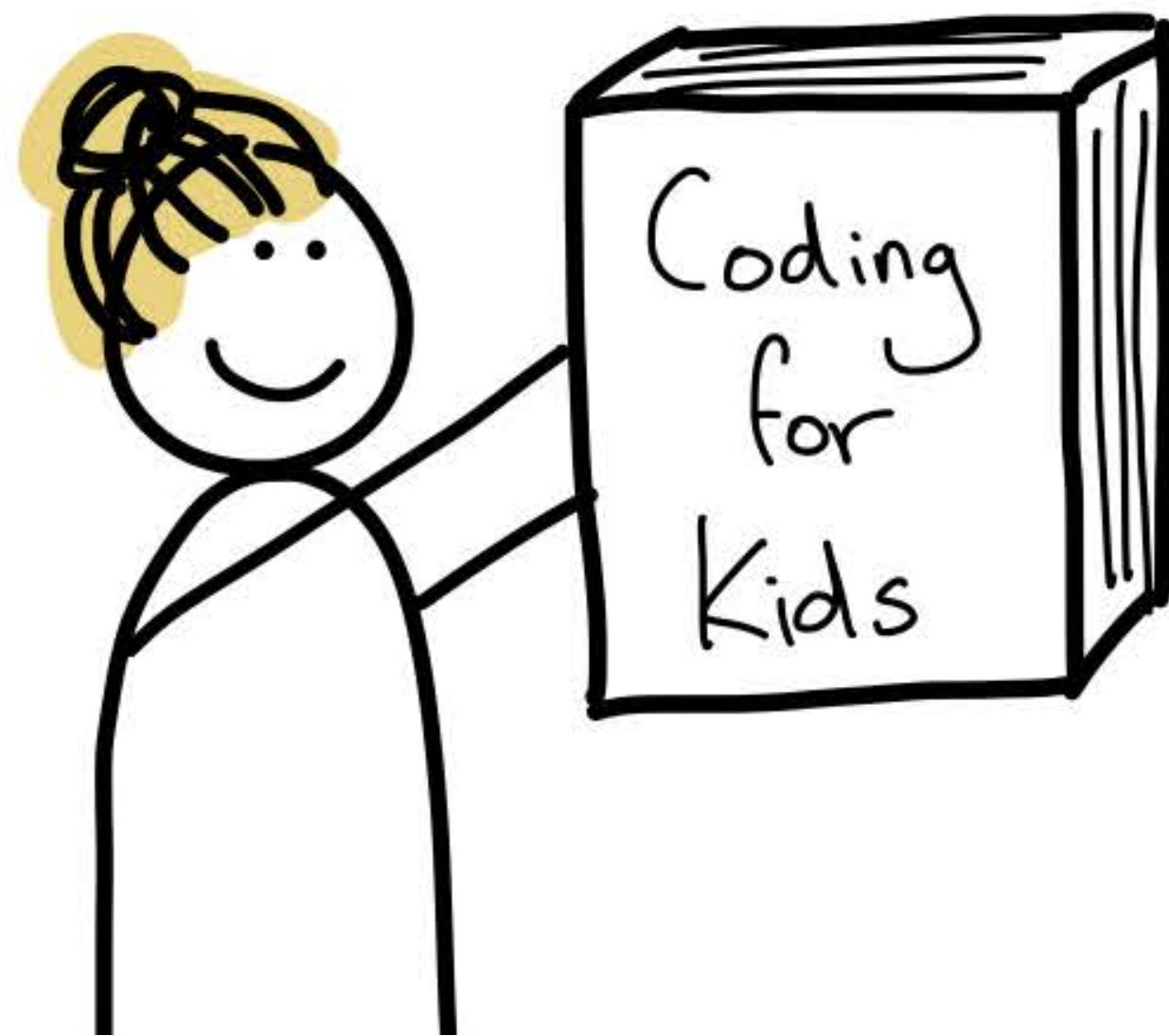




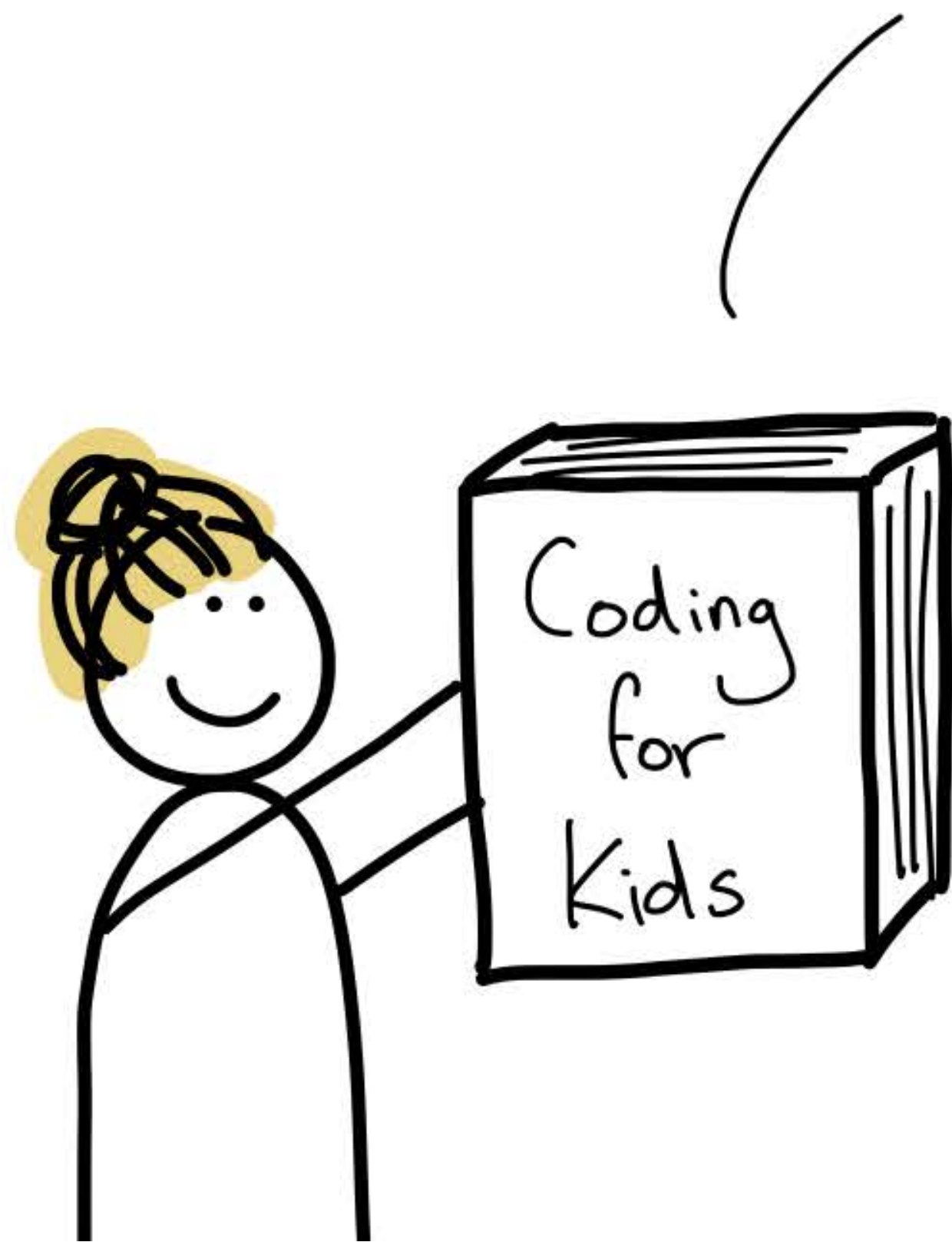




"The best part of
programming is
finding mistakes"



Reken erop dat je veel fouten zult maken en veel van dit soort foutmeldingen te zien krijgt. Denk erom, programmeurs leren alleen maar meer door het maken van fouten en door uit te zoeken waar de fout zit. Zelfs de beste programmeurs ter wereld maken fouten, zoals het vergeten van een " in hun code.



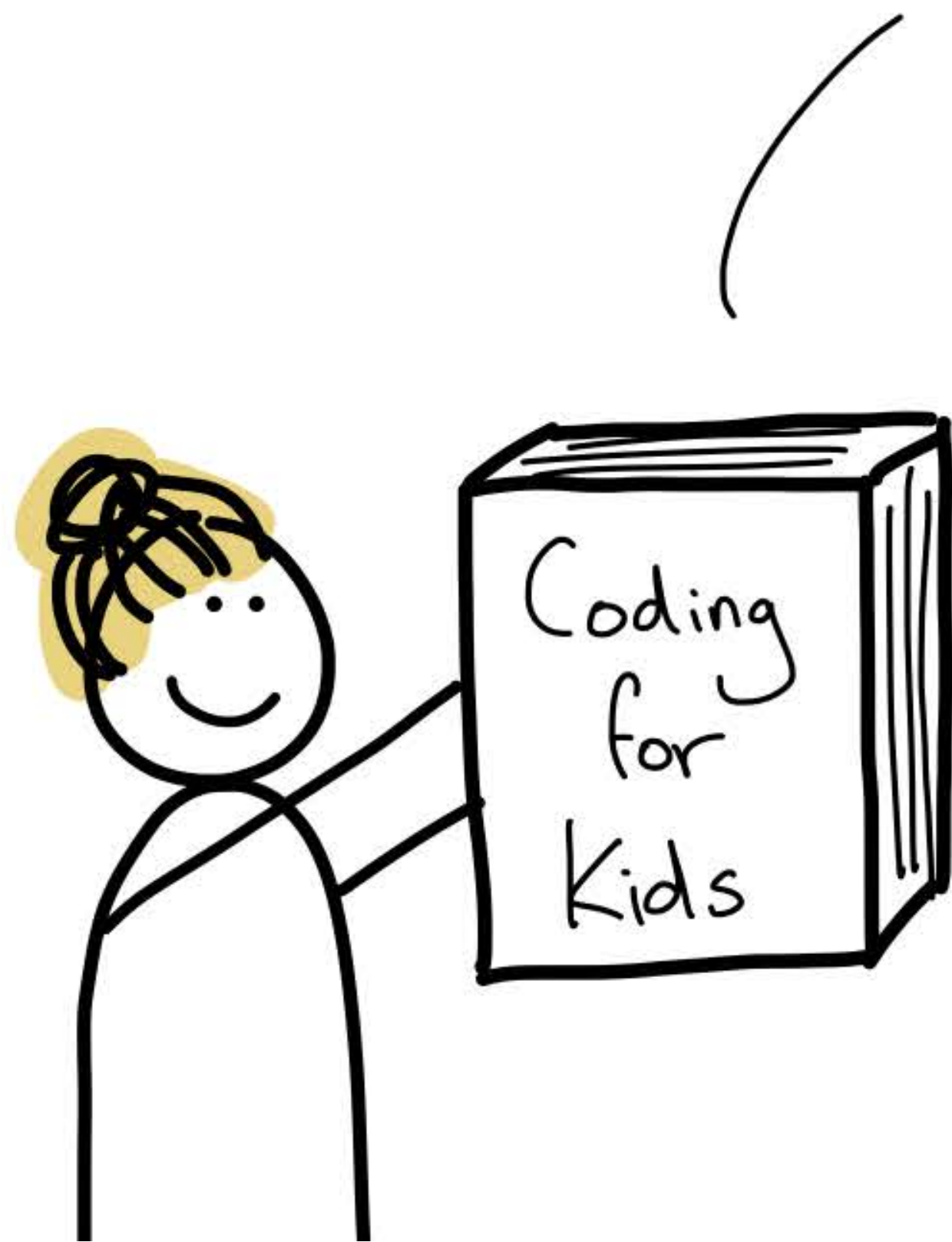
"Programmers only learn from making mistakes"

Heb plezier!

Coderen lijkt veel op puzzels oplossen. Het is een uitdaging, vaak lukt het niet, en soms is het frustrerend. Maar je beleeft ook een doorbraak als je een probleem weet op te lossen en het geeft een kick als je codering werkt. Werk op je eigen niveau: als een



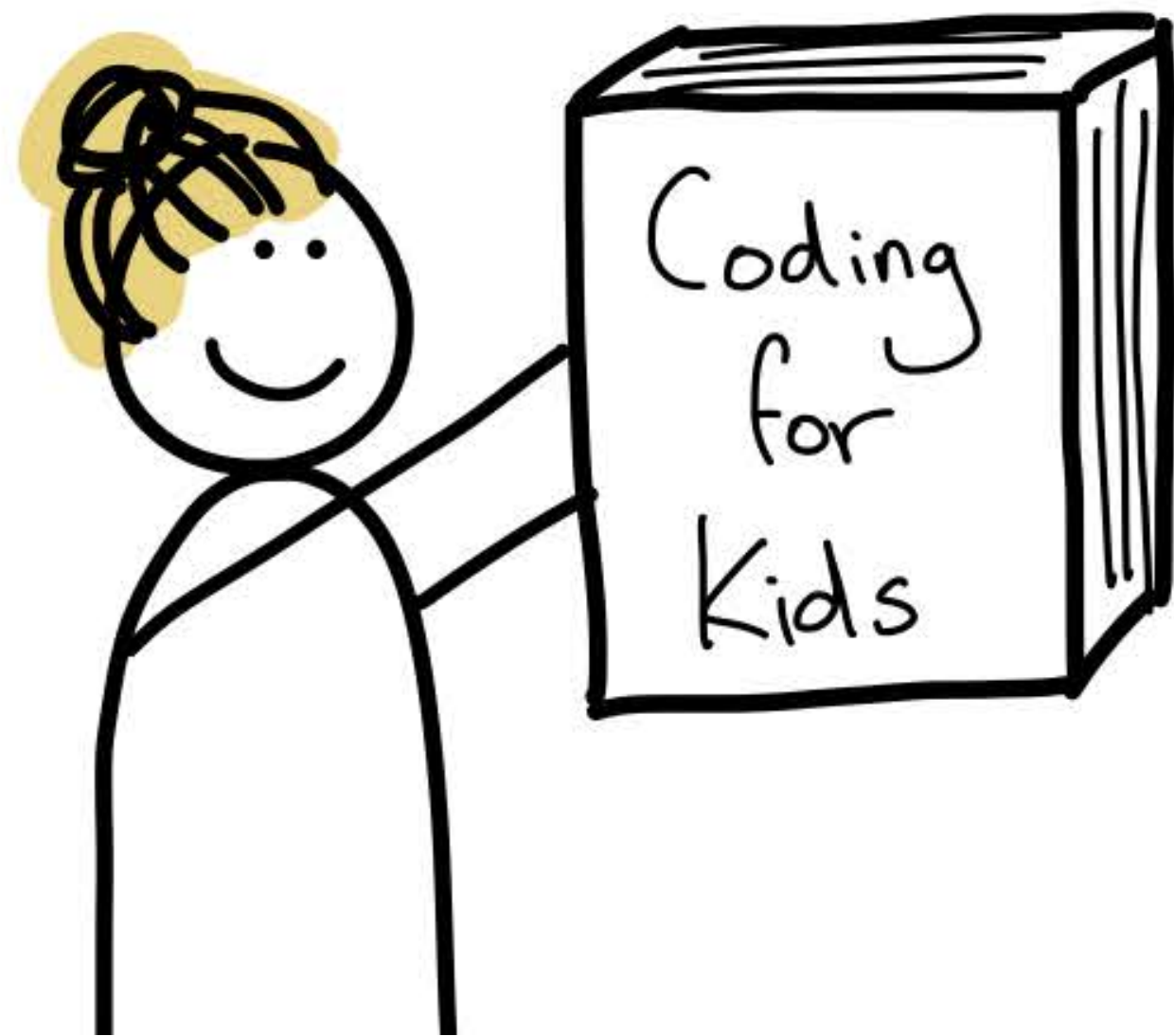
"You will fail often,
and it will be frustrating"



Computer Coding for Kids

belangstelling. Wees nooit bang om te rotzooien, prutsen en experimenteren en houd je niet aan de regels, maar blijf nieuwsgierig. En het belangrijkste: het is leuk!

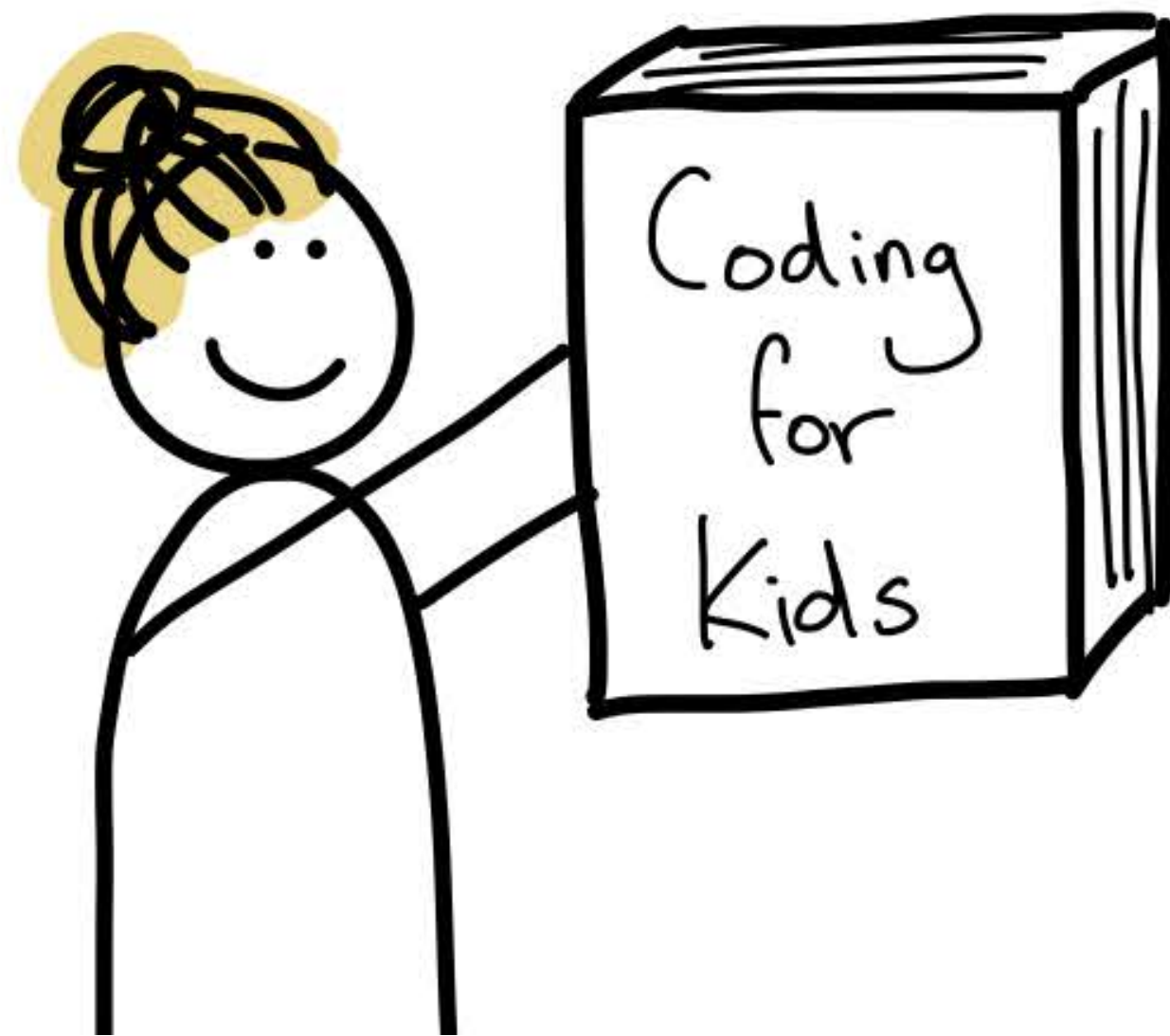
"Never be afraid to mess around and experiment"



Computer Coding for Kids

belangstelling. Wees nooit bang om te rotzooien, prutsen en experimenteren en houd je niet aan de regels, maar blijf nieuwsgierig. En het belangrijkste: het is leuk!

"Break the rules"



Computer Coding for Kids

The first character, "F", is in position 0

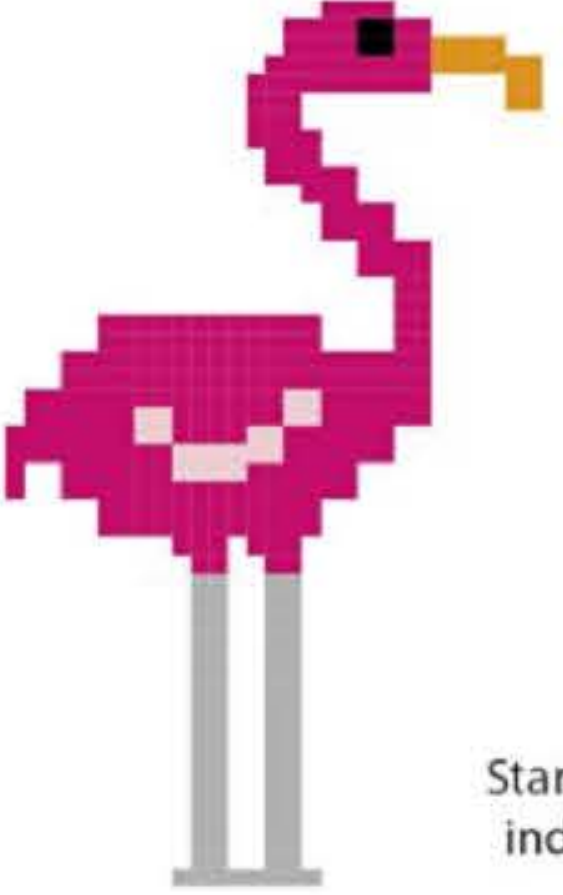
3 "Slicing"
Two indexes can be used to pull out a part of the string or "slice" it. The letter in the last position isn't included.

```
>>> a[1:7]
```

Colon defines the range of characters

'LAMING'

A slice from index 1 to index 6 of variable "a"



4 From the start or the end
If you leave off the start or end index, Python will automatically use the first or the last character of the string.

```
>>> a[:3]
```

'FLA'

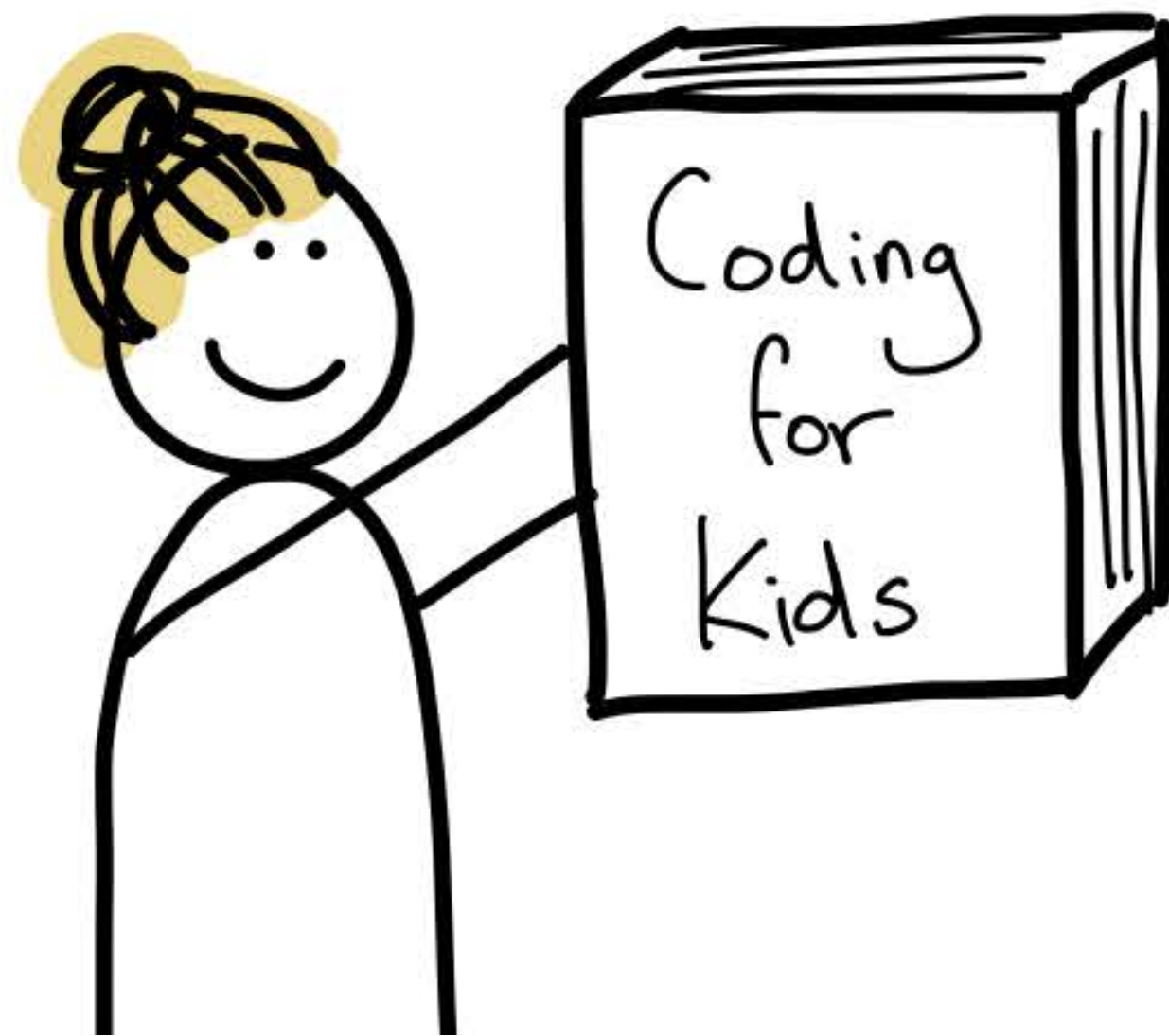
```
>>> a[3:]
```

'MINGO'

Starts at index 0

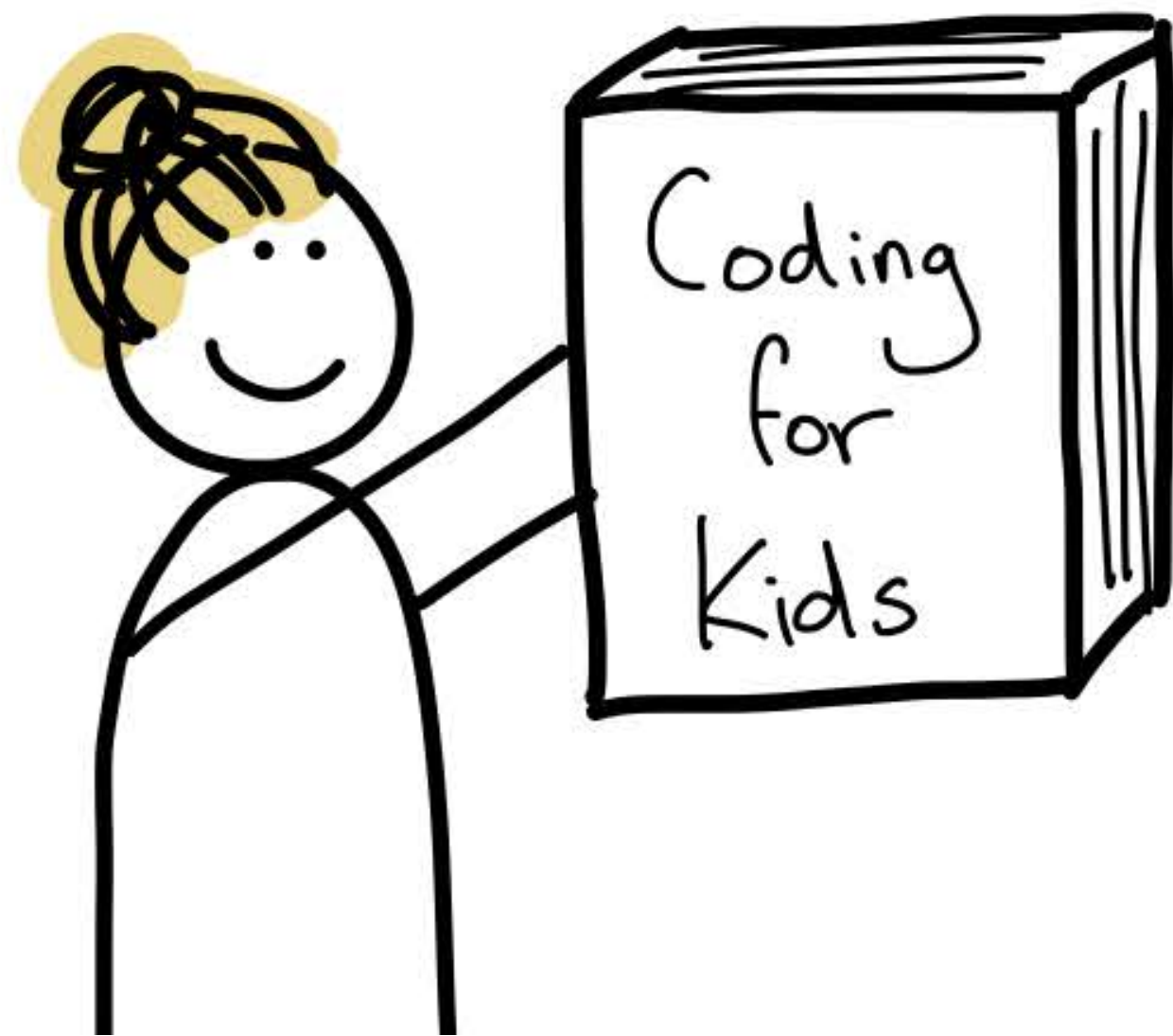
Ends at index 7

"Break the rules"

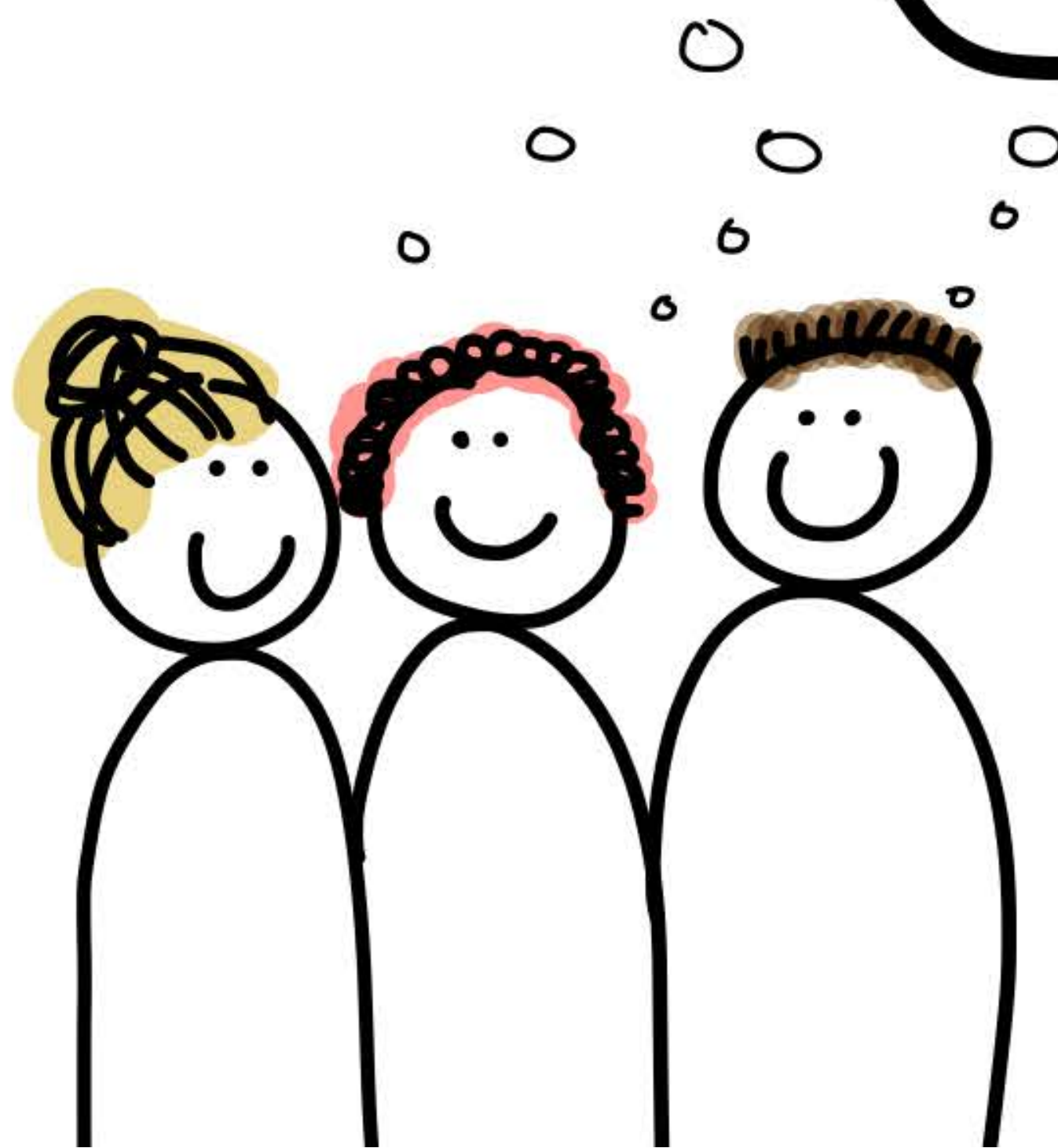


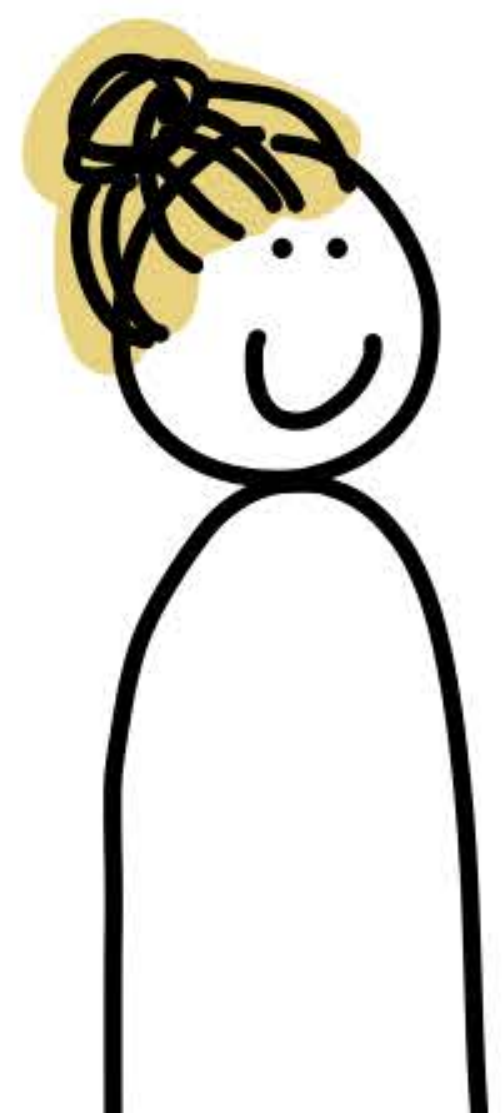
belangstelling. Wees nooit bang om te rotzooien, prutsen en experimenteren en houd je niet aan de regels, maar blijf nieuwsgierig. En het belangrijkste: het is leuk!

"And most importantly:
it's fun"



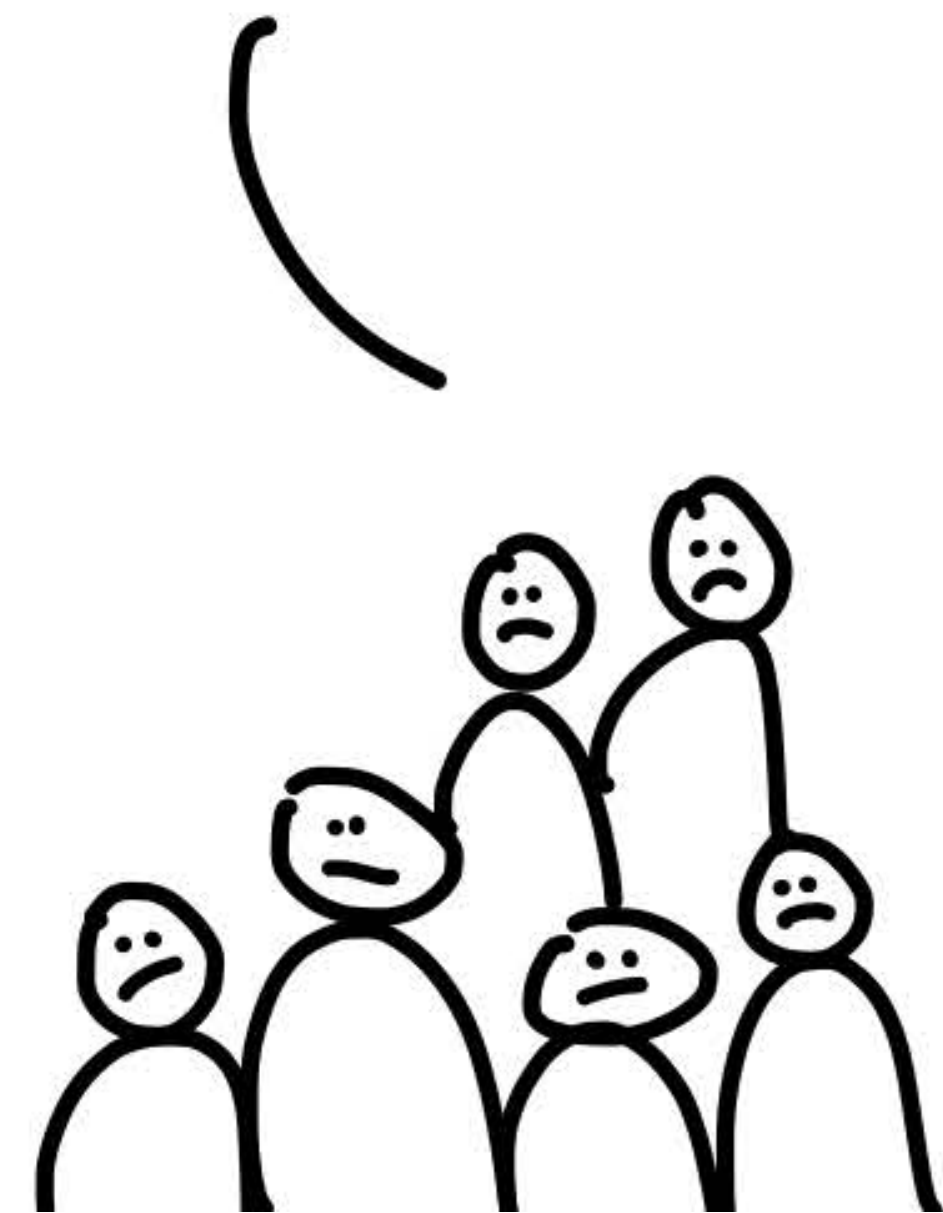
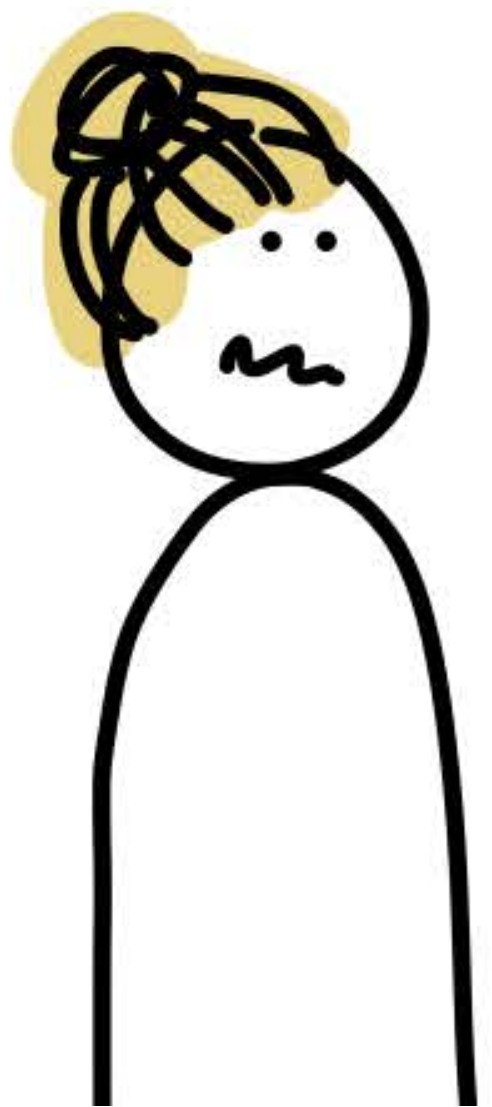
Just let
them explore!



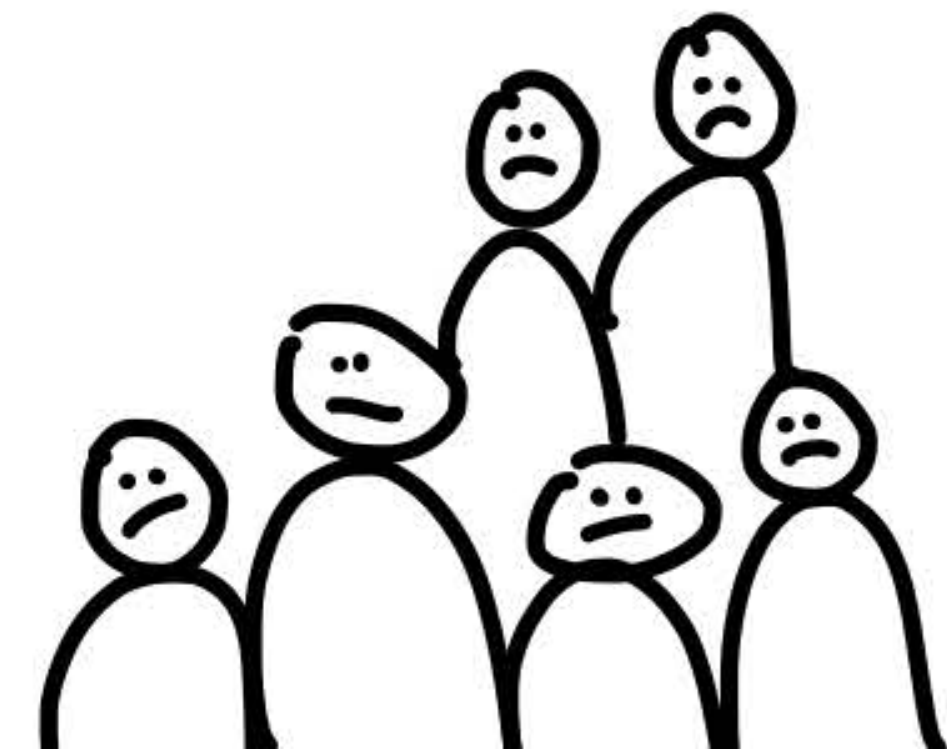
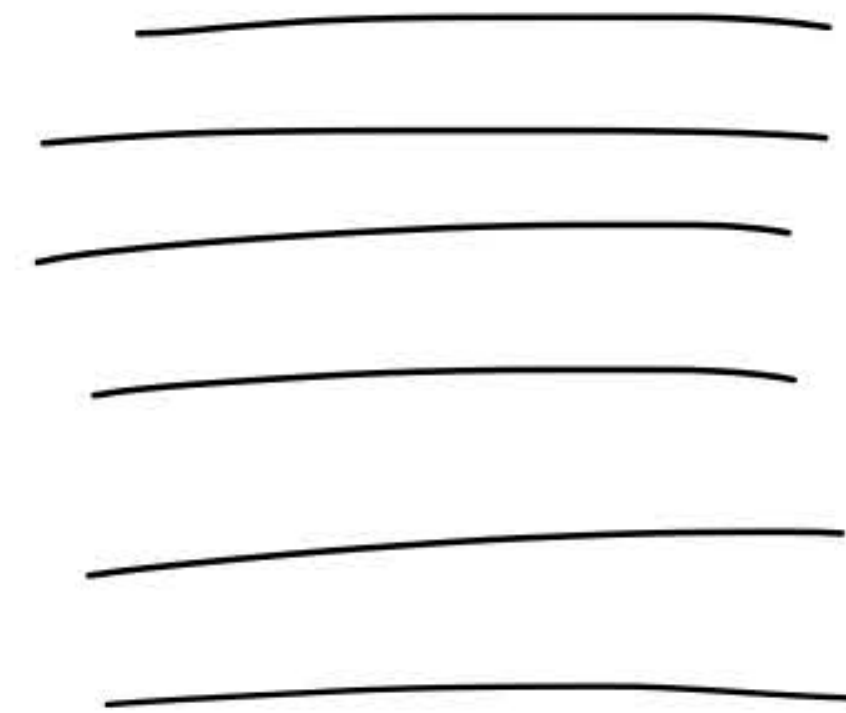


Just let
them explore!

This is hard!

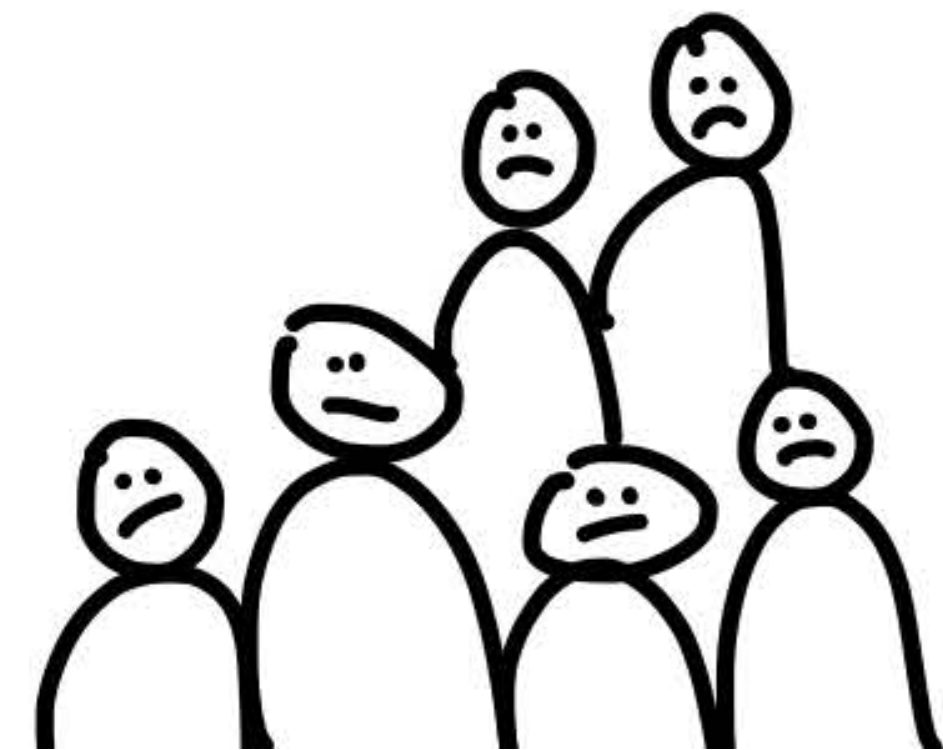
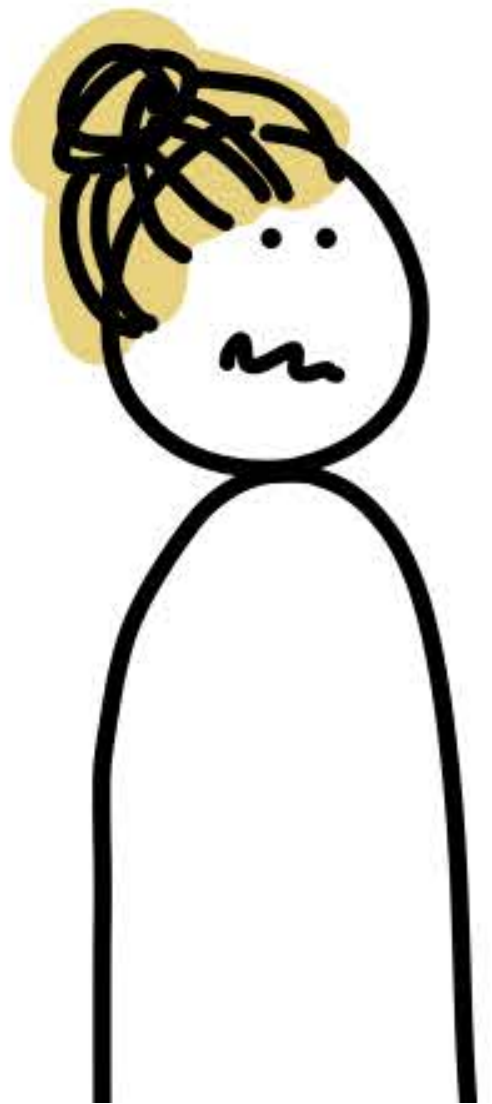


Skill progression
demonstrated by
users in Scratch
Scaffidi&Chambers



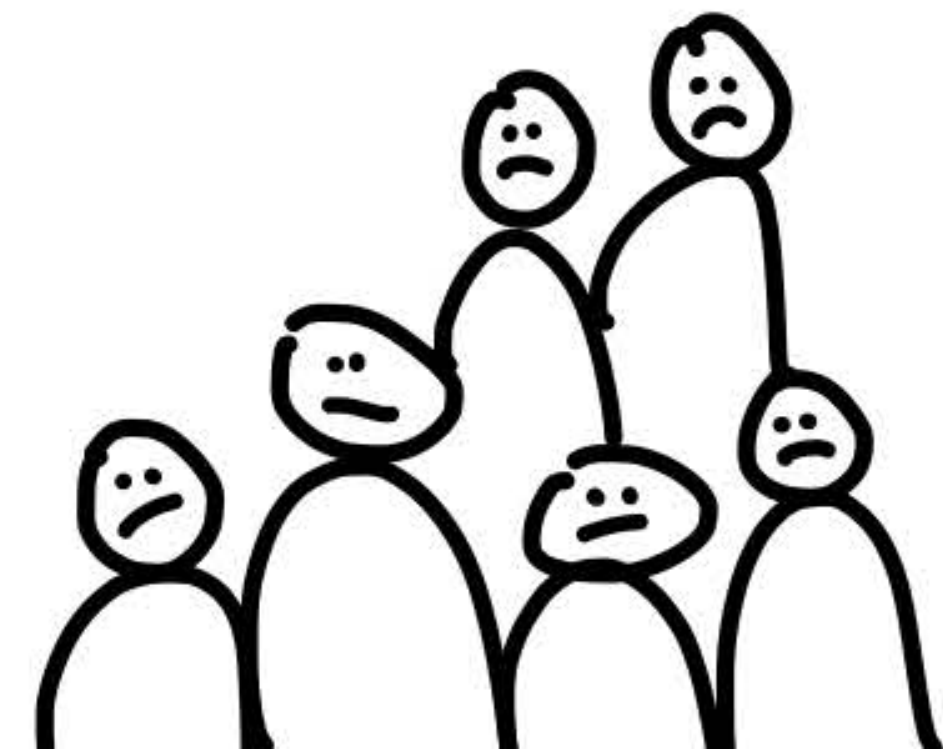
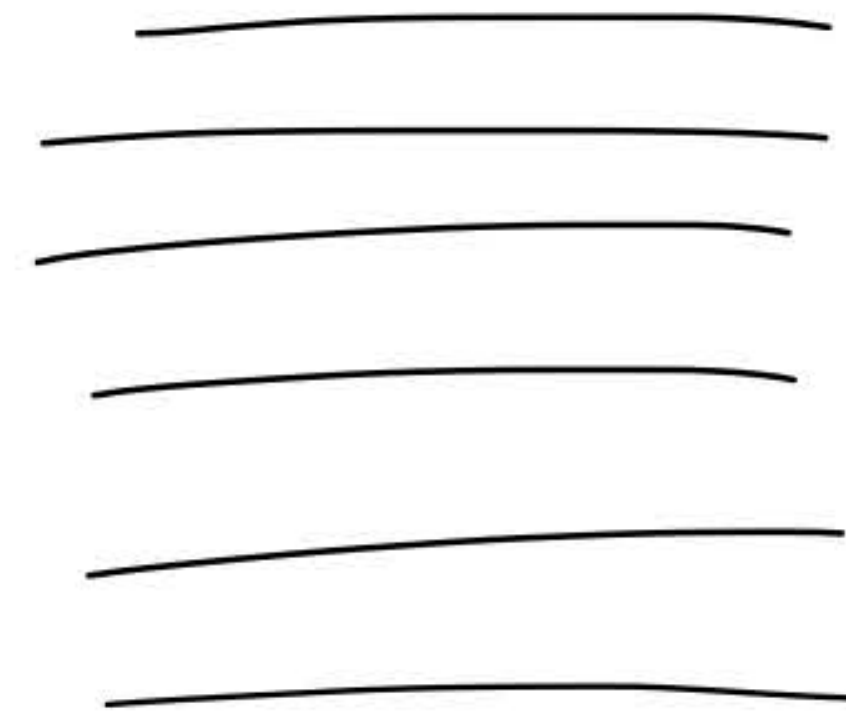
— High dropout

Skill progression
demonstrated by
users in Scratch
Scaffidi & Chambers

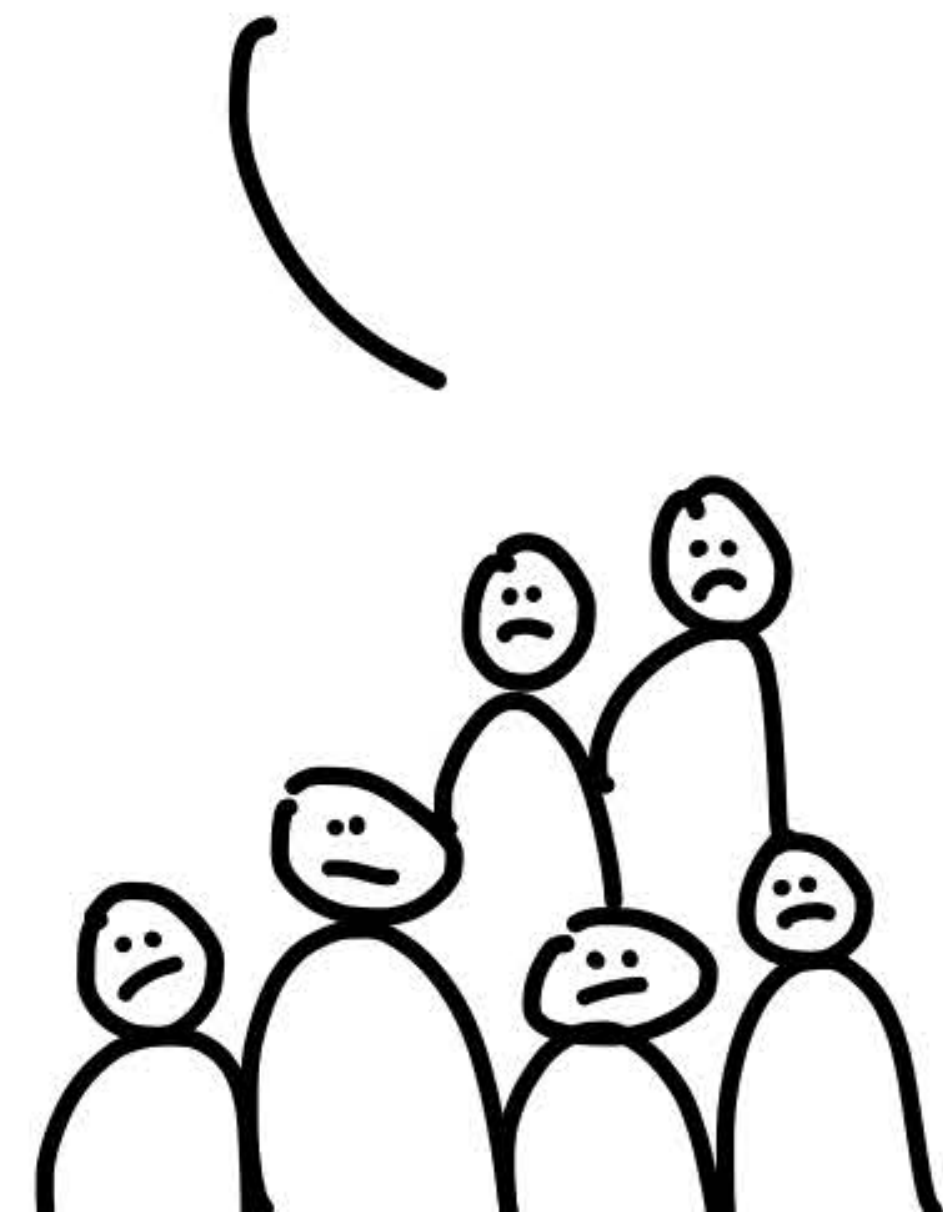
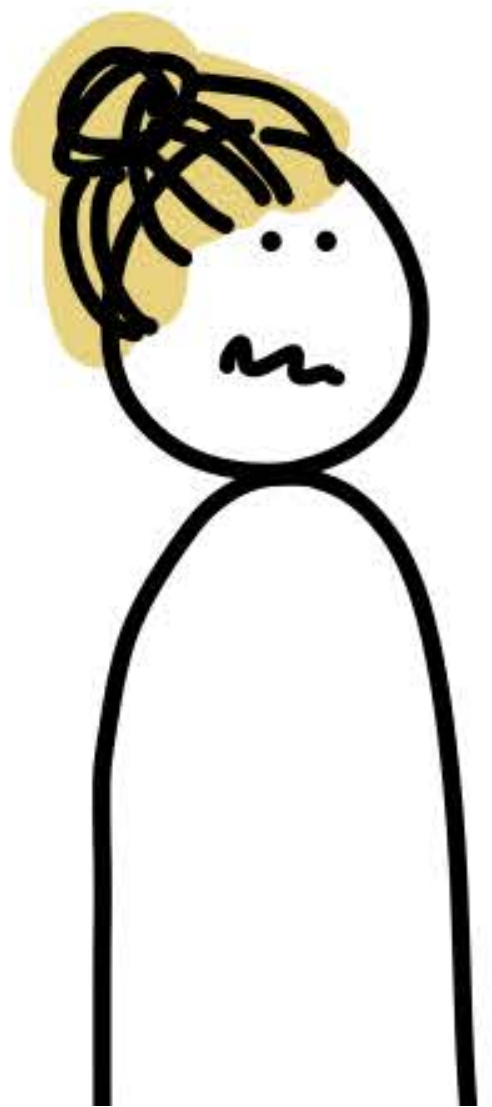


- High dropout
- Flat skill level

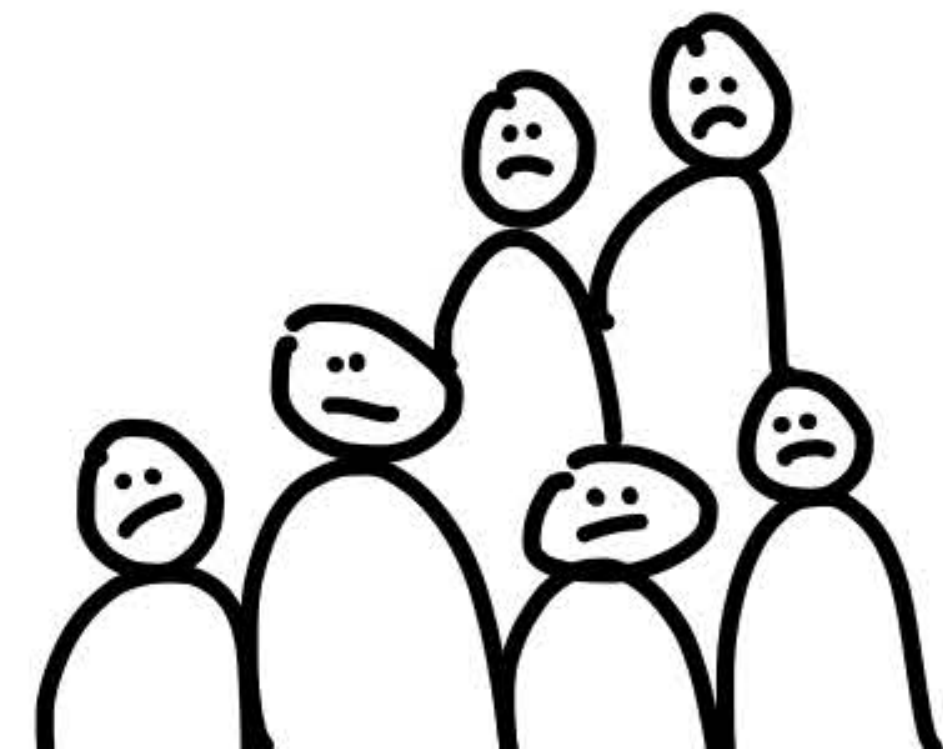
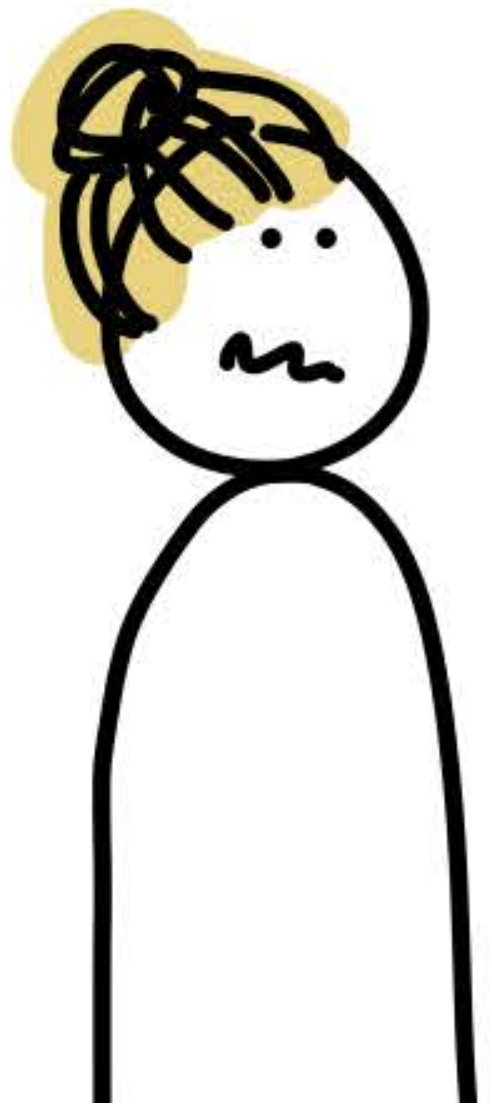
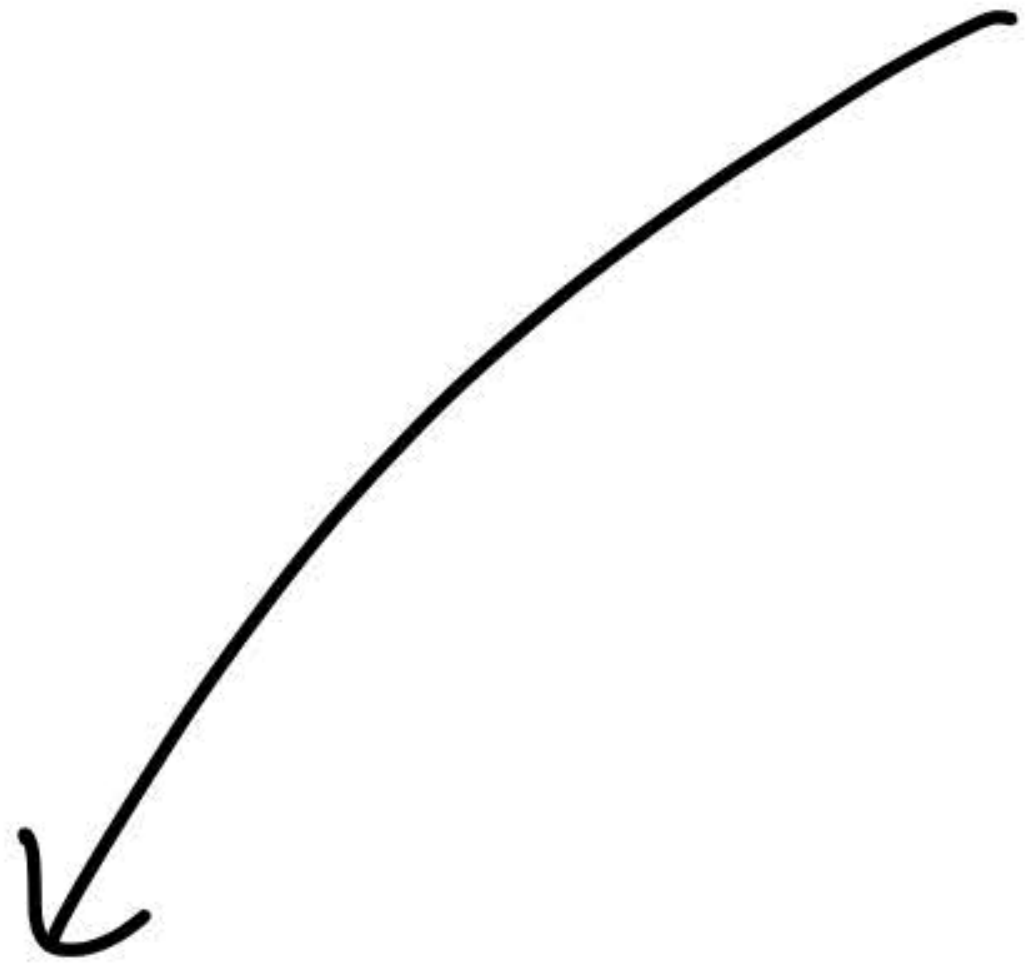
Skill progression
demonstrated by
users in Scratch
Scaffidi & Chambers



This is hard!



Doesn't know anything
about teaching



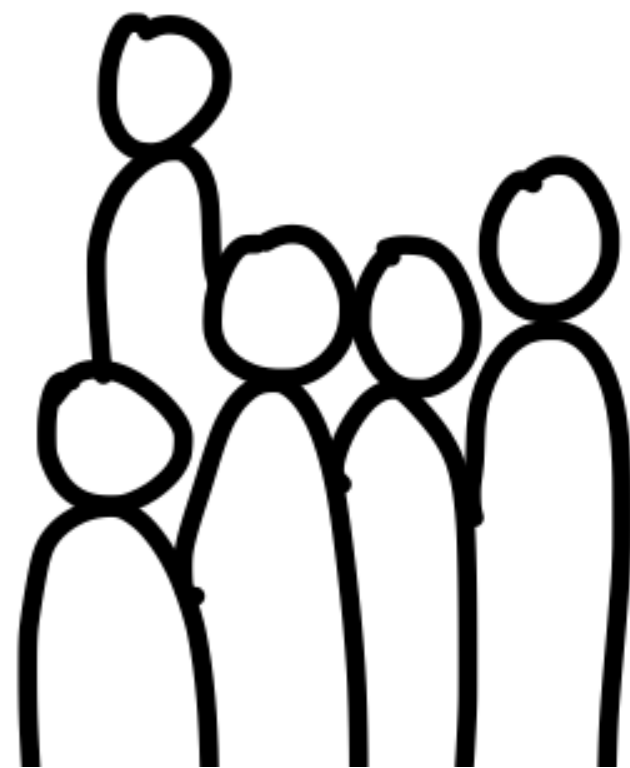
4 years in
School



4 years in
School



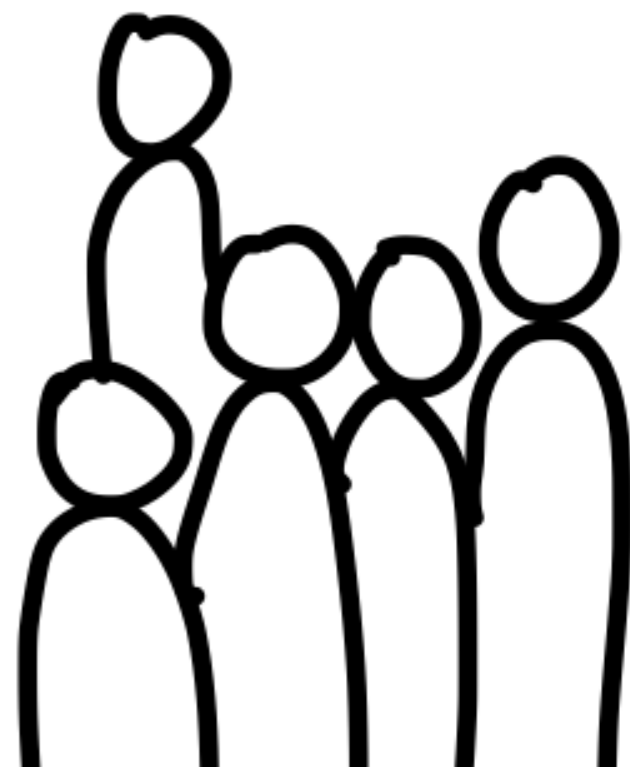
5 years in
School



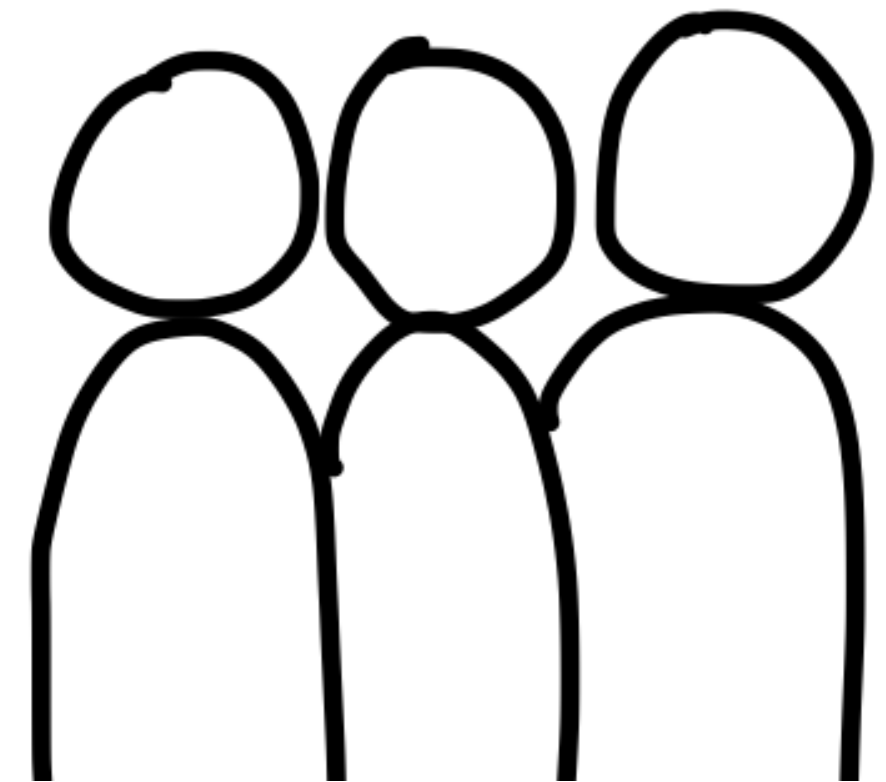
4 years in
School



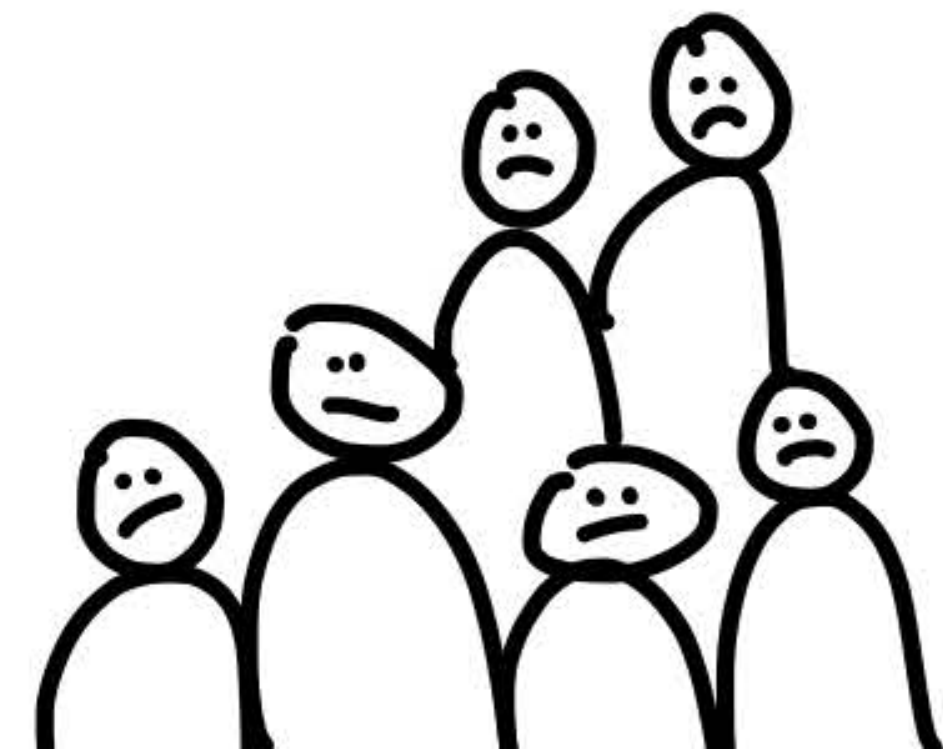
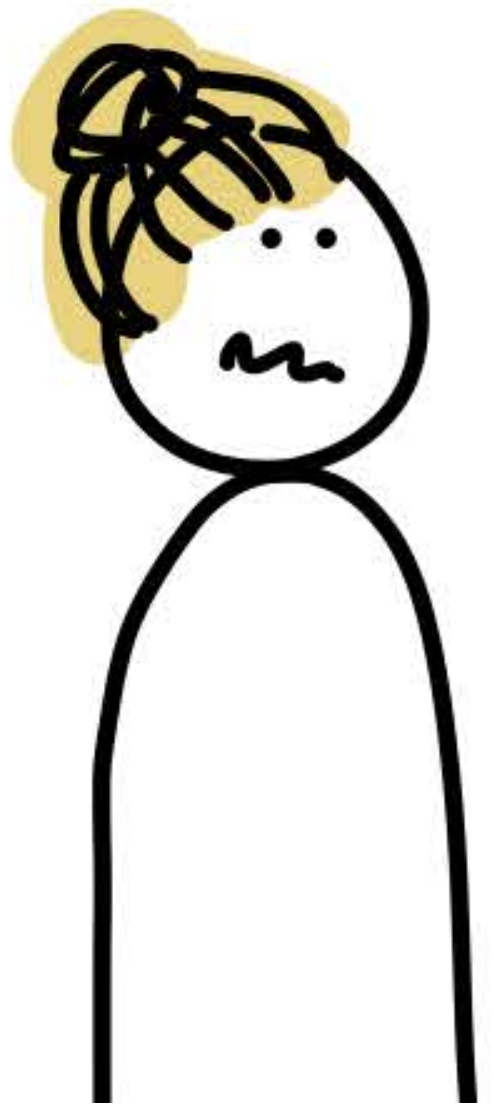
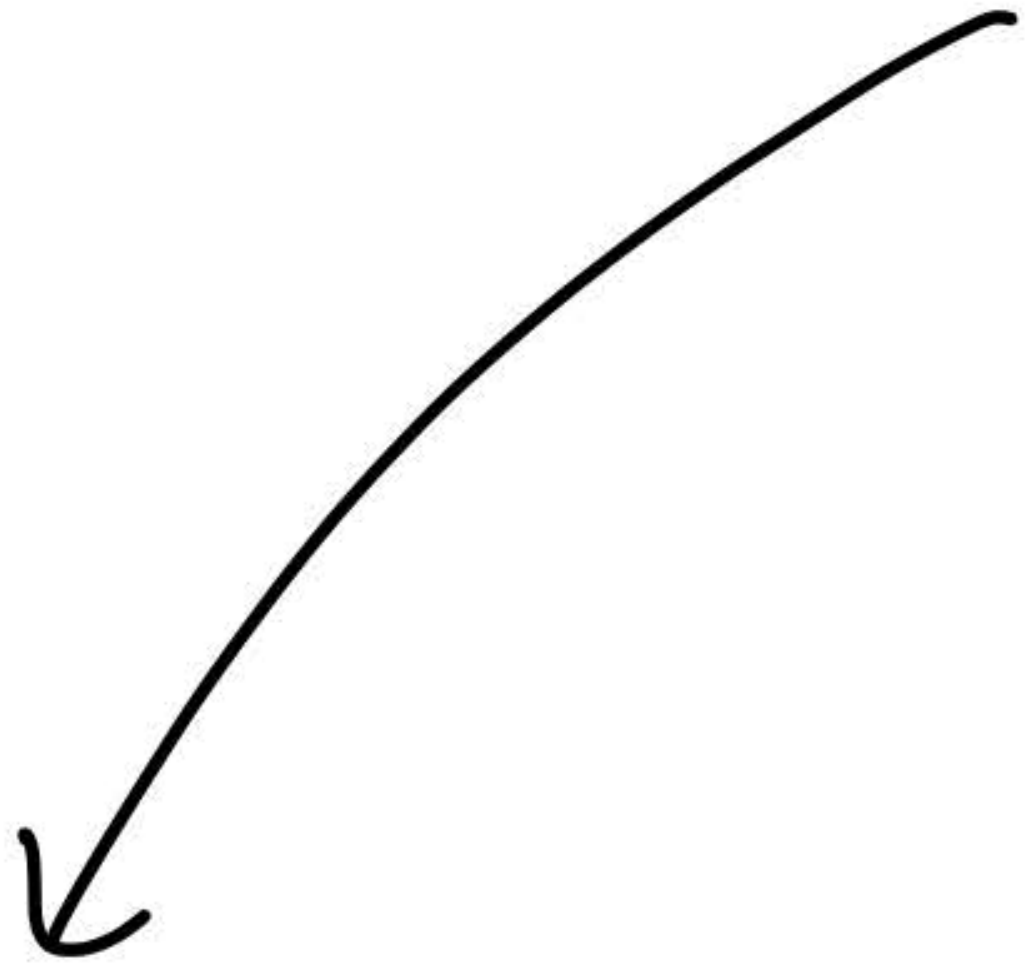
5 years in
School



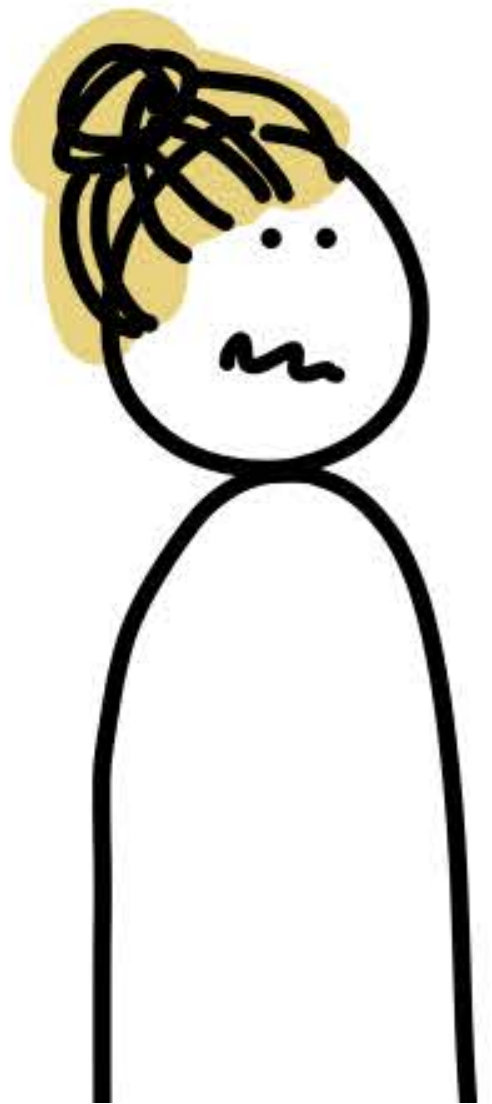
PhD +
12 afternoons
of Bloom

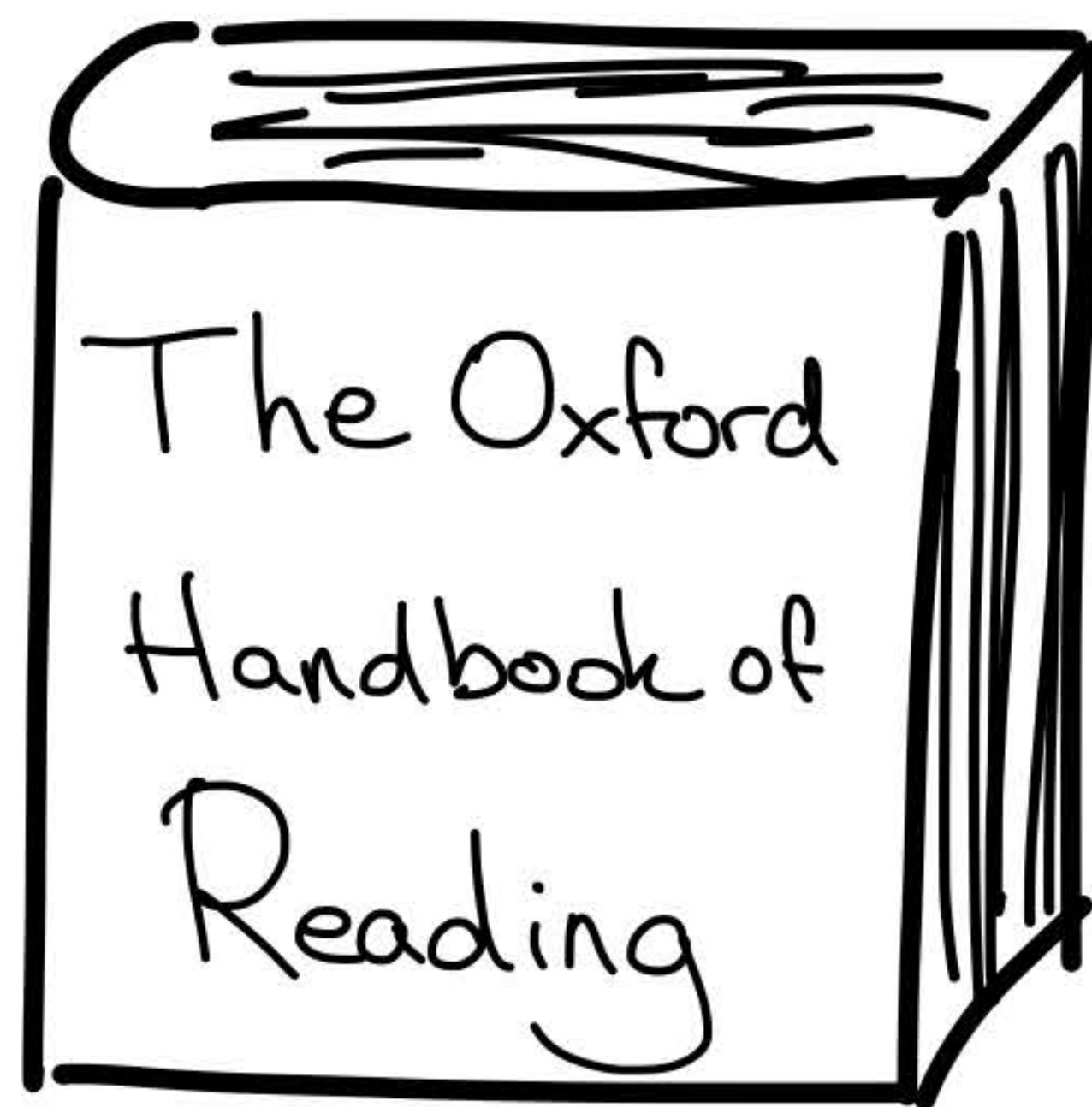


Doesn't know anything
about teaching

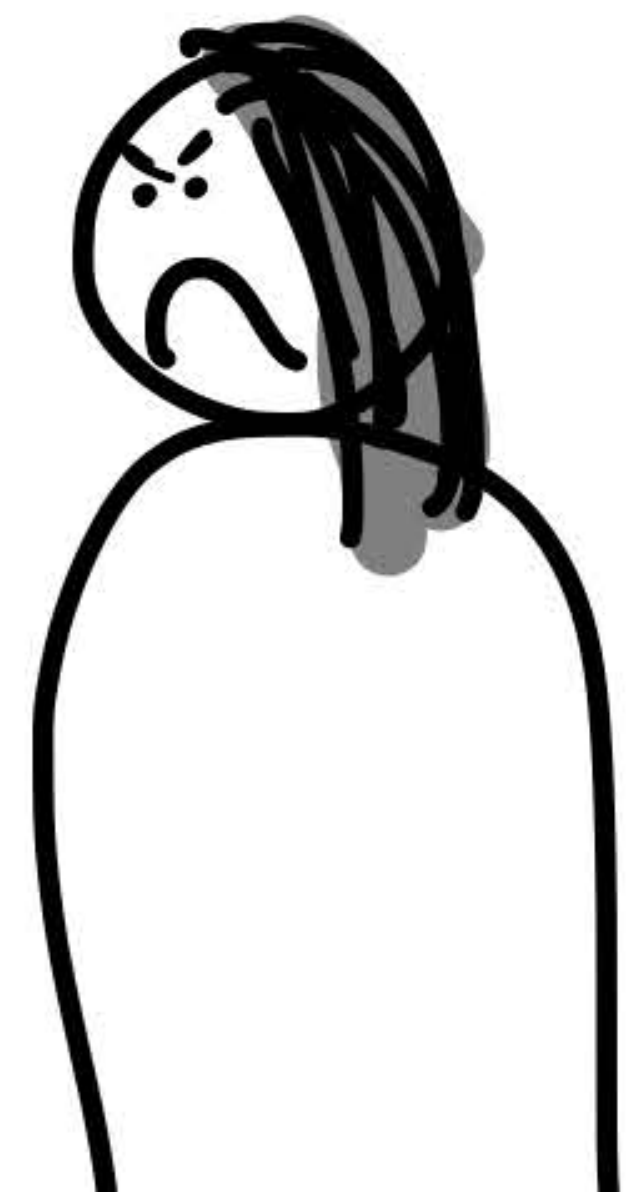
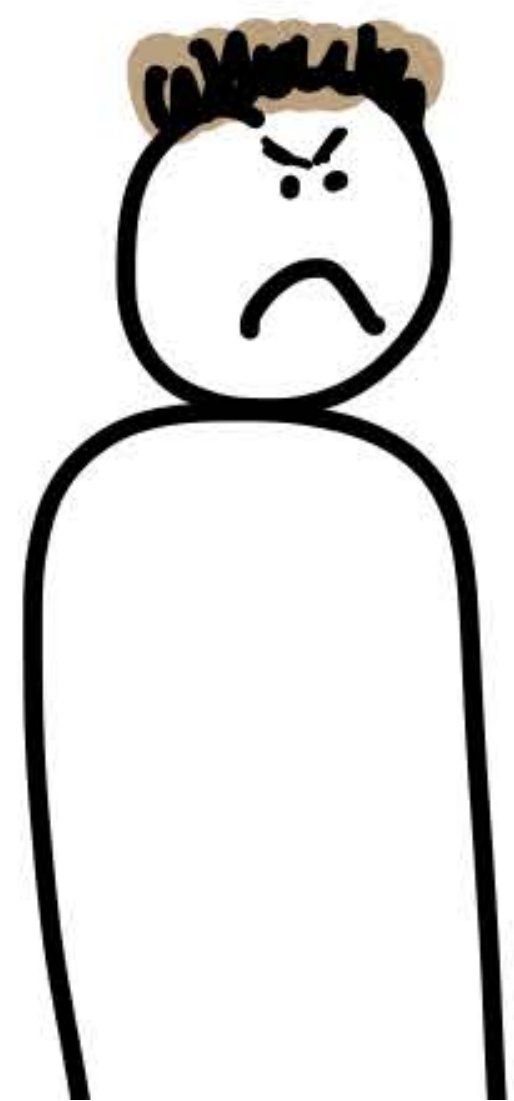


How do we
teach things?



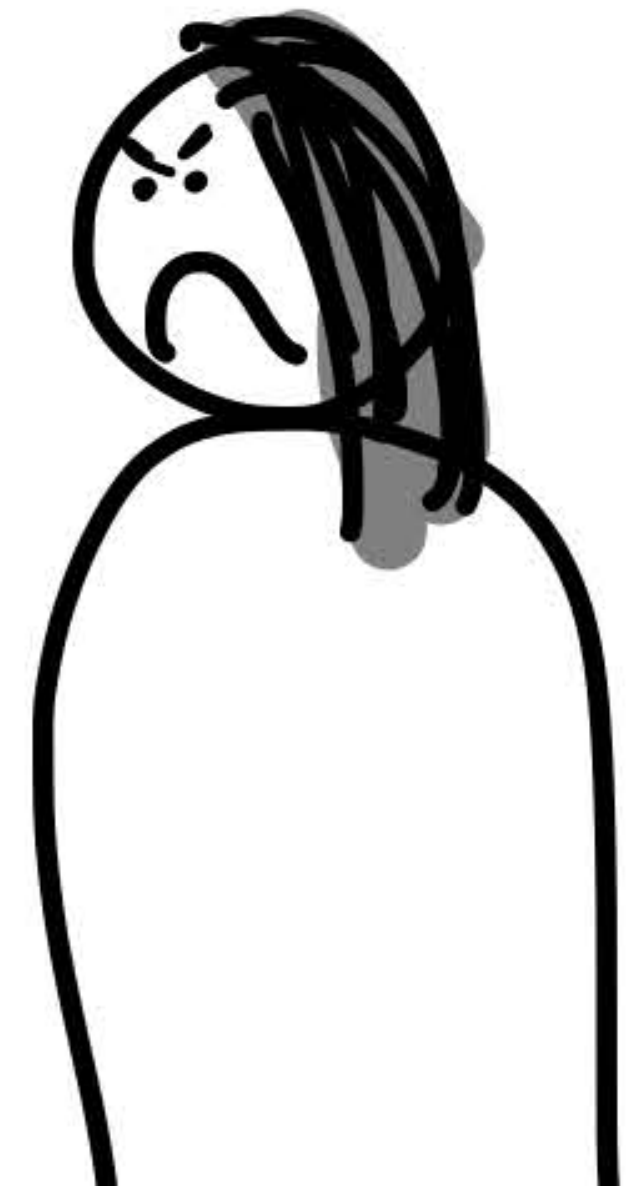
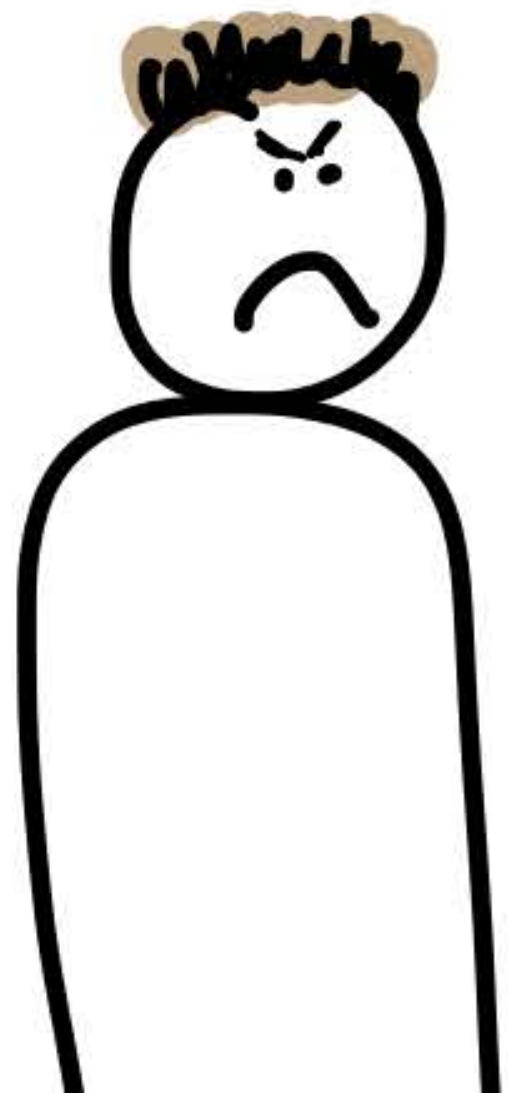


Phonics vs. Whole Language



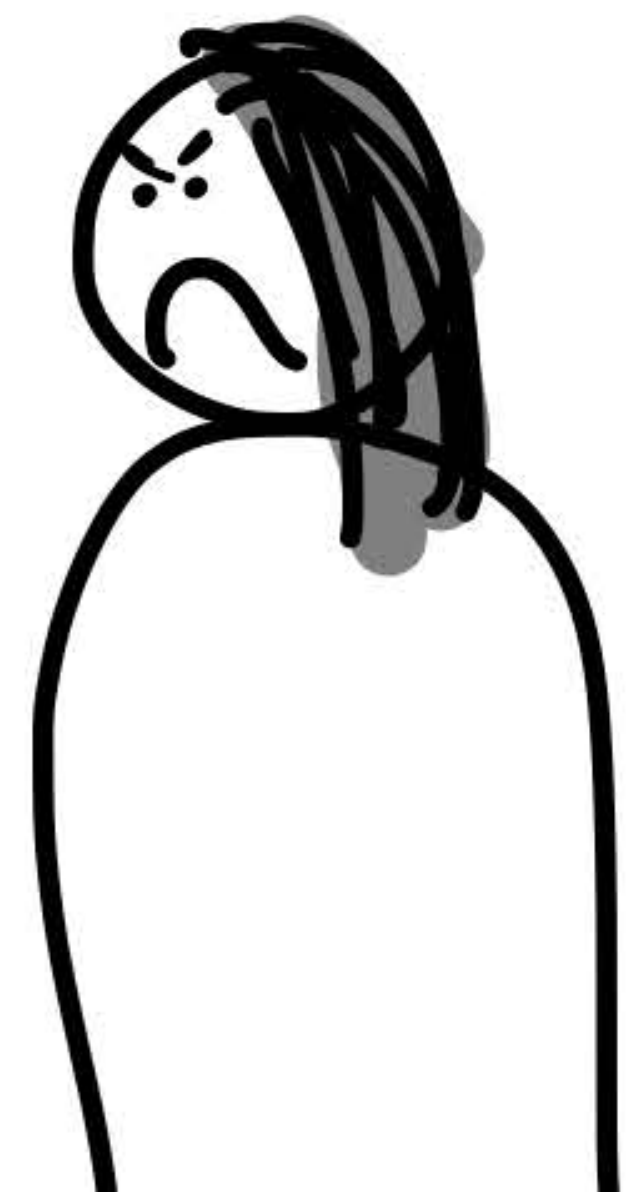
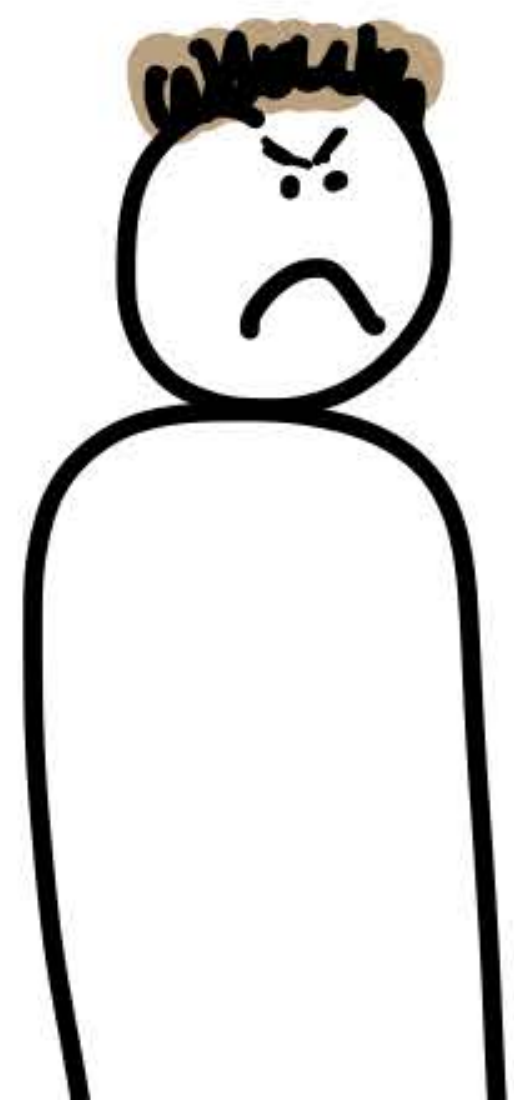
Phonics vs. Whole Language

— r · e a · d

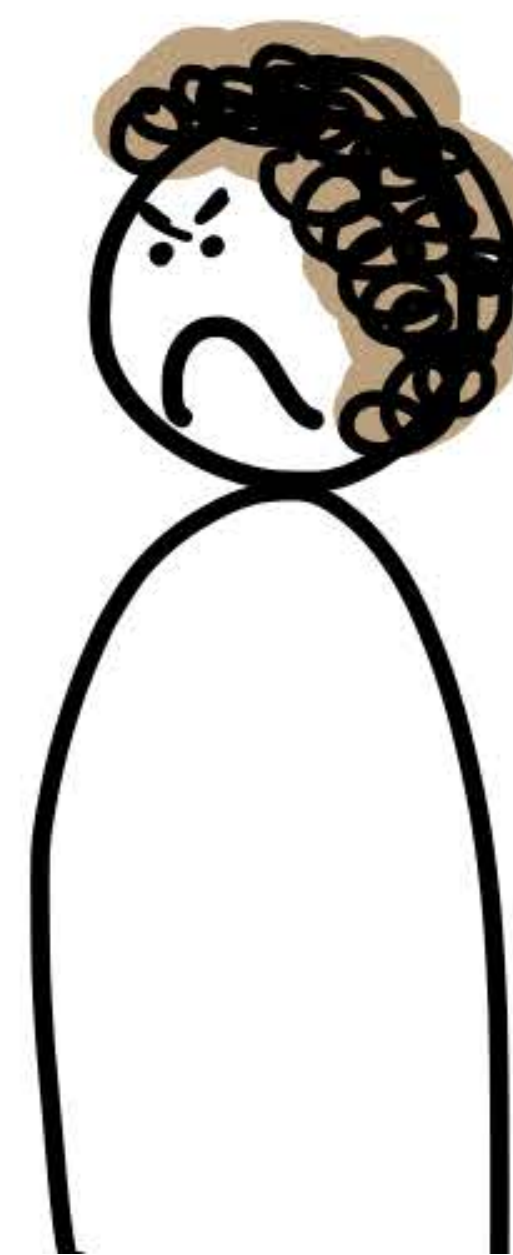


Phonics vs. Whole Language

I love books ~

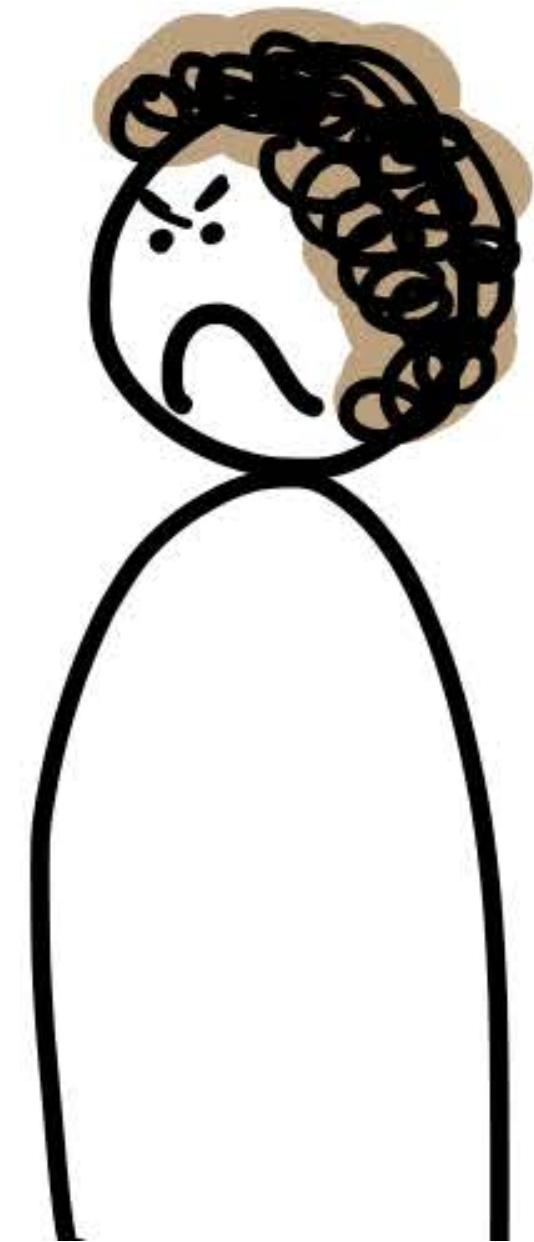


The math wars



The math wars

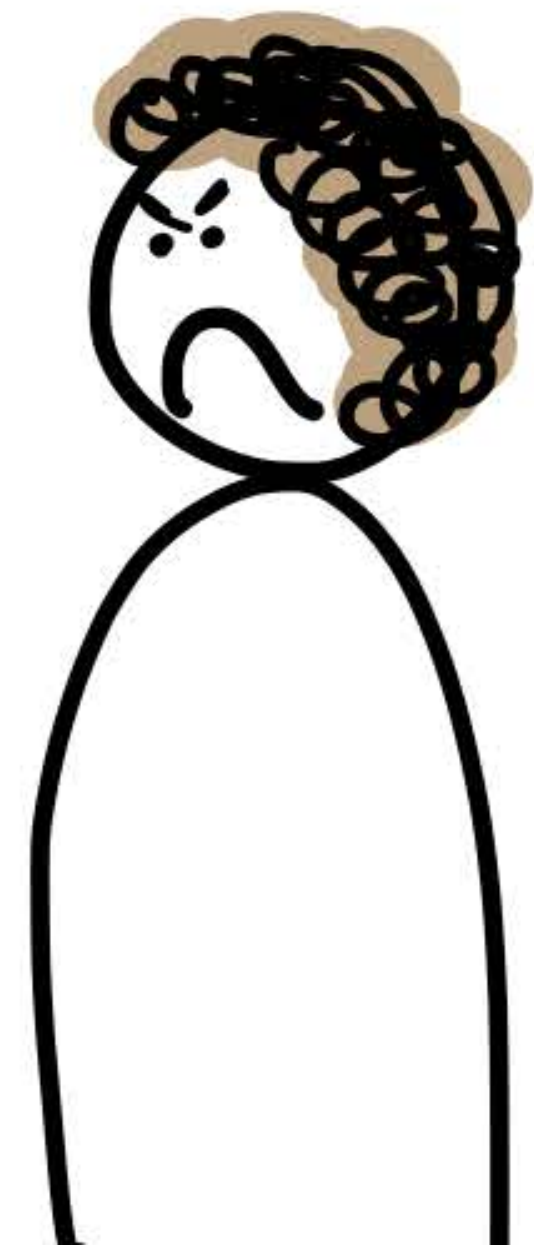
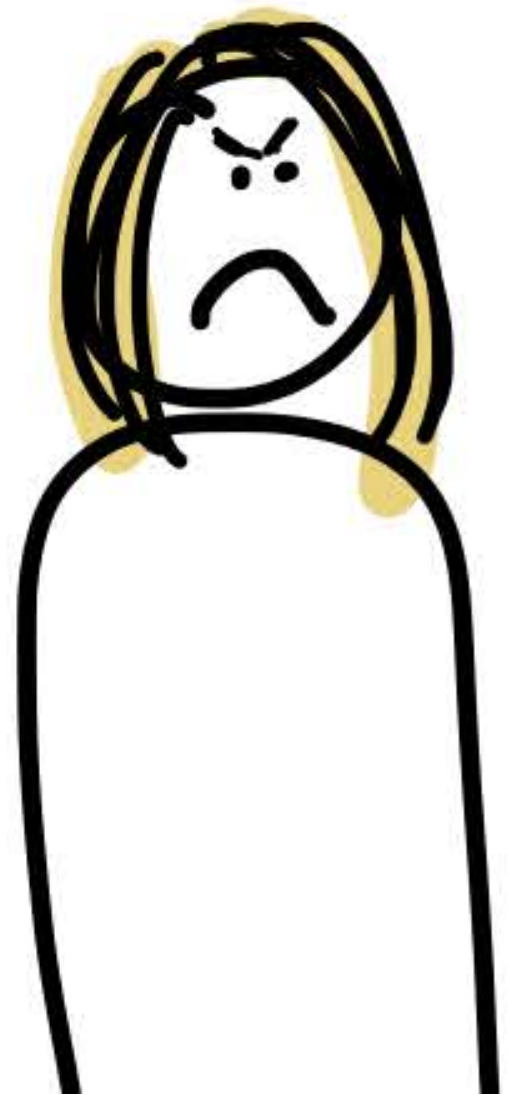
Explanation
&
practice



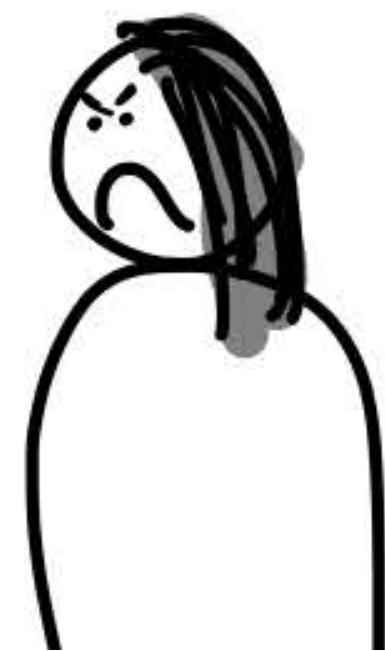
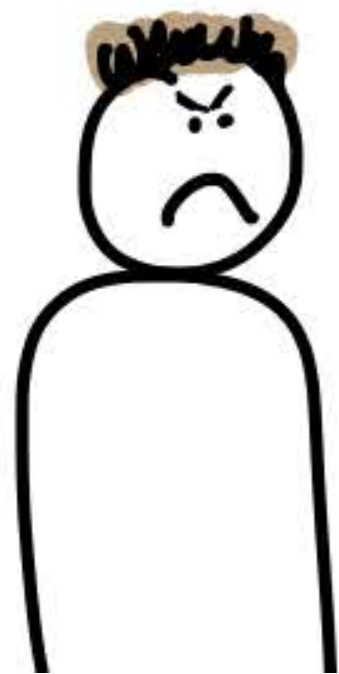
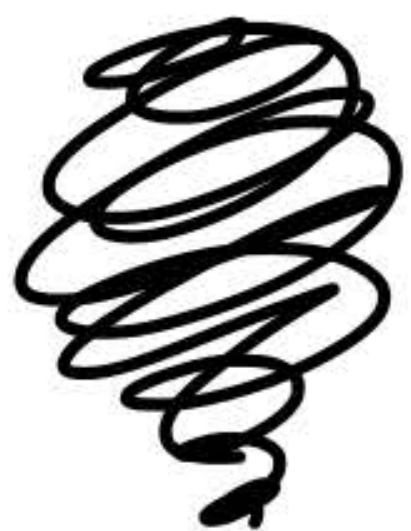
The math wars

Exploration
&

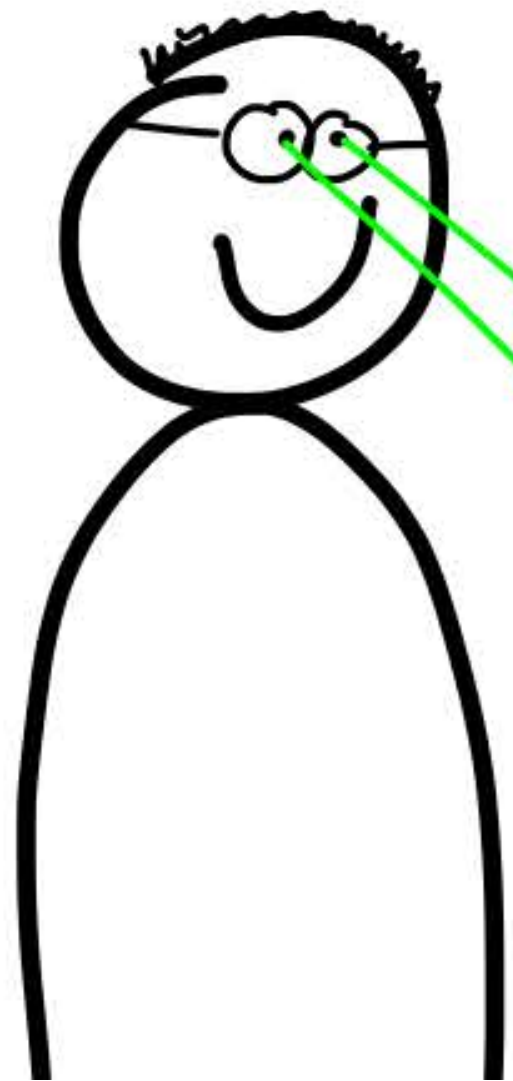
Problem
solving



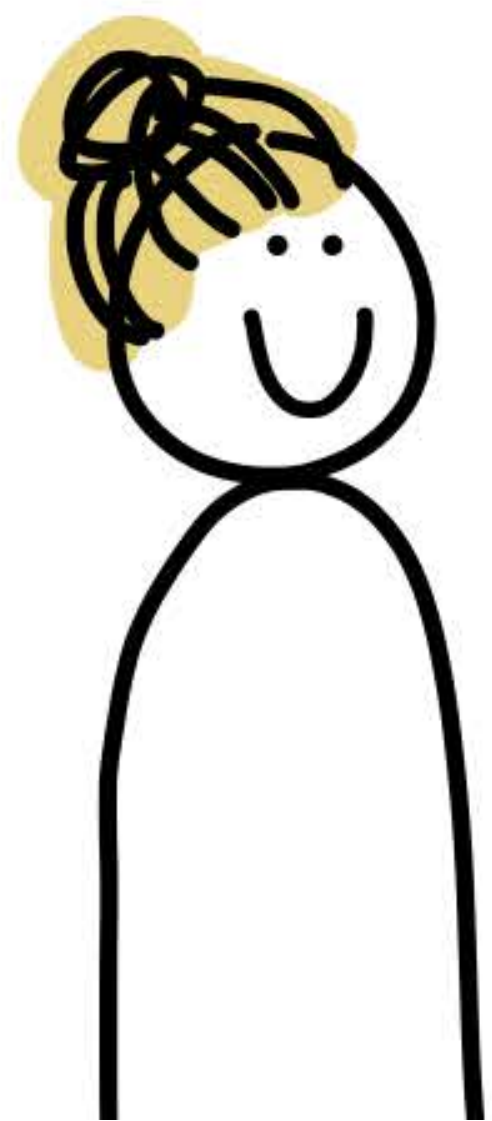
Where is programming's
pedagogical debate?



Technology is
covert philosophy -
Alan Blackwell



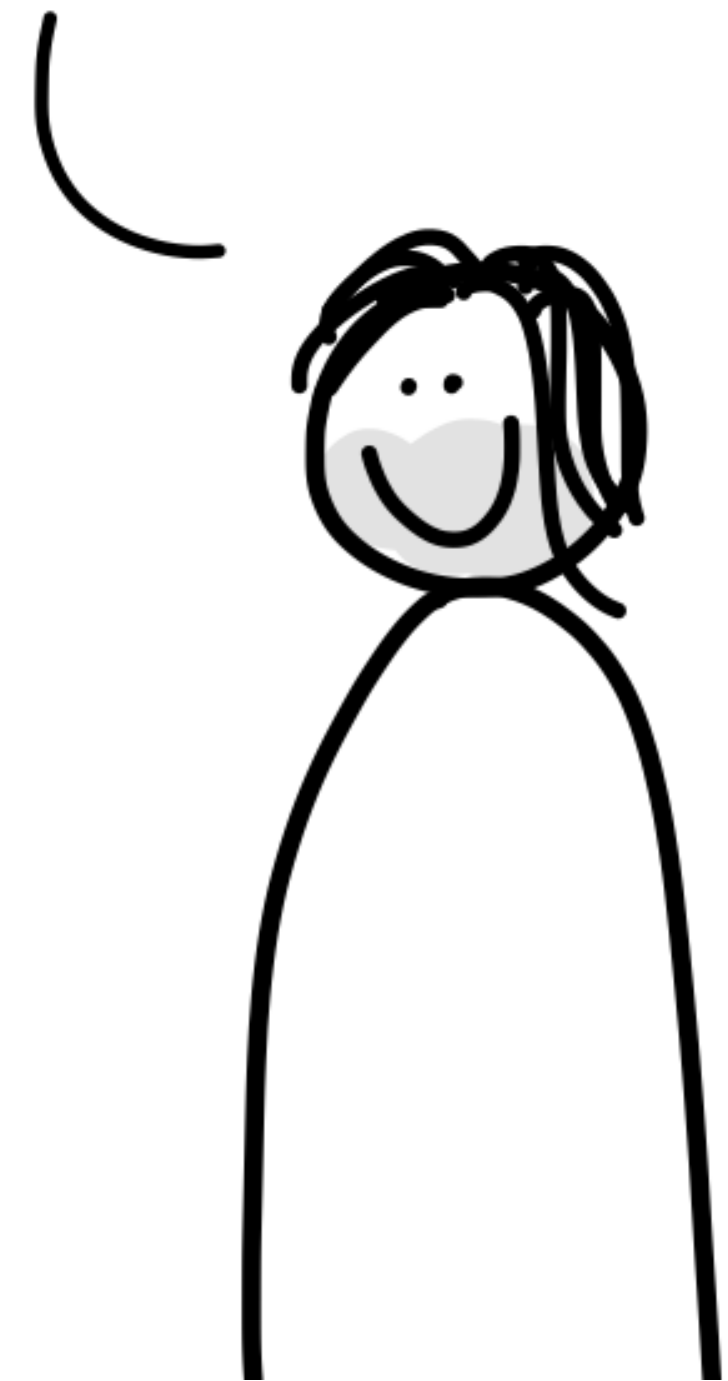
Education is
covert philosophy



How to teach programming?

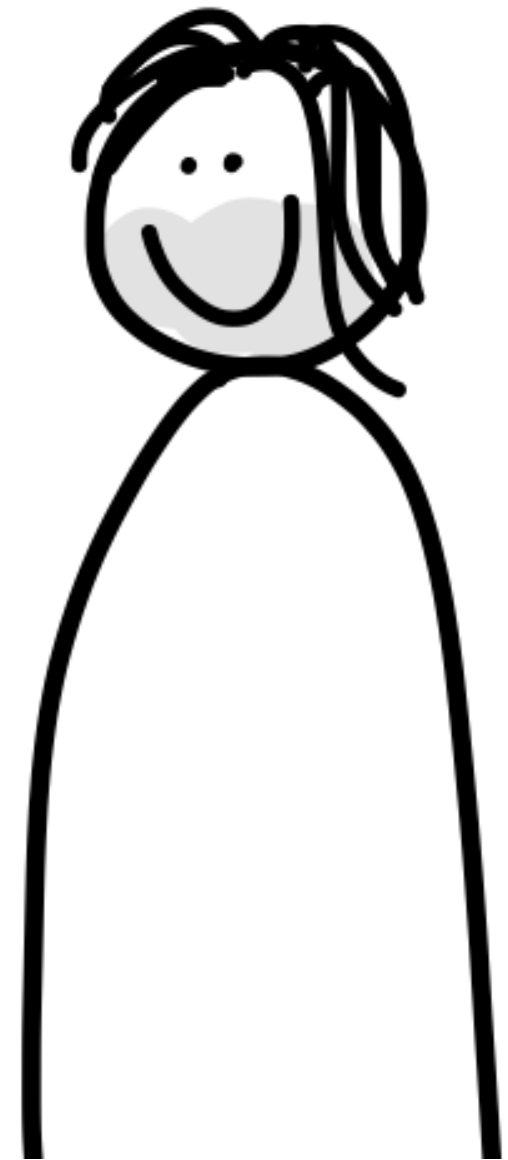
How to teach programming?

I created LOGO



How to teach programming?

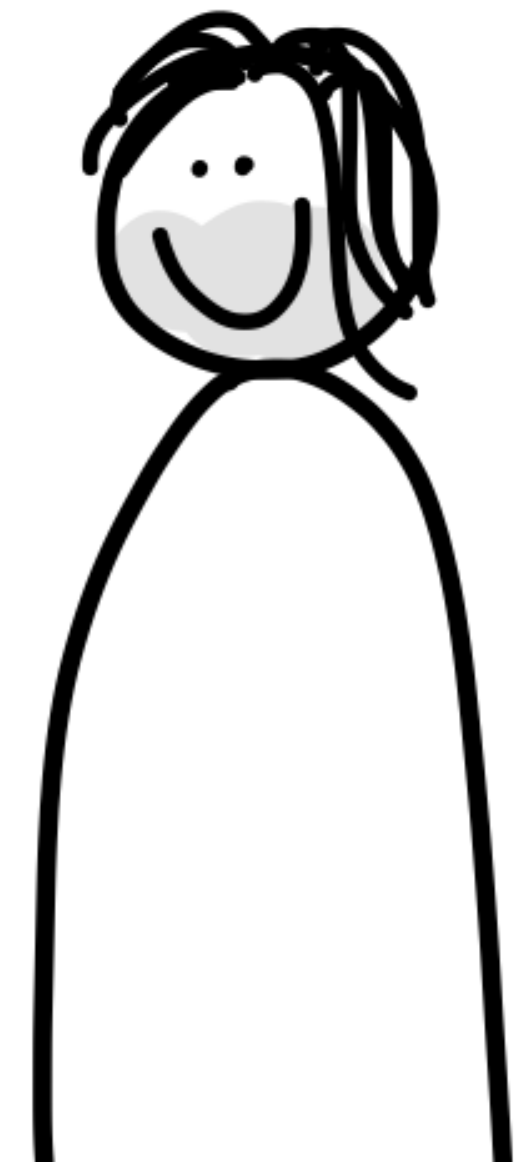
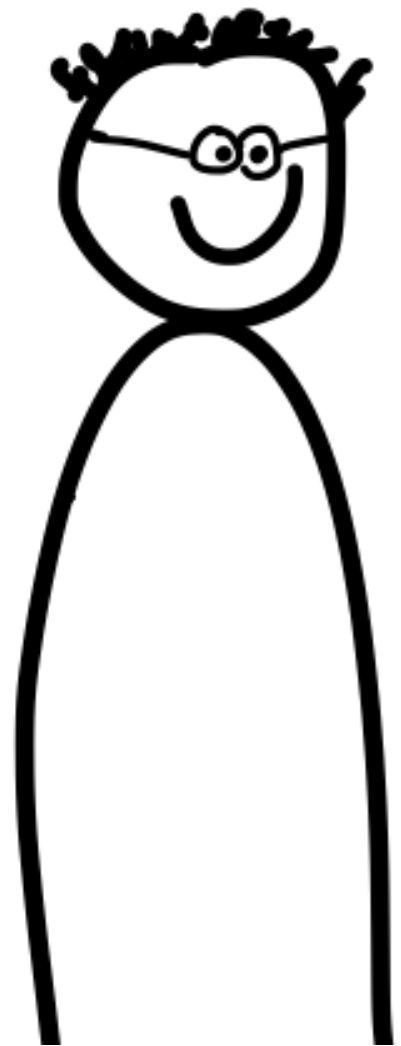
I am Seymour Papert



How to teach programming?

I am Seymour Papert

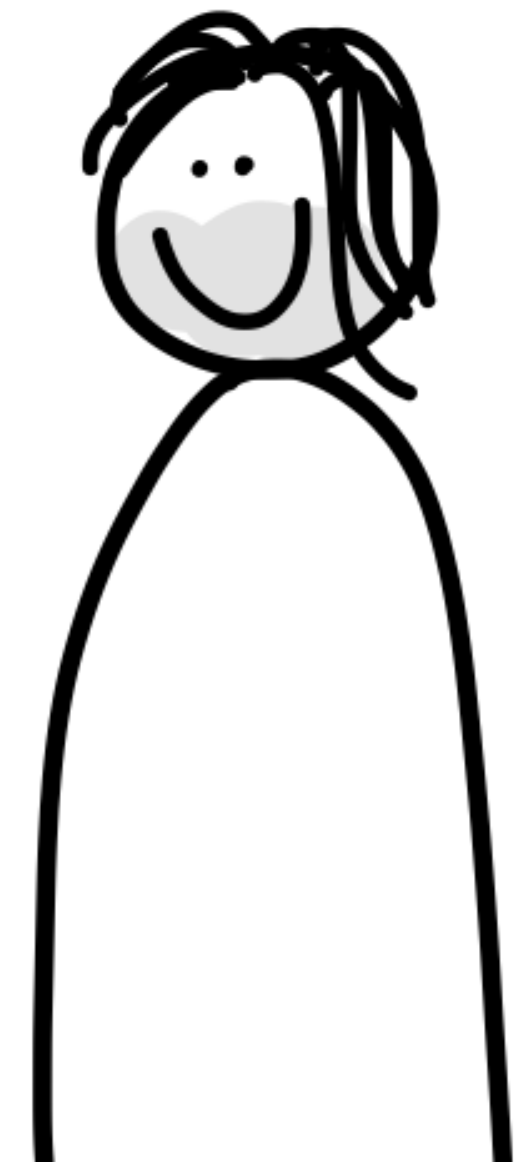
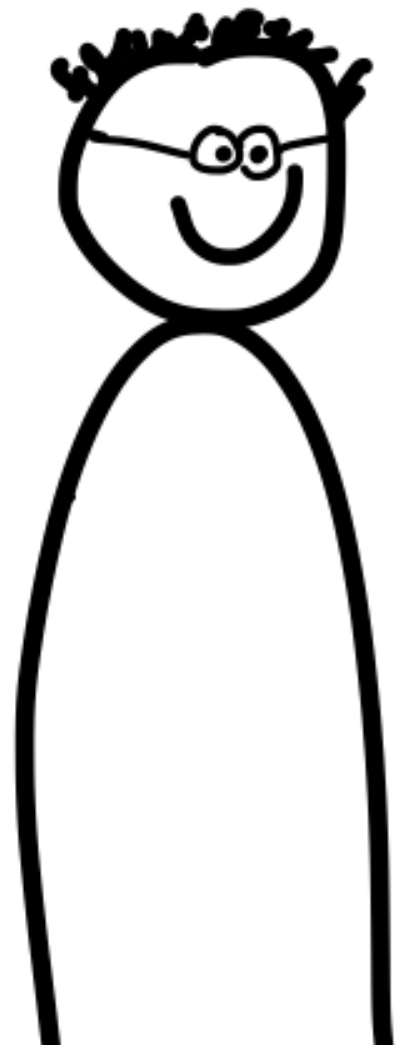
- I am Jean Piaget



How to teach programming?

I am Seymour Papert

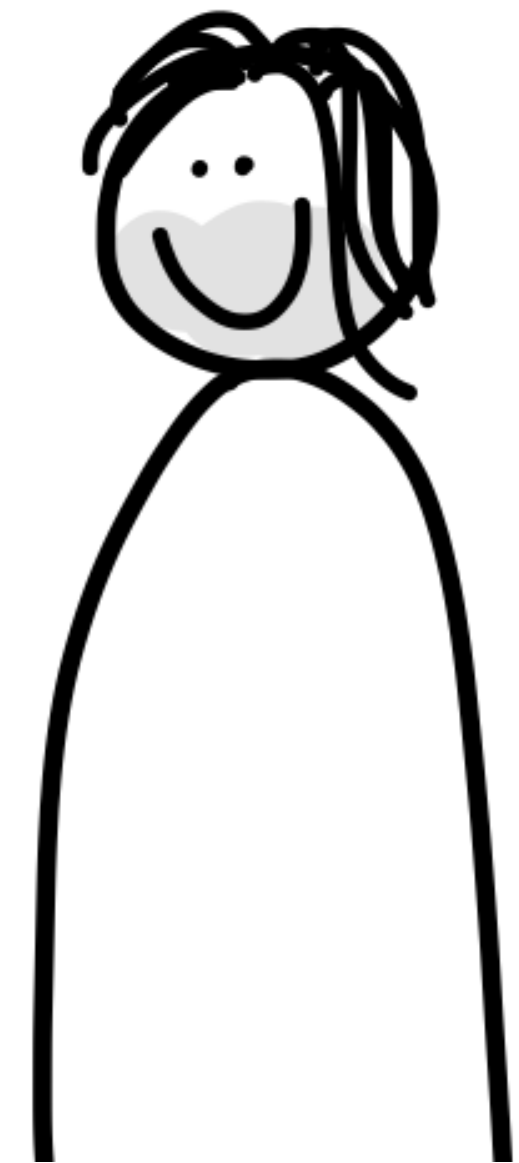
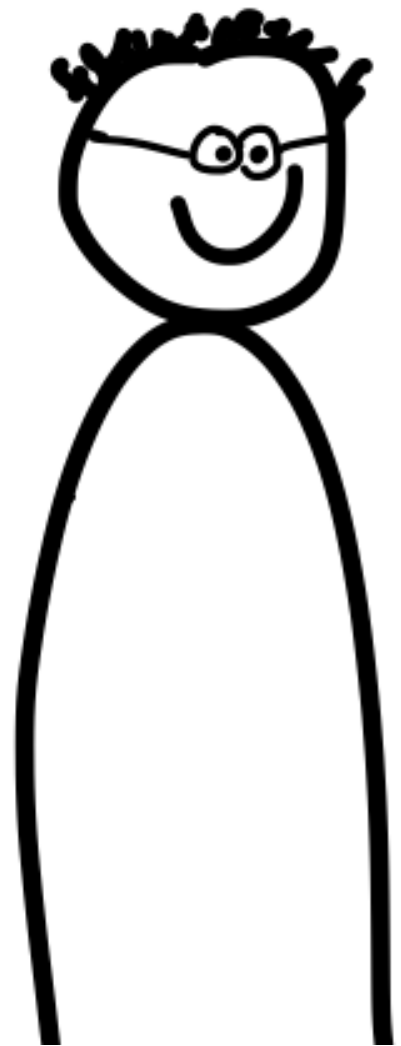
I founded
constructivism



How to teach programming?

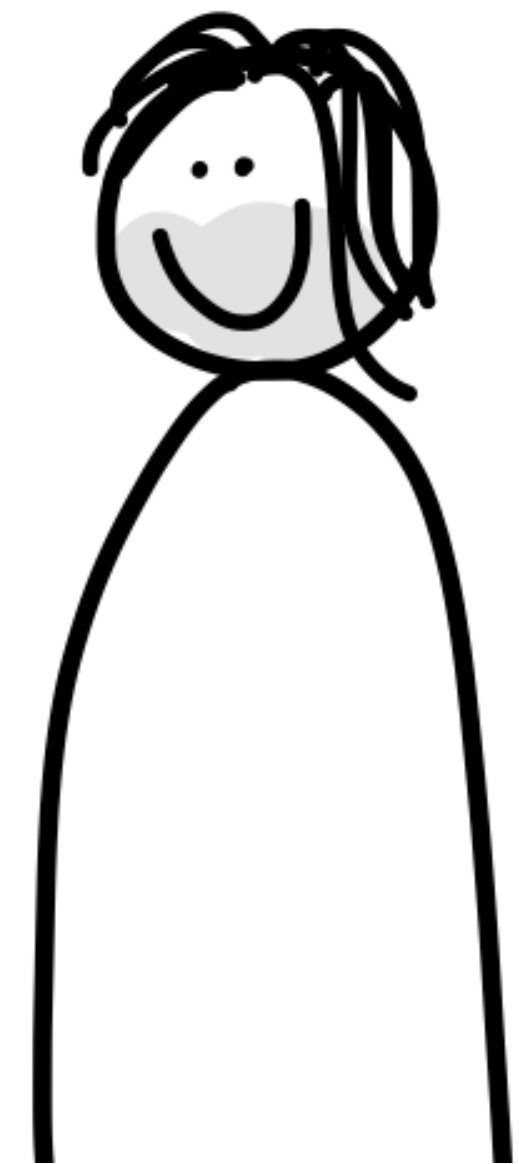
I am Seymour Papert

Nobody understands
my work better

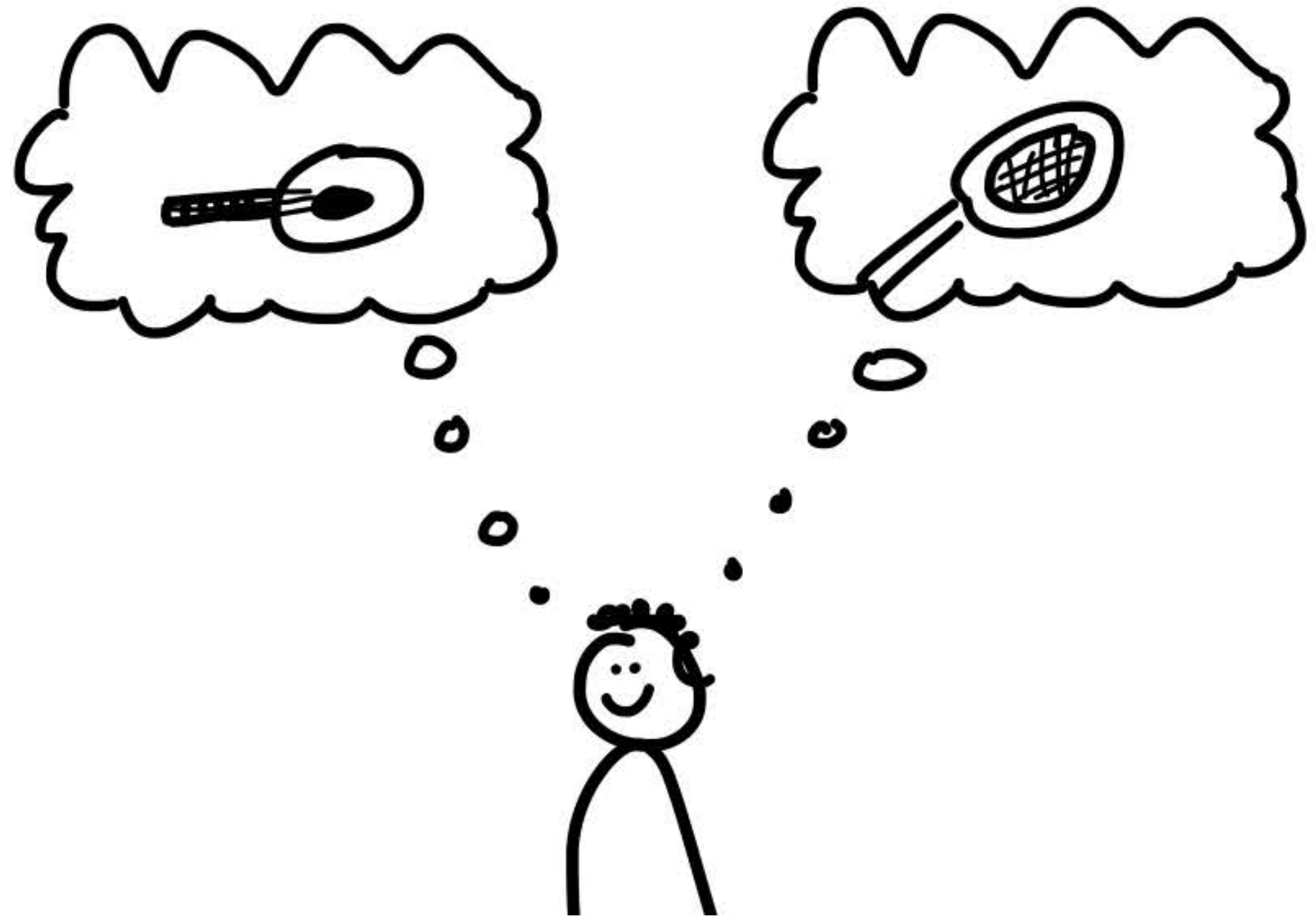


How to teach programming?

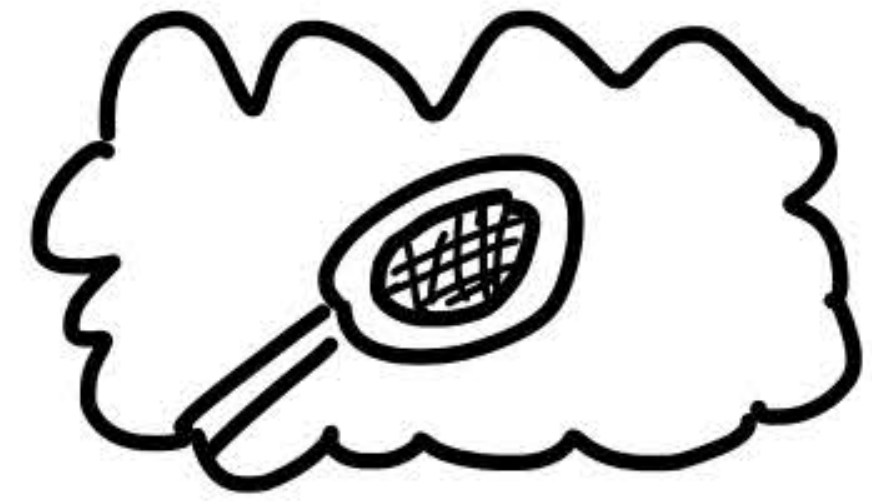
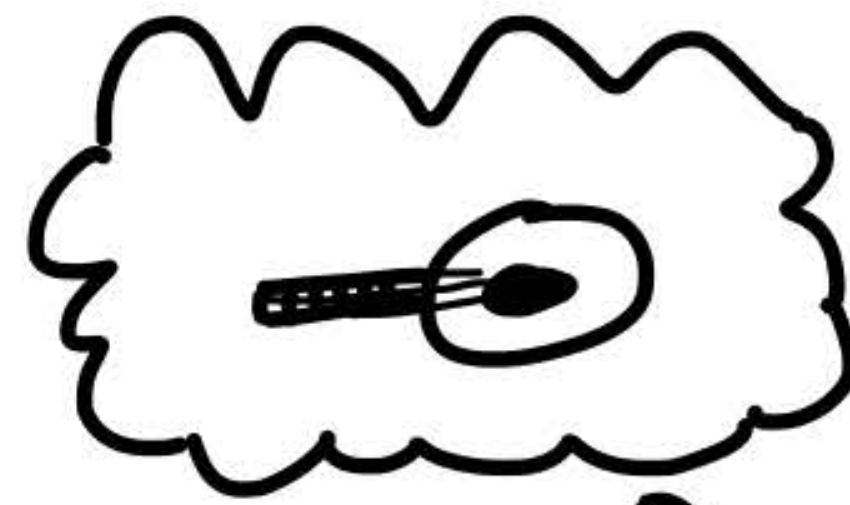
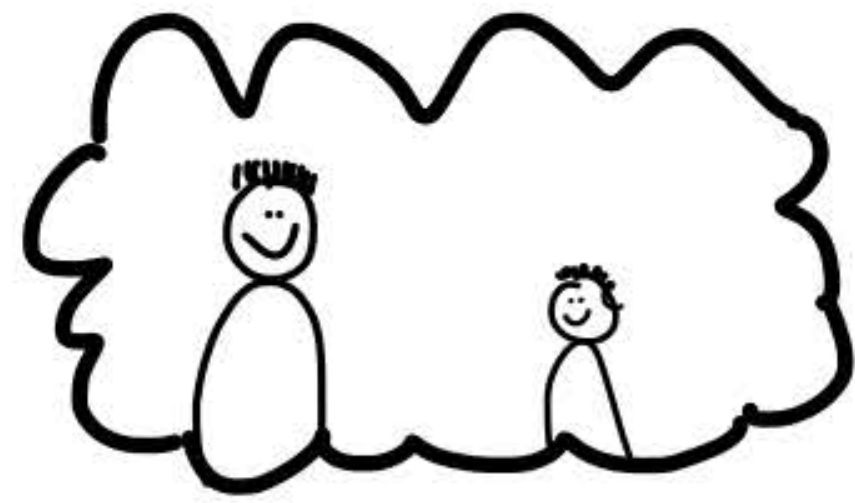
"By explaining something
you take away the
opportunity for a
child to discover it"



How to teach other things?

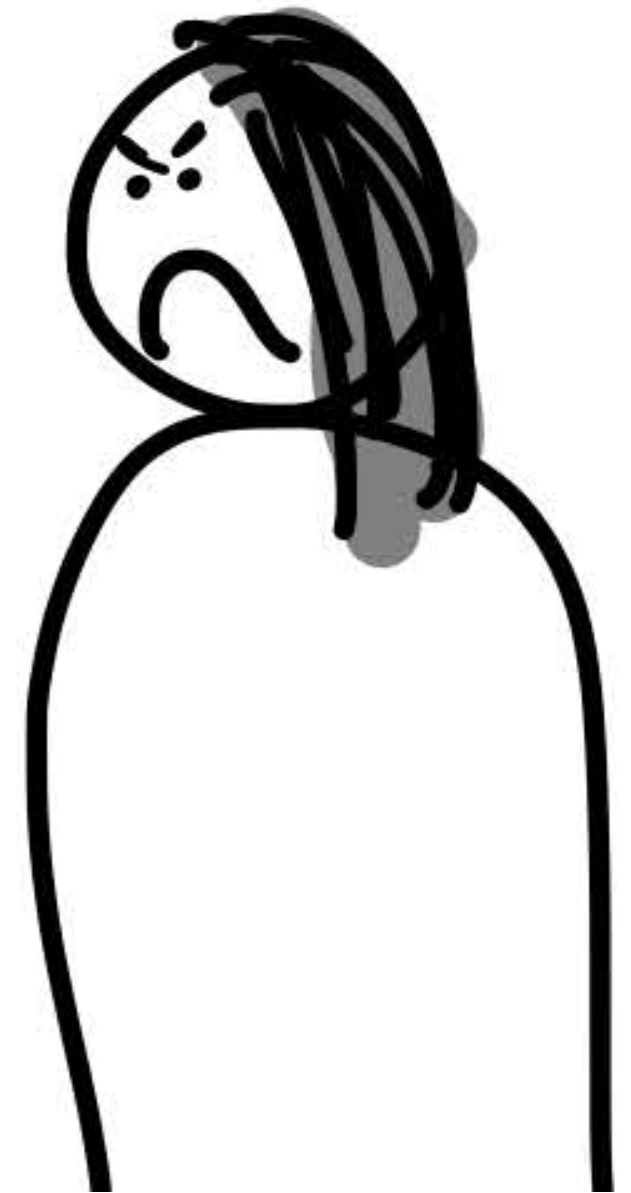
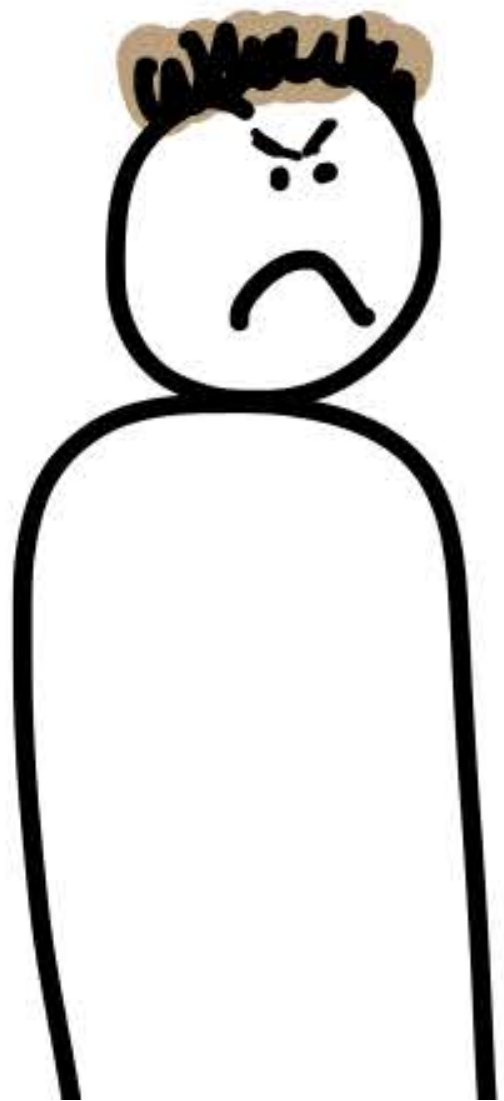


How to teach other things?



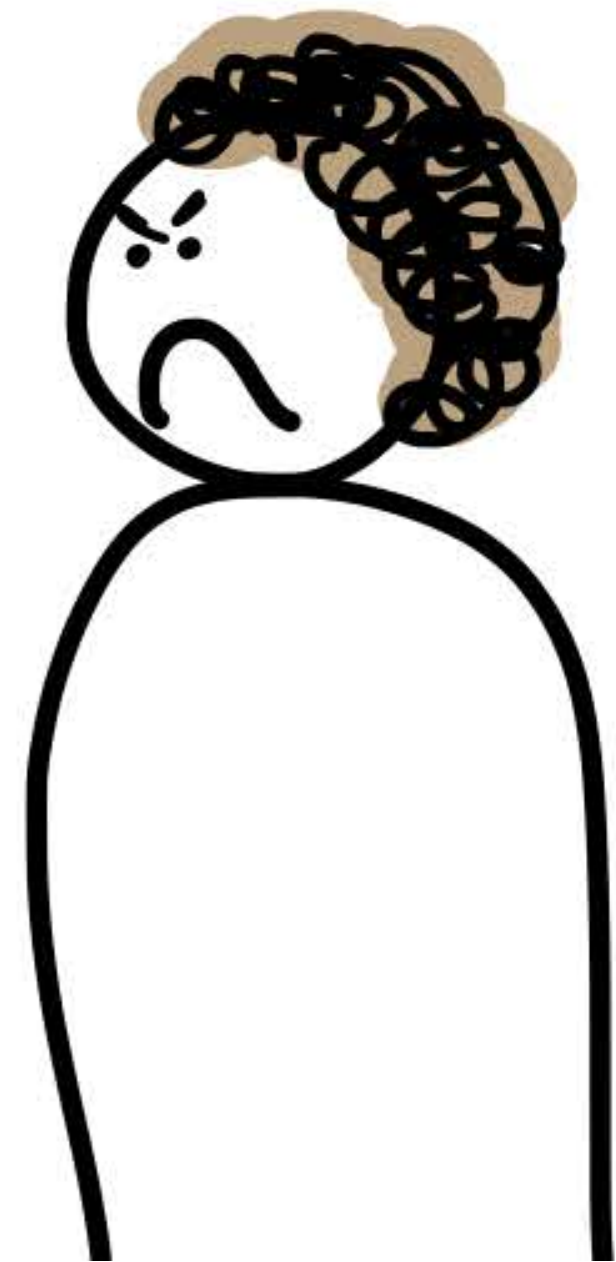
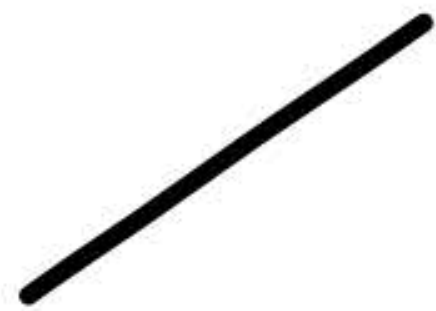
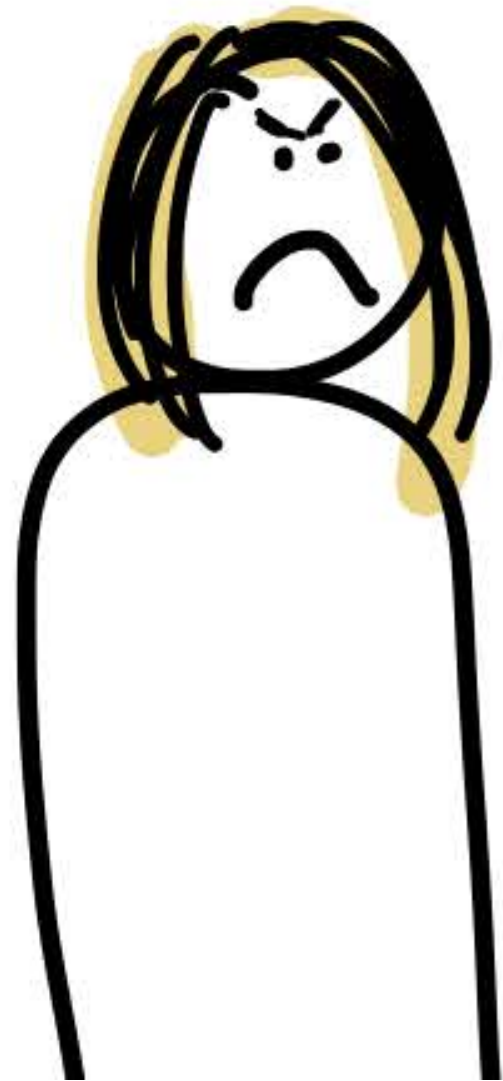
How to teach other things?

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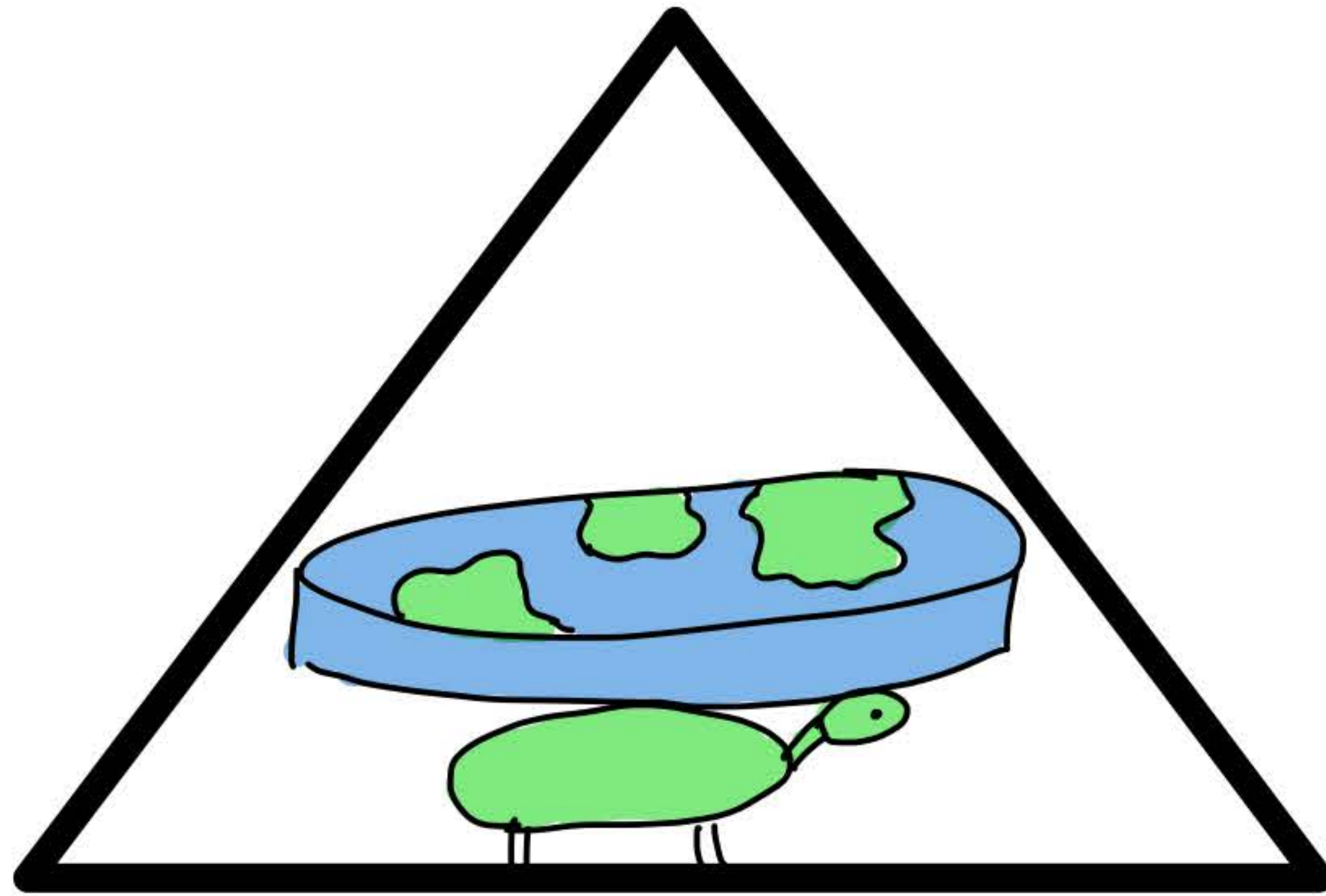


How to teach other things?

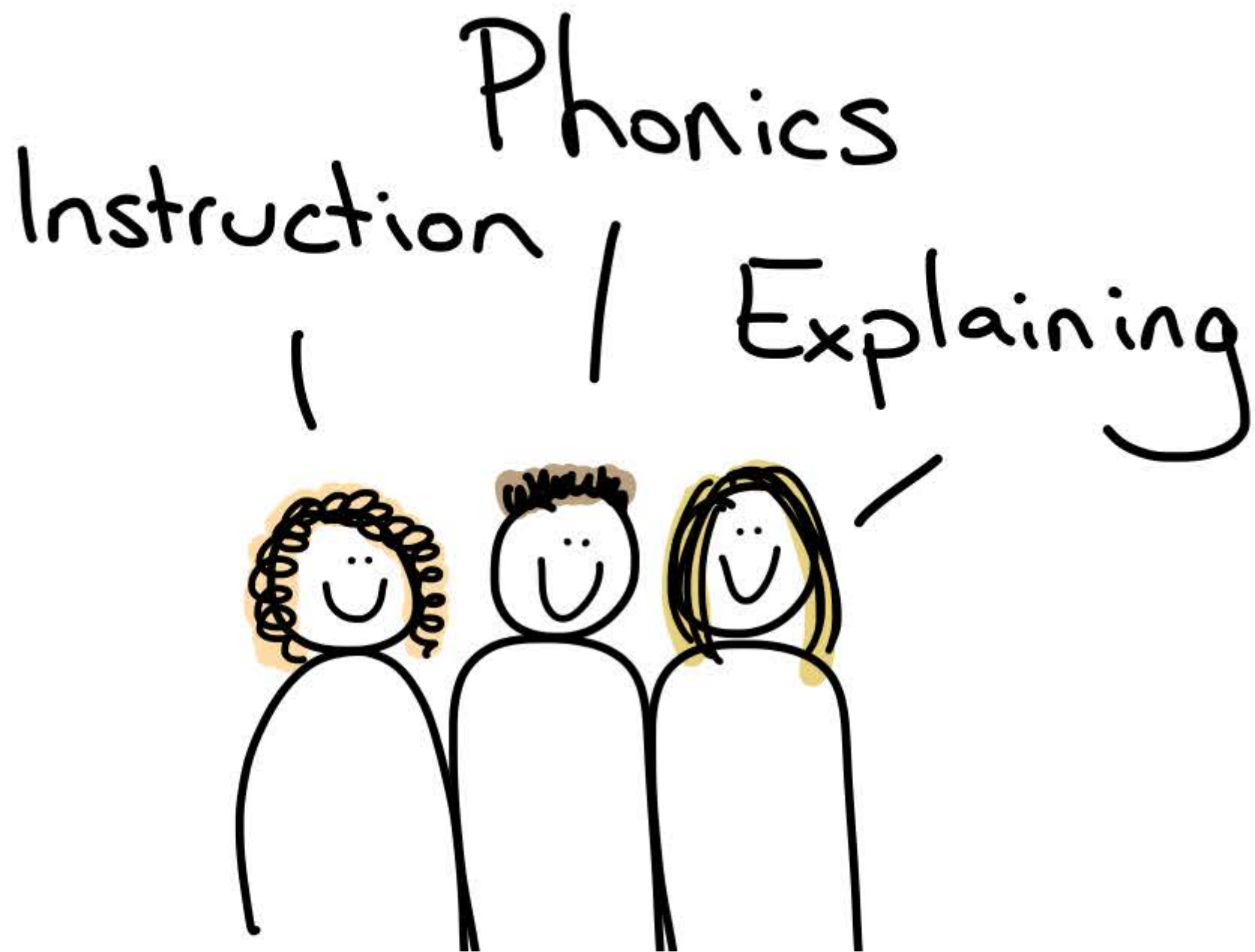
Explanation
&
practice



Beware! Controversy ahead



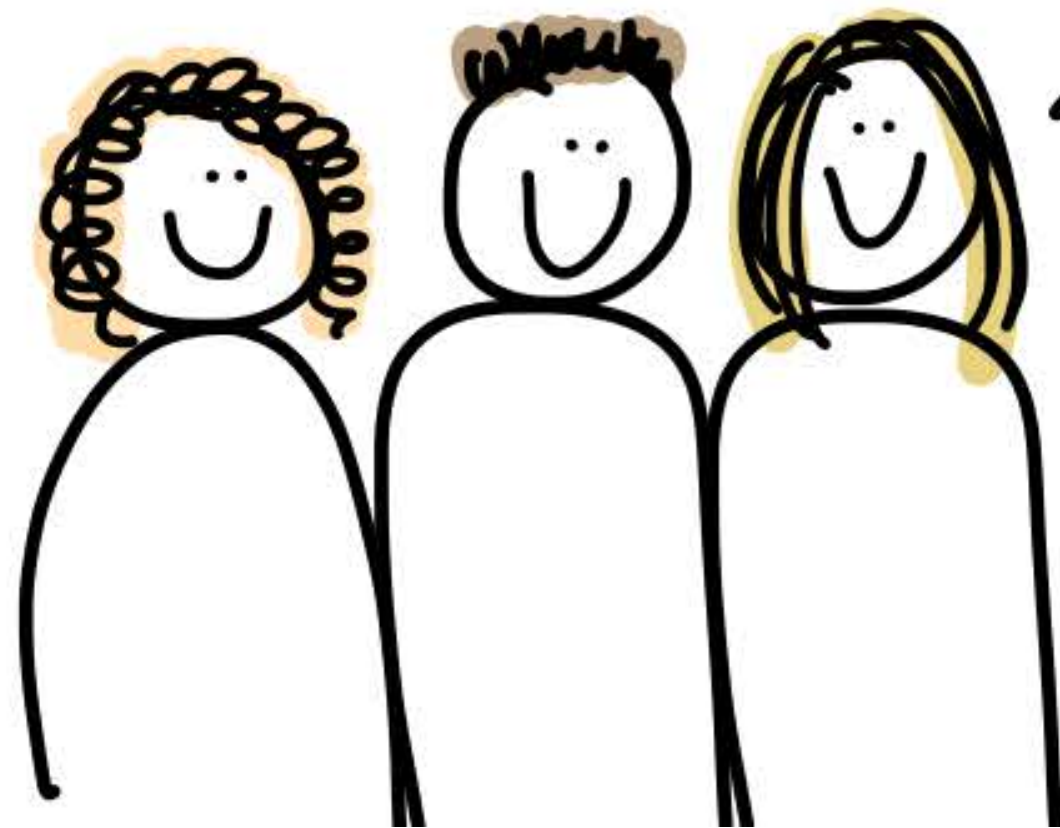
How to teach other things?



How to teach other things?

1

Phonics
Instruction / Explaining



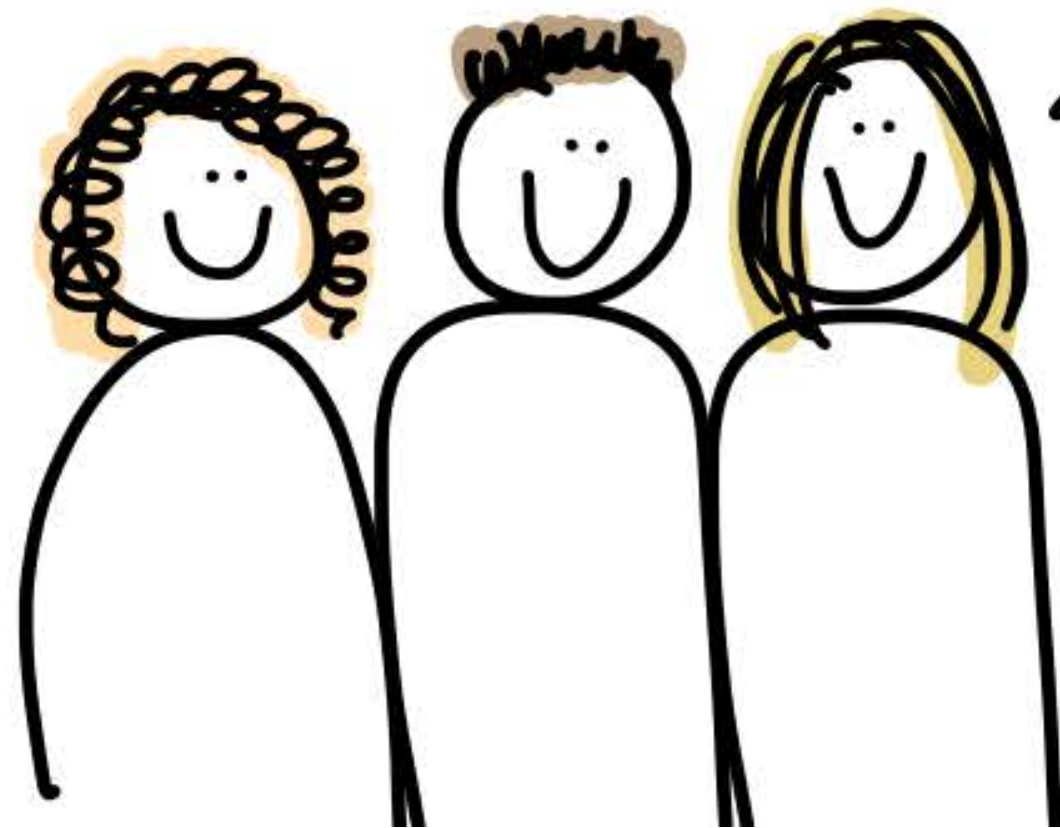
Whole language
Inquiry / Exploration



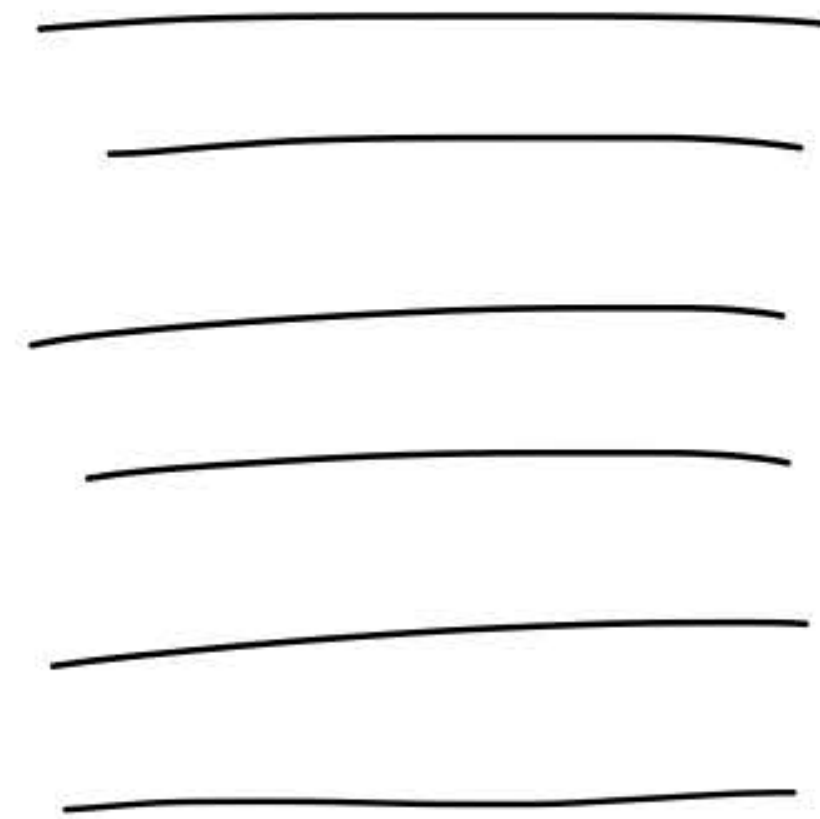
How to teach other things?



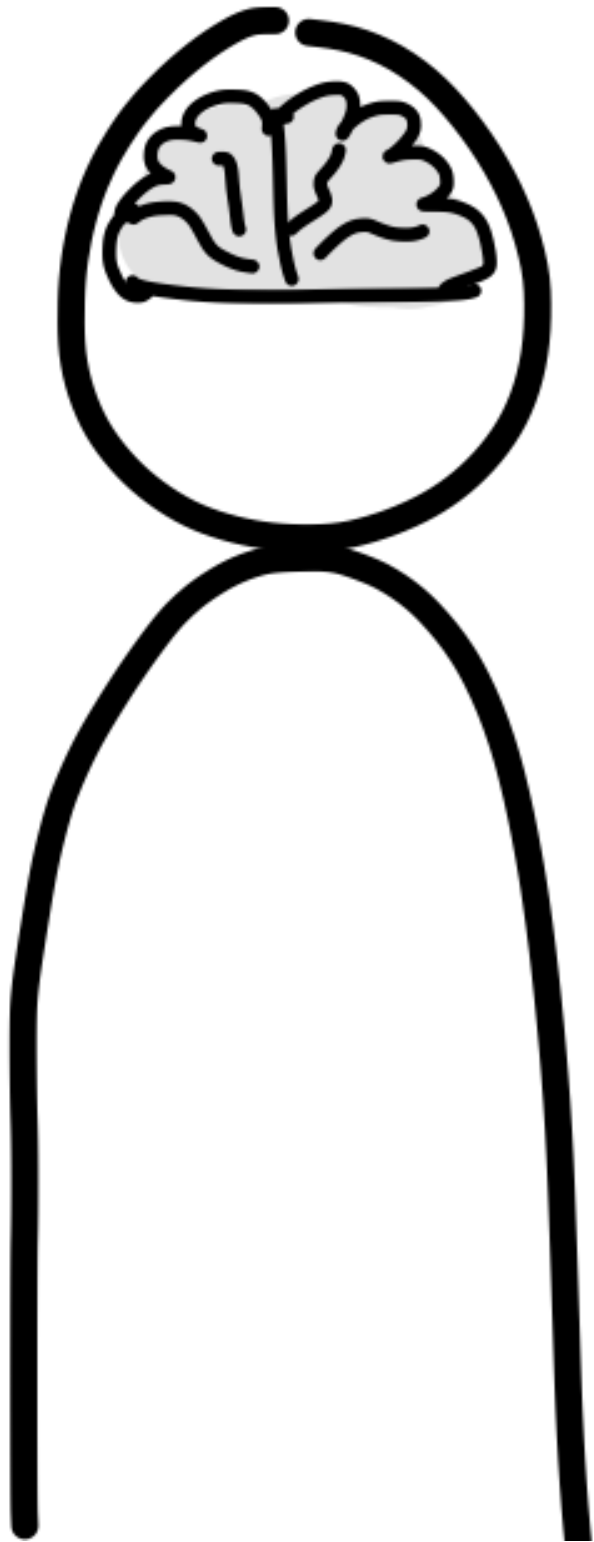
Phonics
Instruction / Explaining



Why minimal guidance
does not work
Kirschner et al.

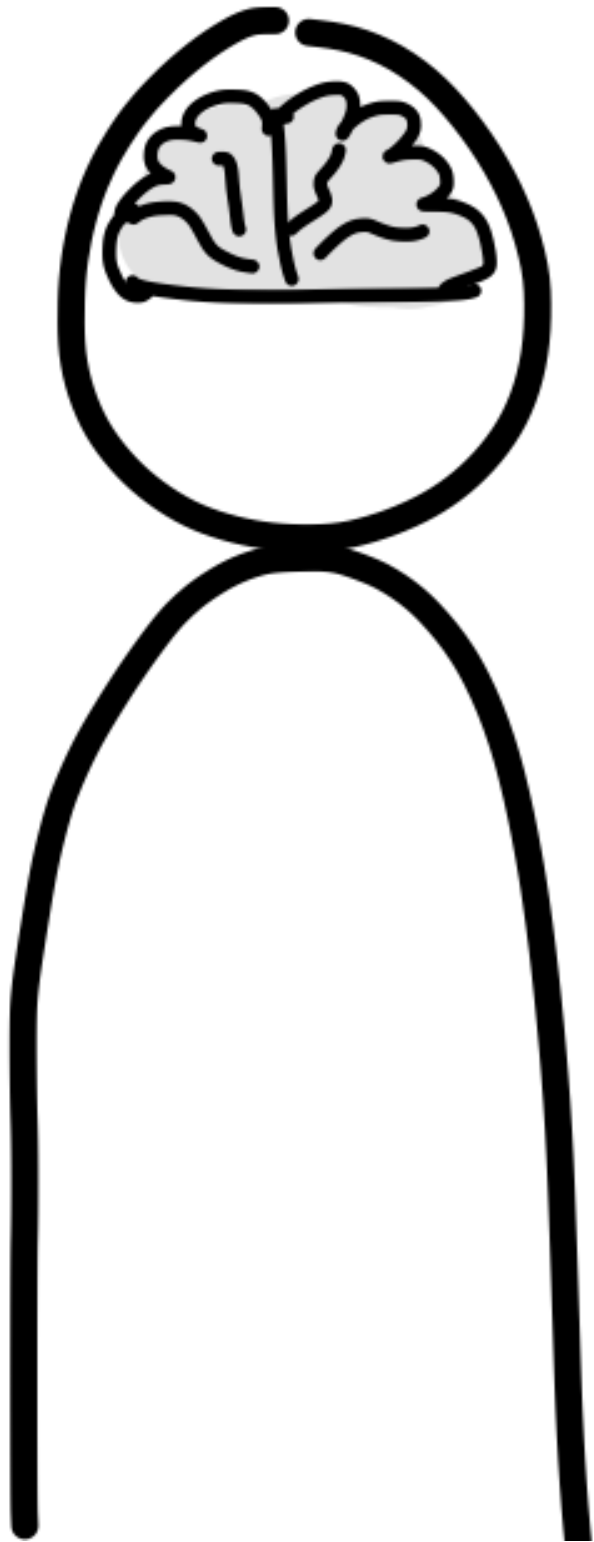


Short term memory

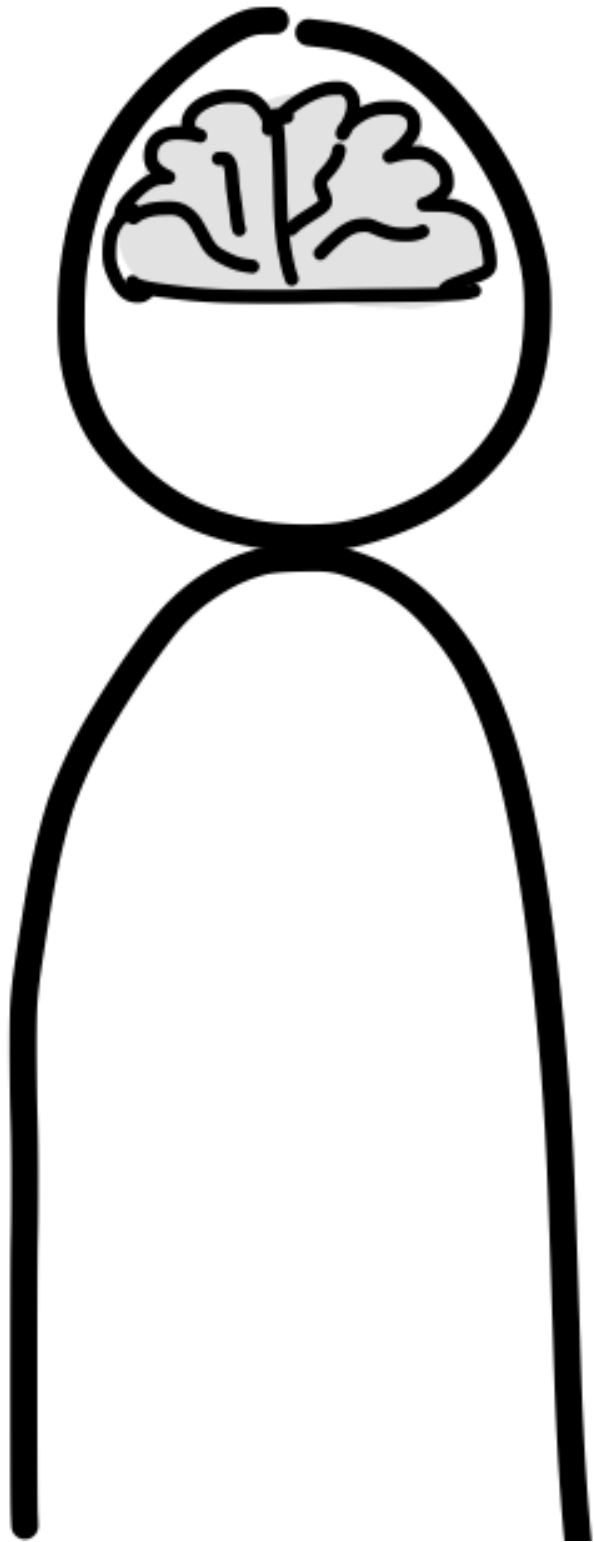


Short term memory

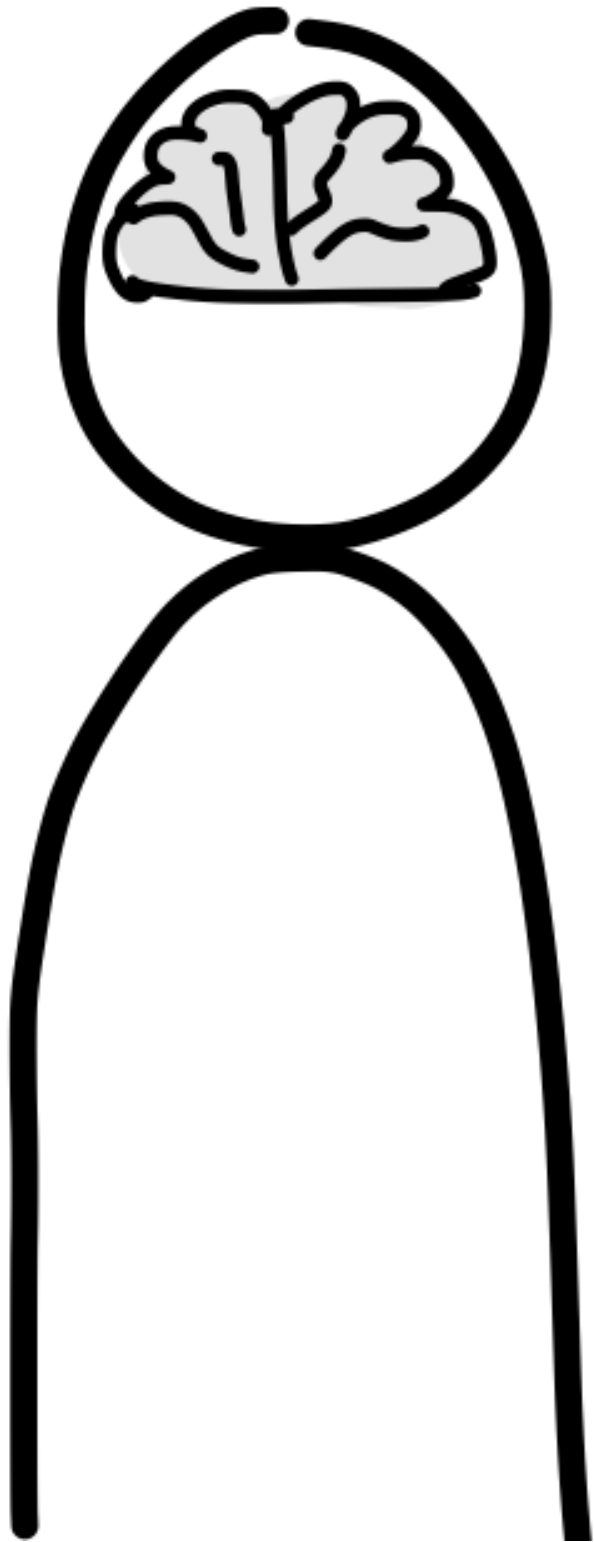
0/3 ◊ \ C < ◊ 1/3)



Short term memory

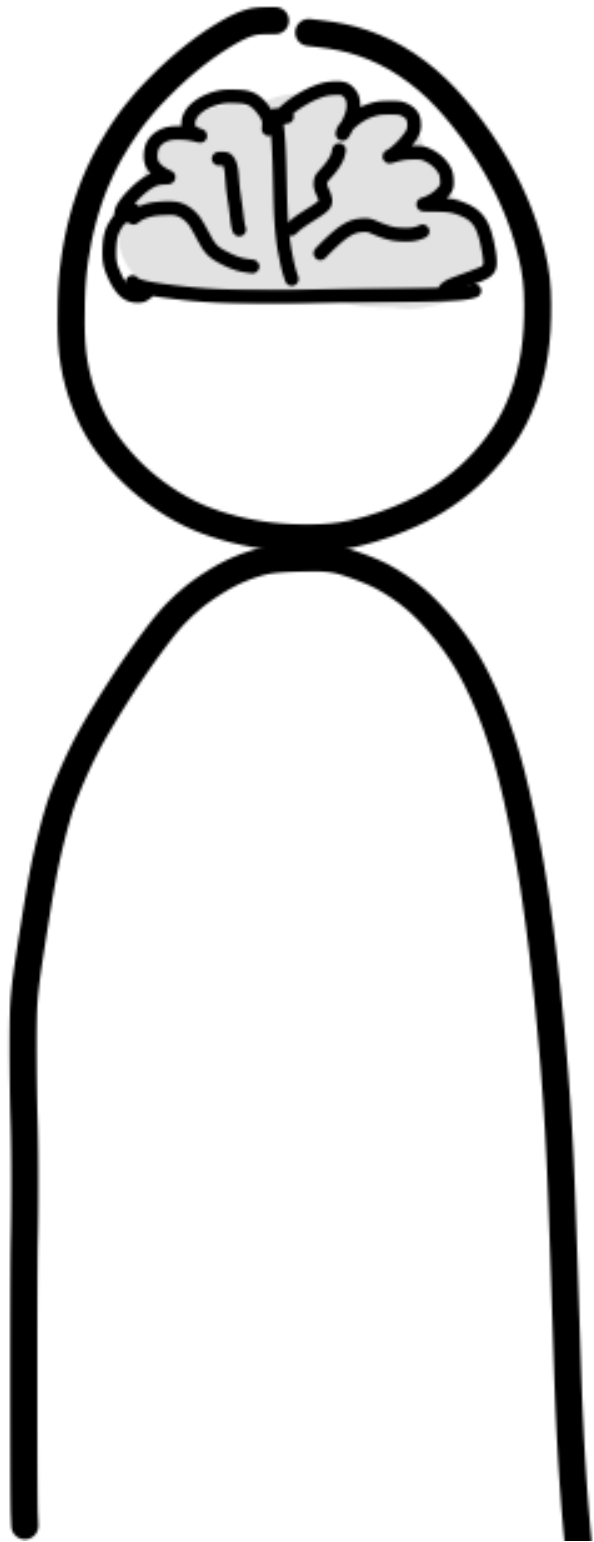


Short term memory

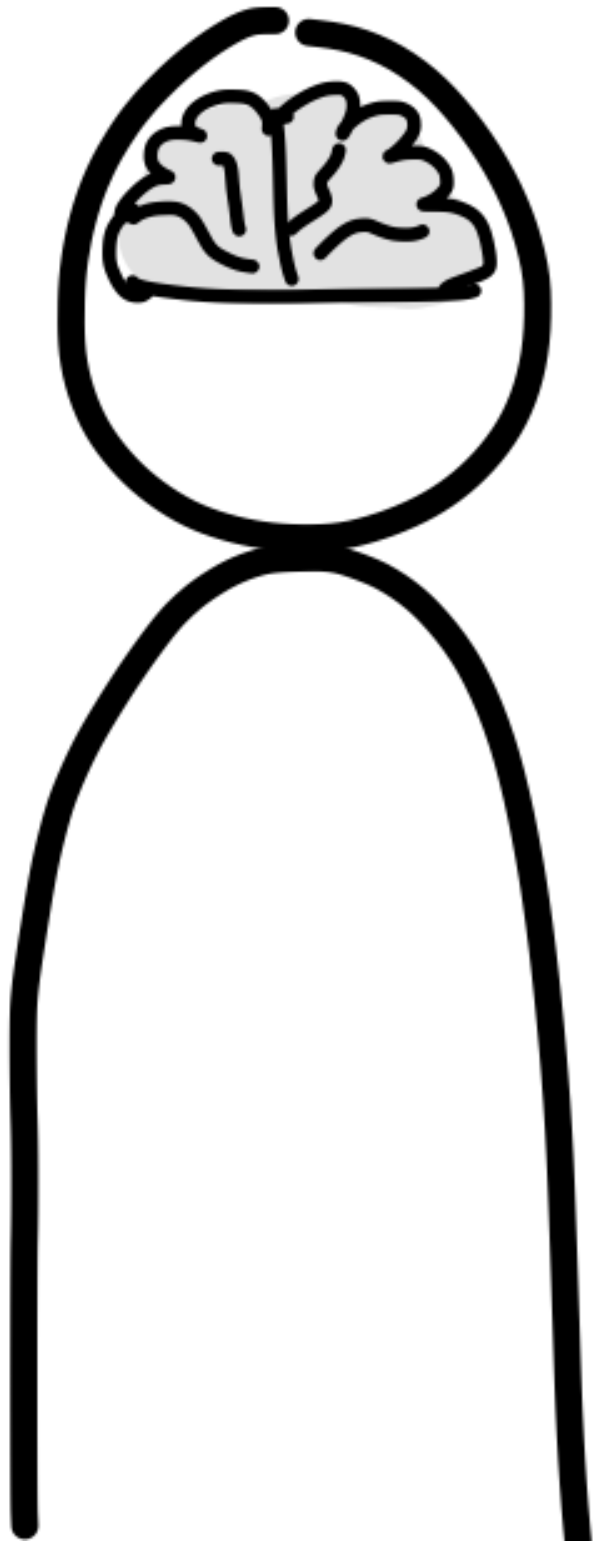


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Short term memory

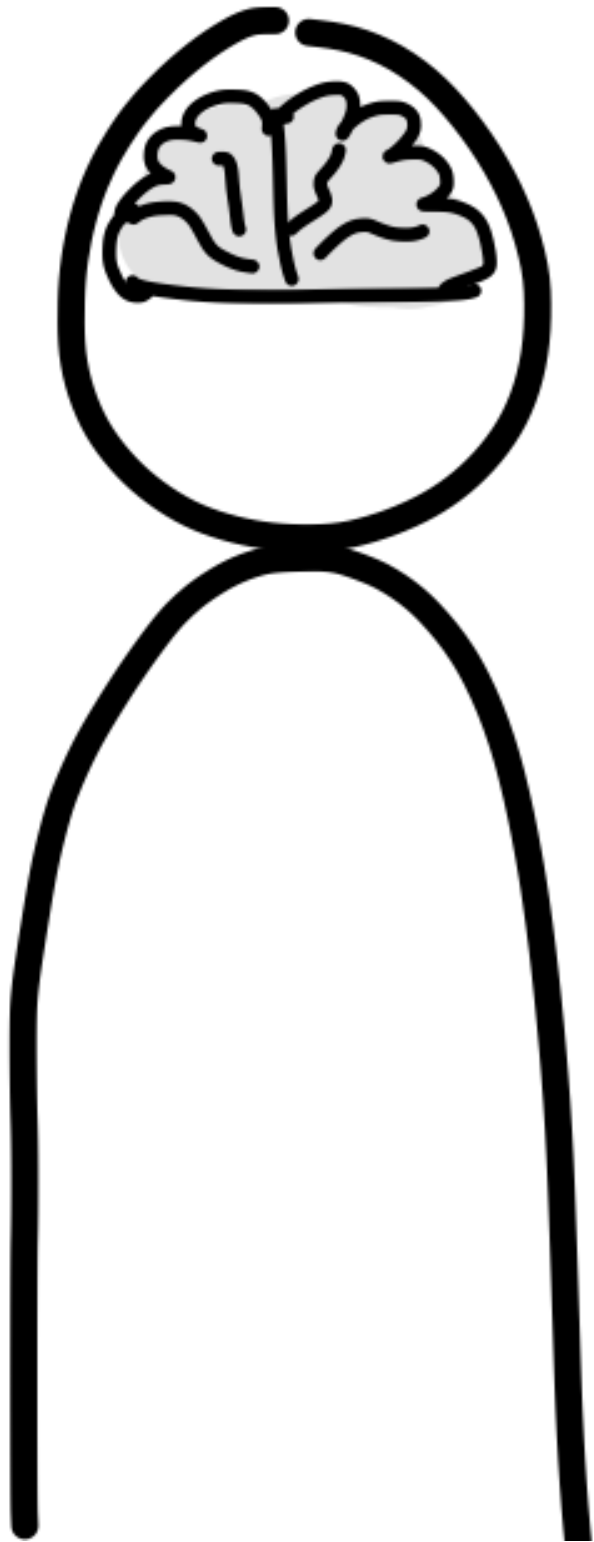


Short term memory

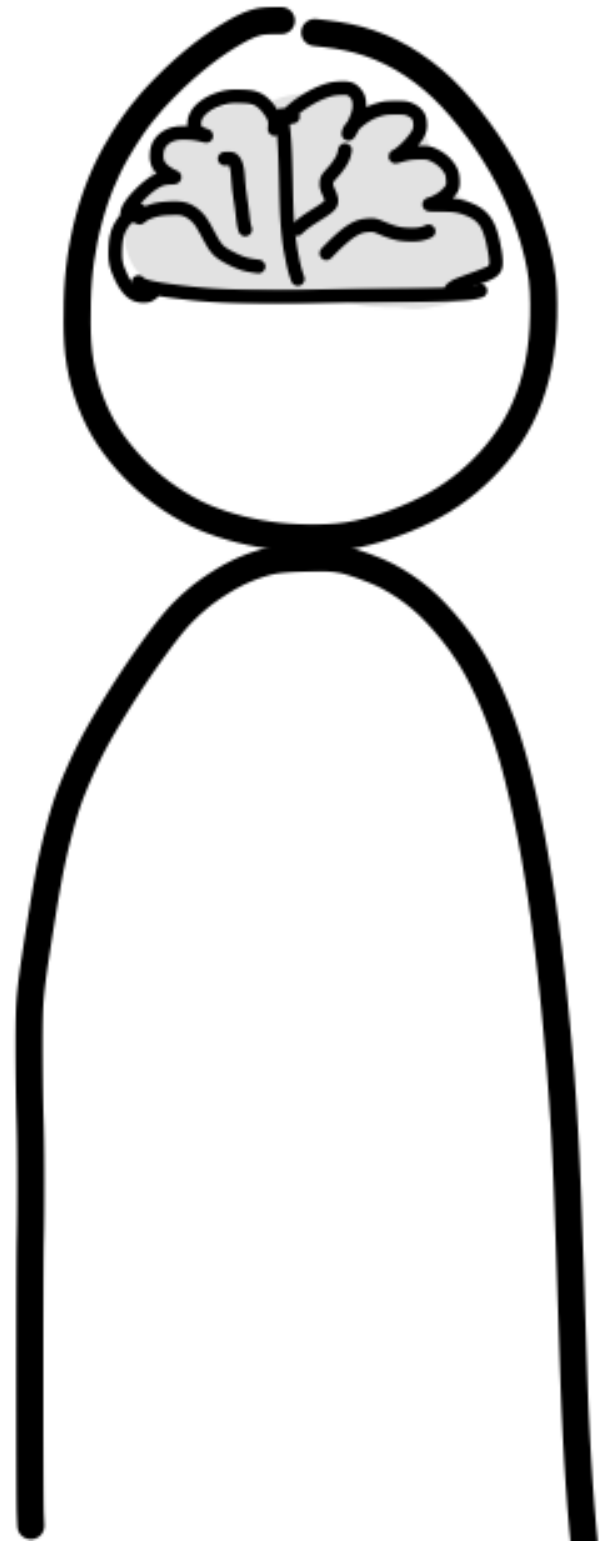


cat loves cake

Short term memory

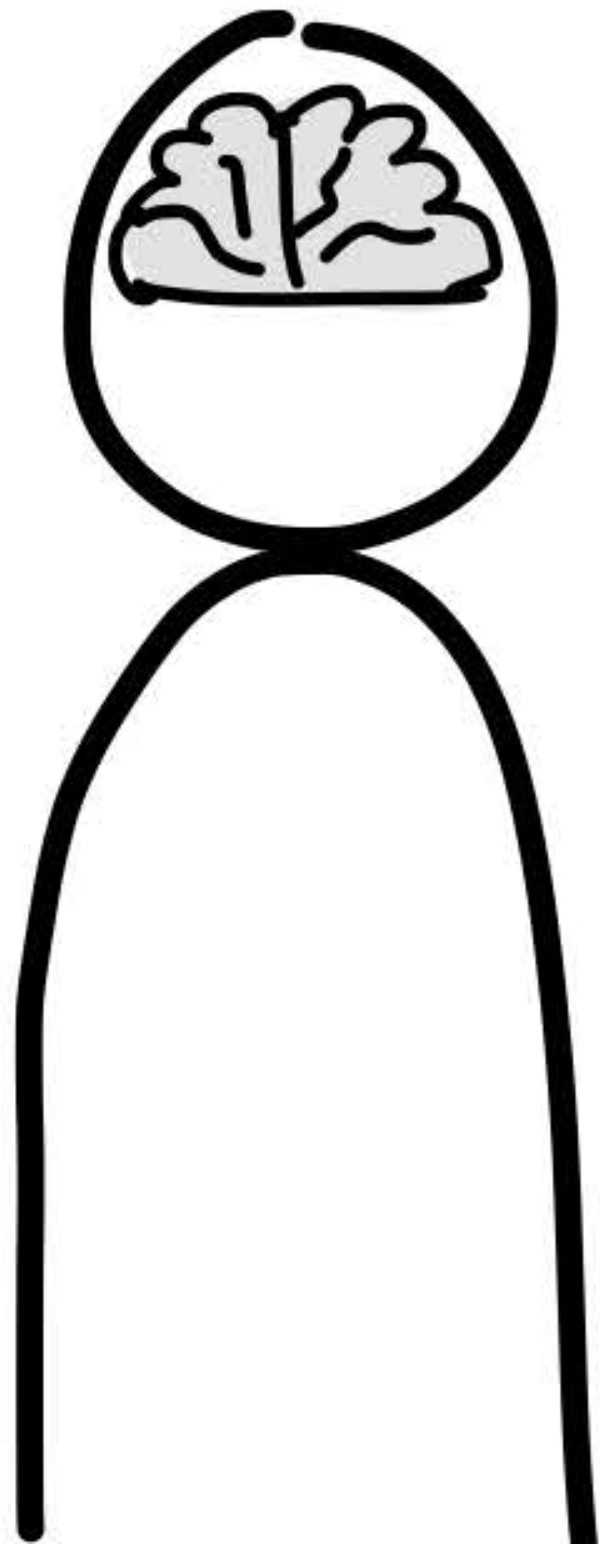


Short term memory



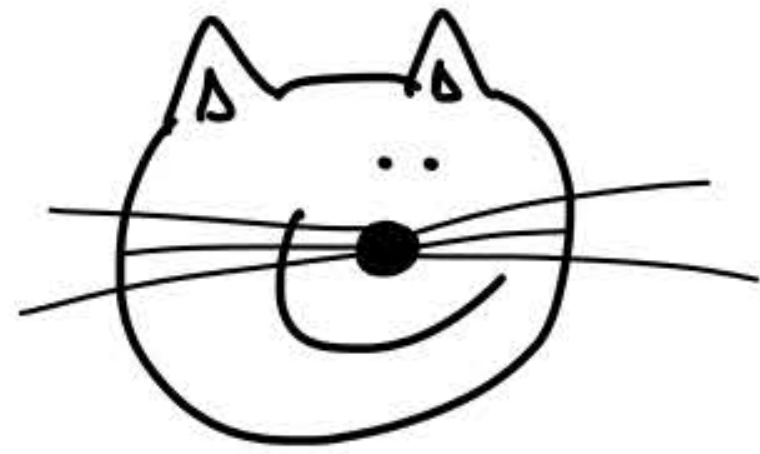
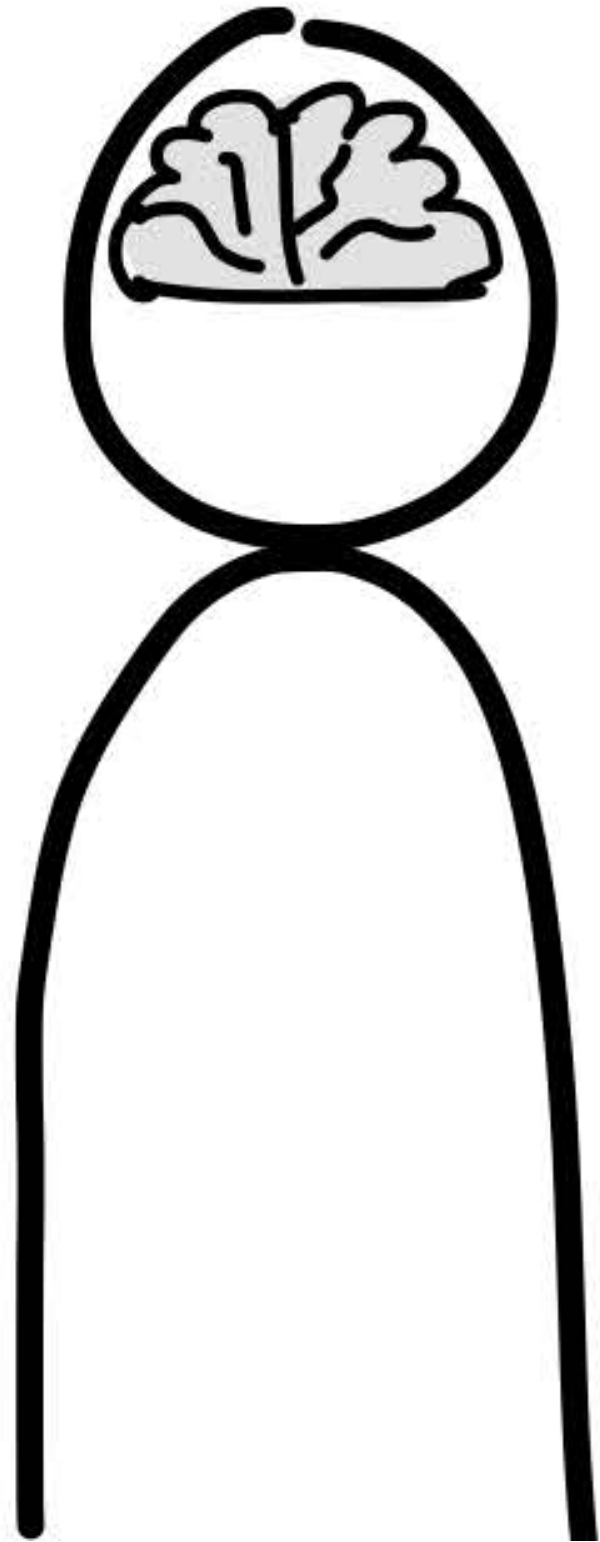
— Can only hold 7 ± 2 items

Short term memory



— Can only hold ⁴~~7~~ ± 2 items

Short term memory



cat loves cake



$\odot/z$ $\diamondsetminus C < \diamond$ $\downarrow/z \cup$



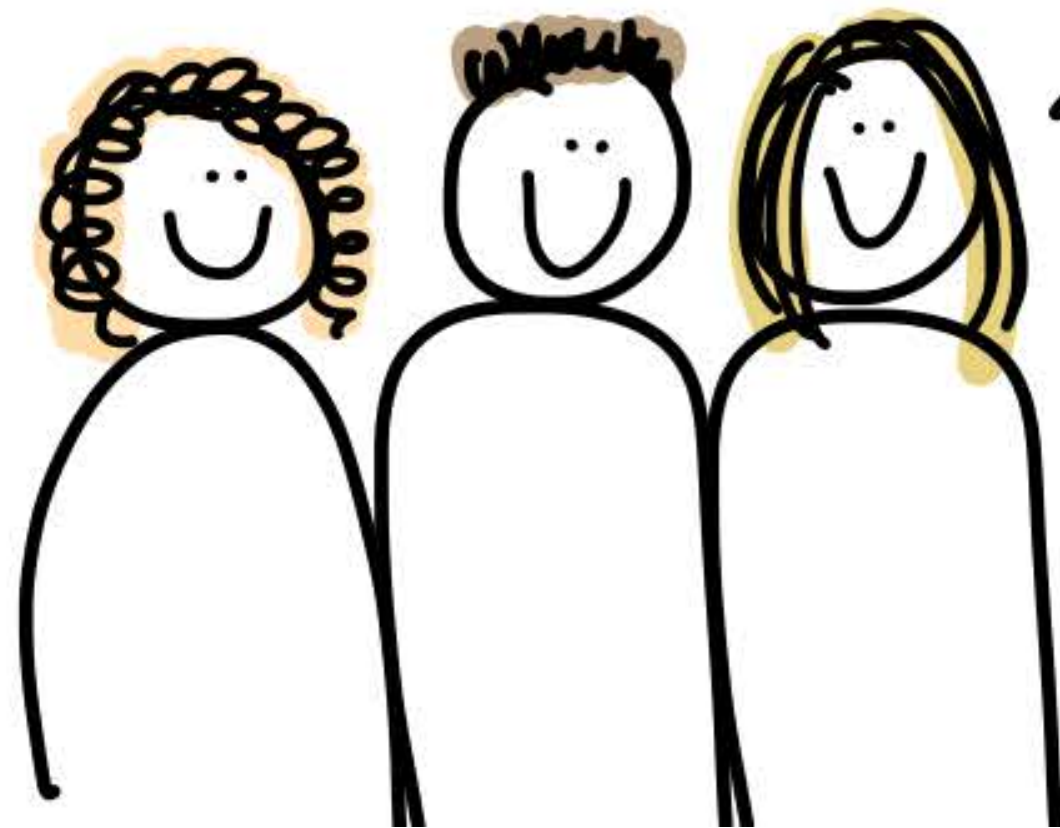
$\odot / 3$ $\diamondsetminus C < \diamond$ $\downarrow / 3 \cup$

↖ Cognitive load

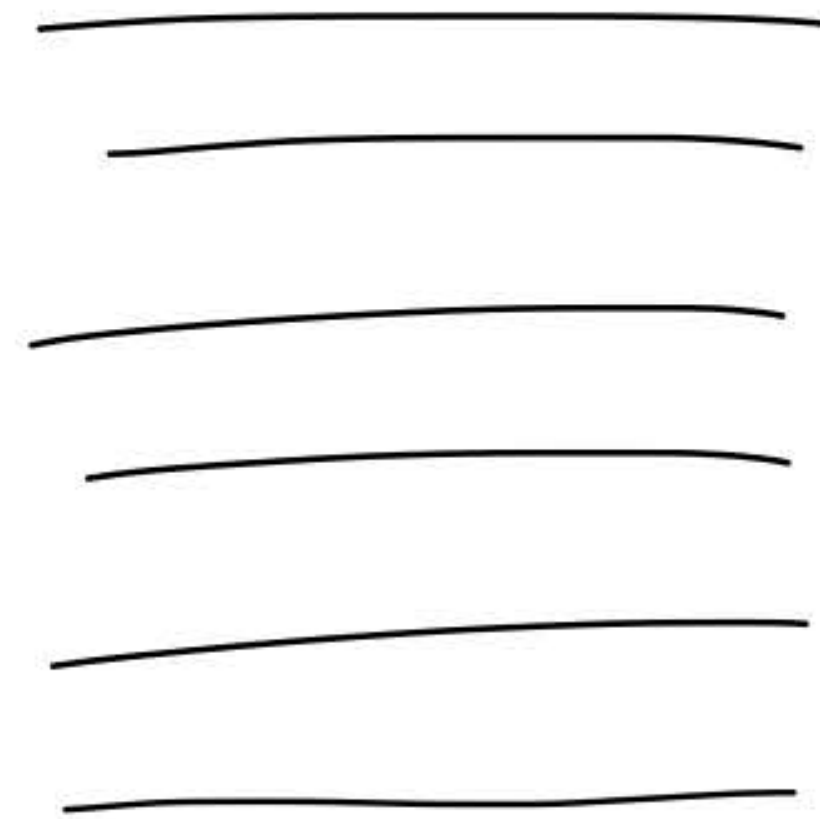
How to teach other things?



Phonics
Instruction / Explaining



Why minimal guidance
does not work
Kirschner et al.



The use of worked
examples for Problem Solving

Sweller & Cooper



The use of worked
examples for Problem Solving

Sweller & Cooper

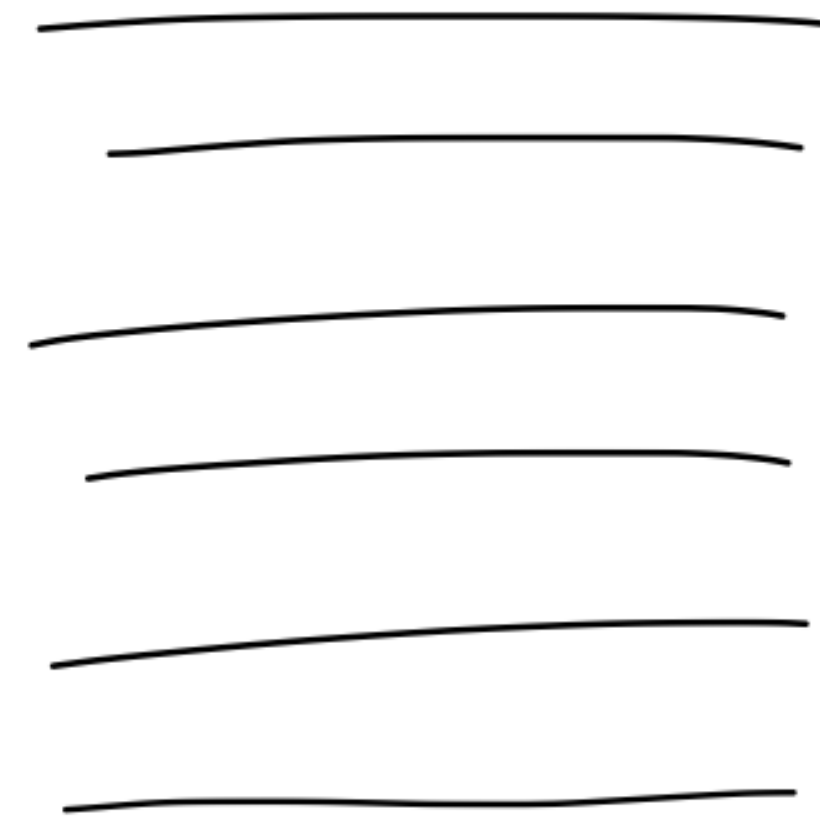


$a = 7 - 4a$
what is a ?



The use of worked
examples for Problem Solving

Sweller & Cooper



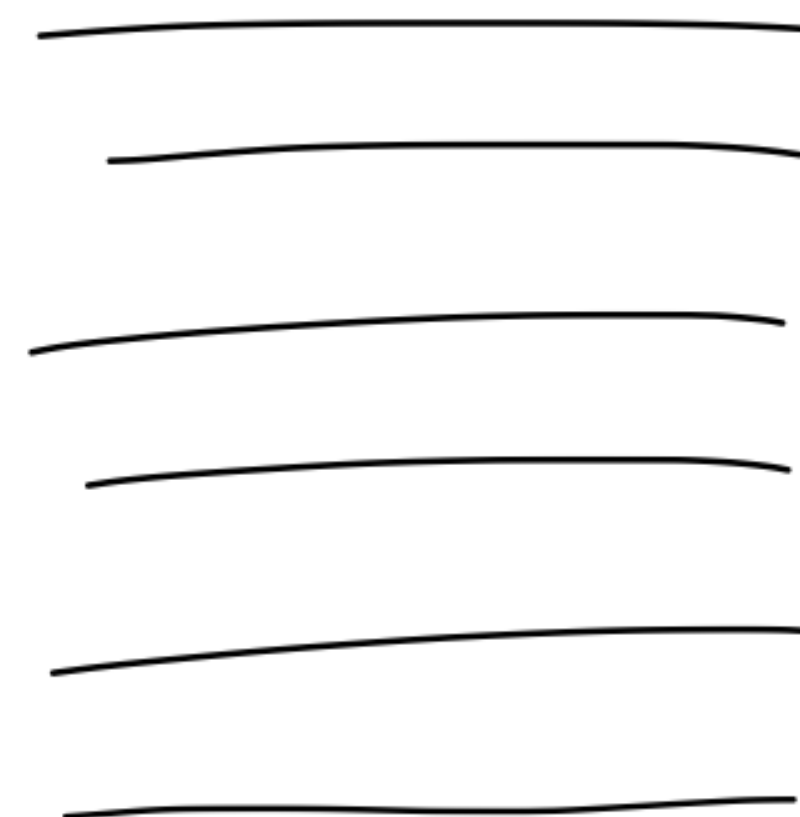
$$\begin{aligned}a &= b - ca \\a + ca &= b \\a(1+c) &= b \\a &= \frac{b}{1+c}\end{aligned}$$

o
o
o



The use of worked
examples for Problem Solving

Sweller & Cooper



$$\begin{aligned}a &= b - ca \\a + ca &= b \\a(1+c) &= b \\a &= \frac{b}{1+c}\end{aligned}$$

$$\begin{aligned}a &= 7 - 4a \\ \text{what is } a?\end{aligned}$$

The use of worked
examples for Problem Solving

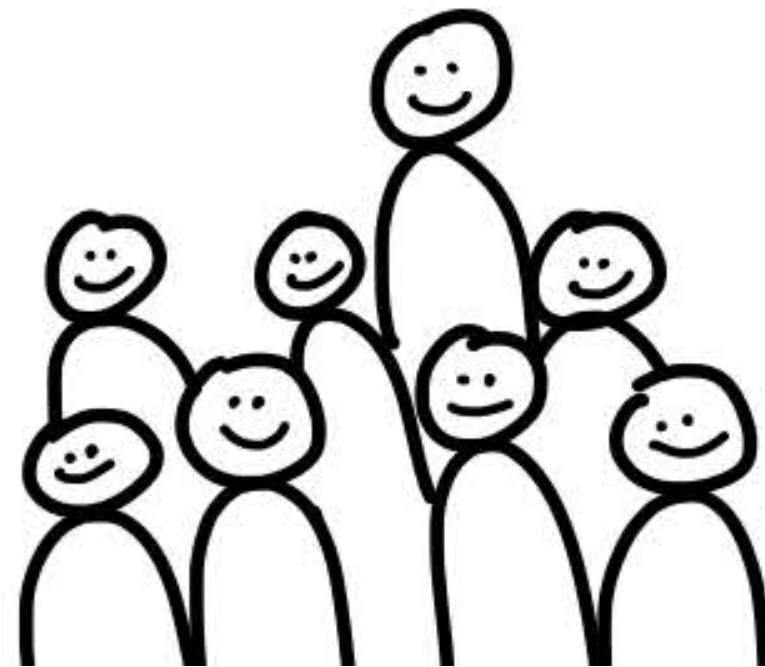
Sweller & Cooper



$$\begin{aligned}a &= b - ca \\a + ca &= b \\a(1+c) &= b \\a &= \frac{b}{1+c}\end{aligned}$$

$$\begin{aligned}a &= 7 - 4a \\ \text{what is } a?\end{aligned}$$

1



The use of worked
examples for Problem Solving

Sweller & Cooper

$$\begin{aligned}a &= b - ca \\a + ca &= b \\a(1+c) &= b \\a &= \frac{b}{1+c}\end{aligned}$$

1

Also on
different problems

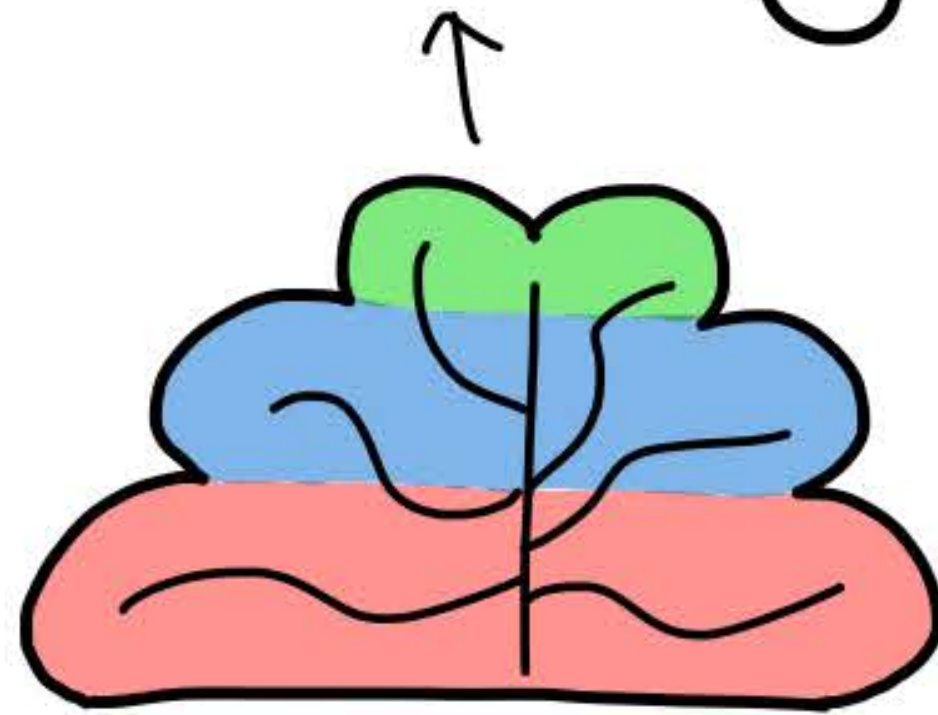
The use of worked
examples for Problem Solving

Sweller & Cooper



$$\begin{aligned} a &= b - ca \\ a + ca &= b \\ a(1+c) &= b \\ a &= \frac{b}{1+c} \end{aligned}$$

Used to store strategies

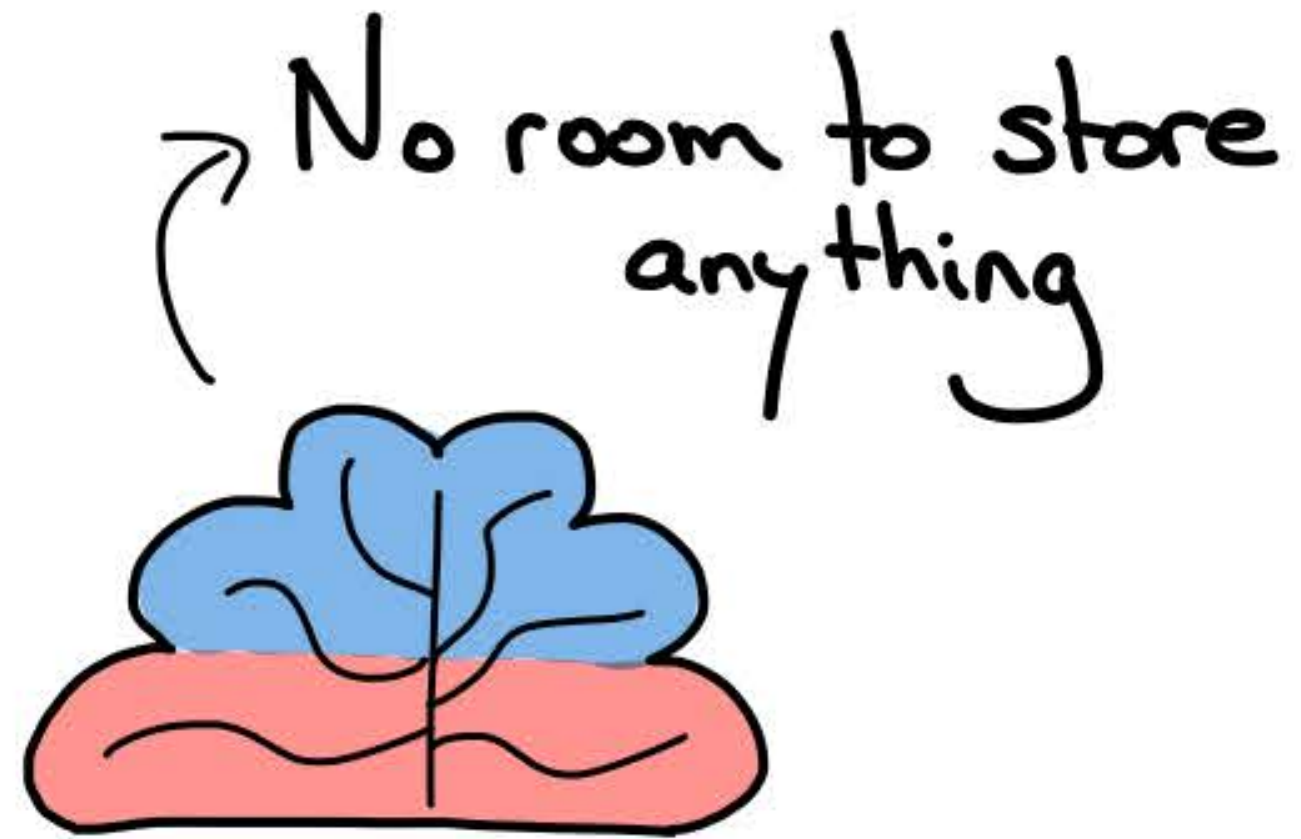


The use of worked
examples for Problem Solving

Sweller & Cooper

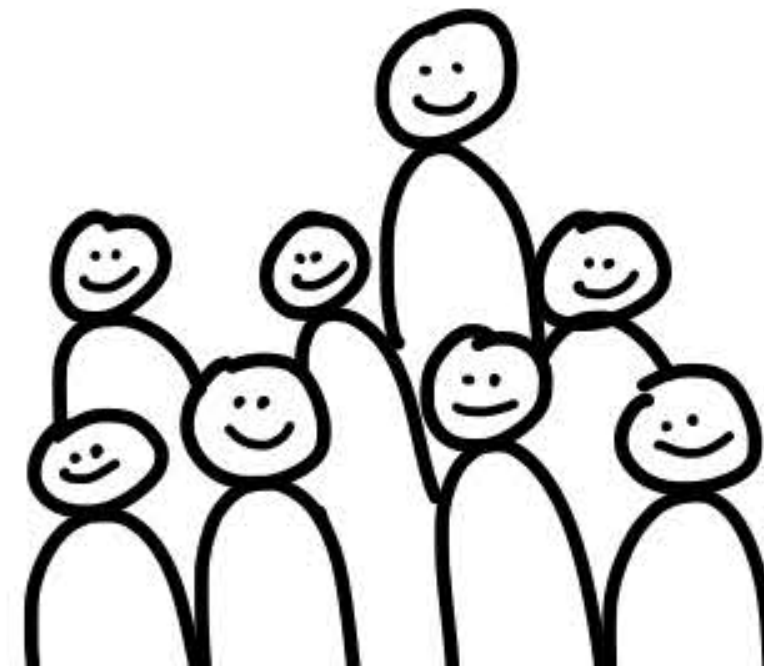
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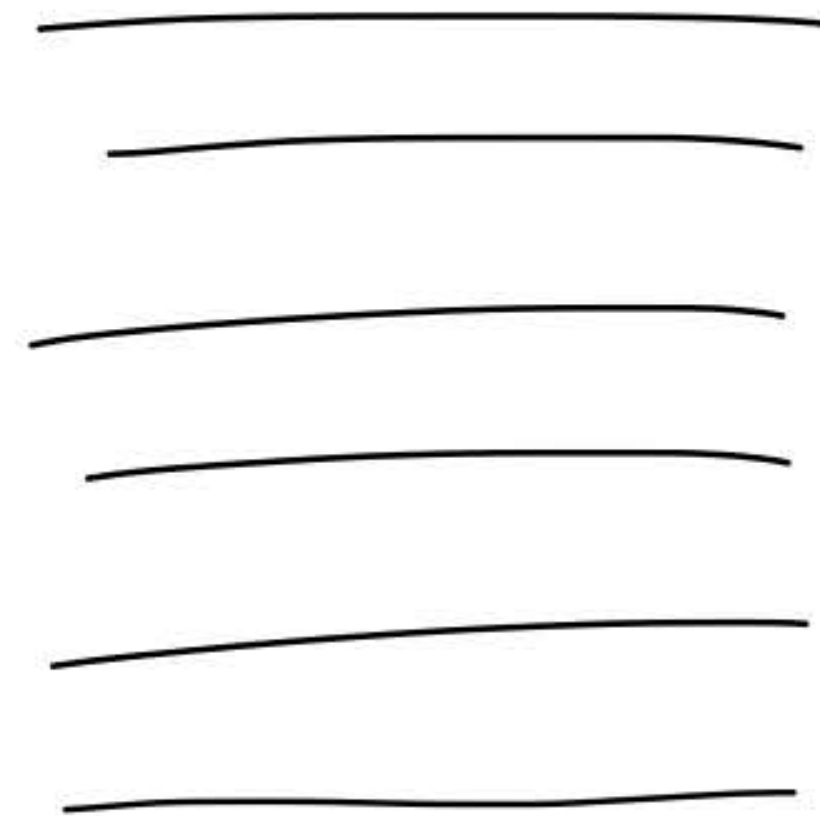
$a = 7 - 4a$
what is a ?

o
o
o



The use of worked
examples for Problem Solving

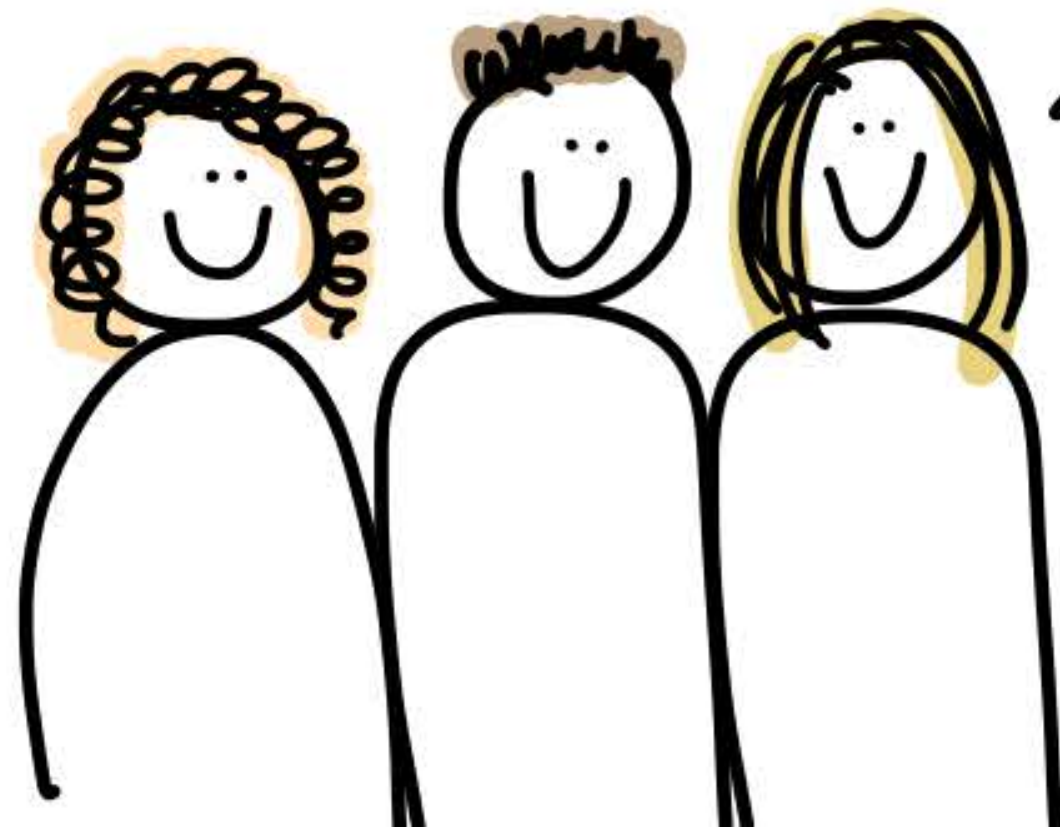
Sweller & Cooper



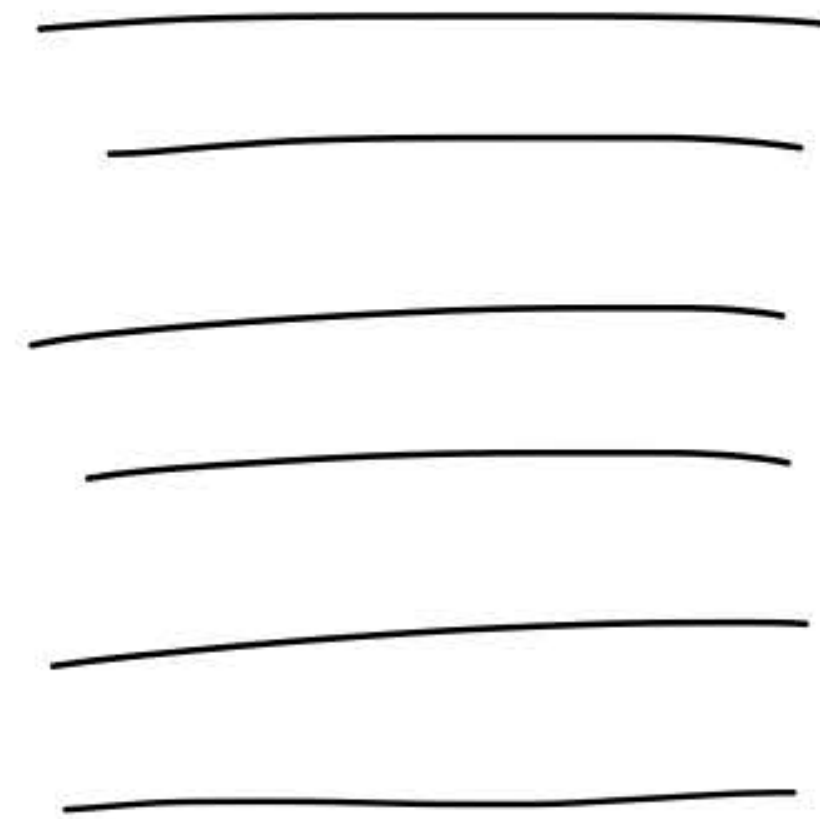
How to teach other things?



Phonics
Instruction / Explaining



Why minimal guidance
does not work
Kirschner et al.



How to teach other things?

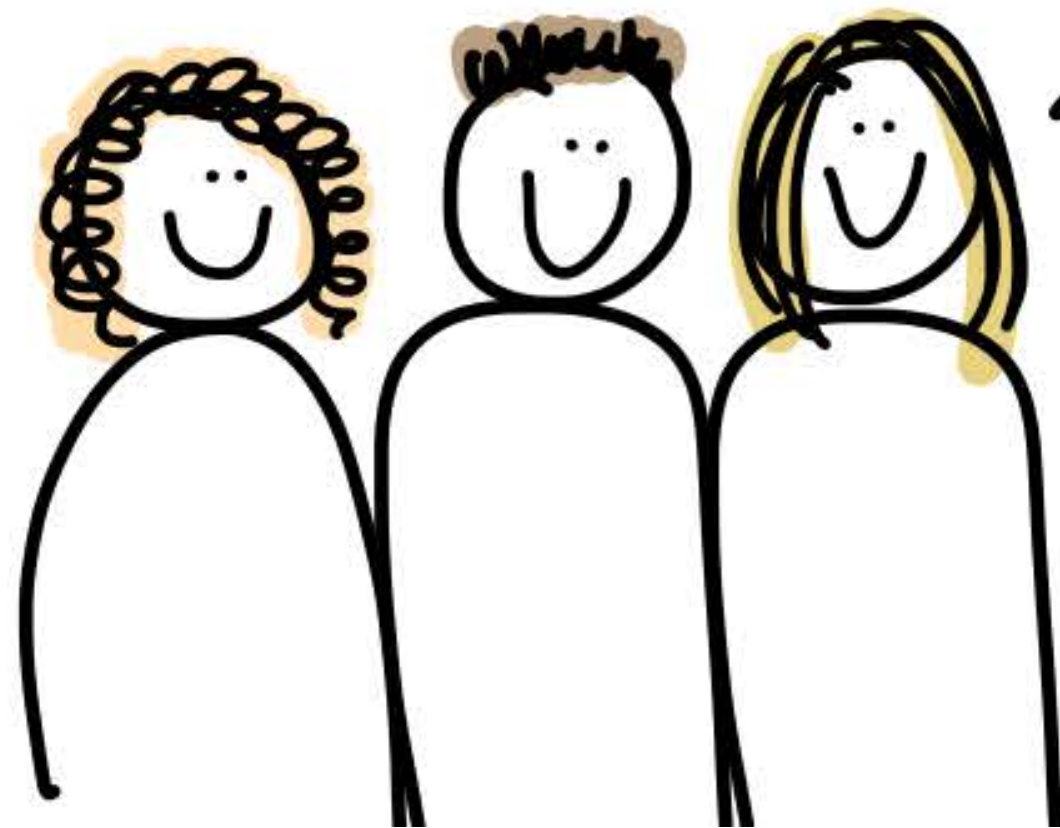
Lower
cognitive
load



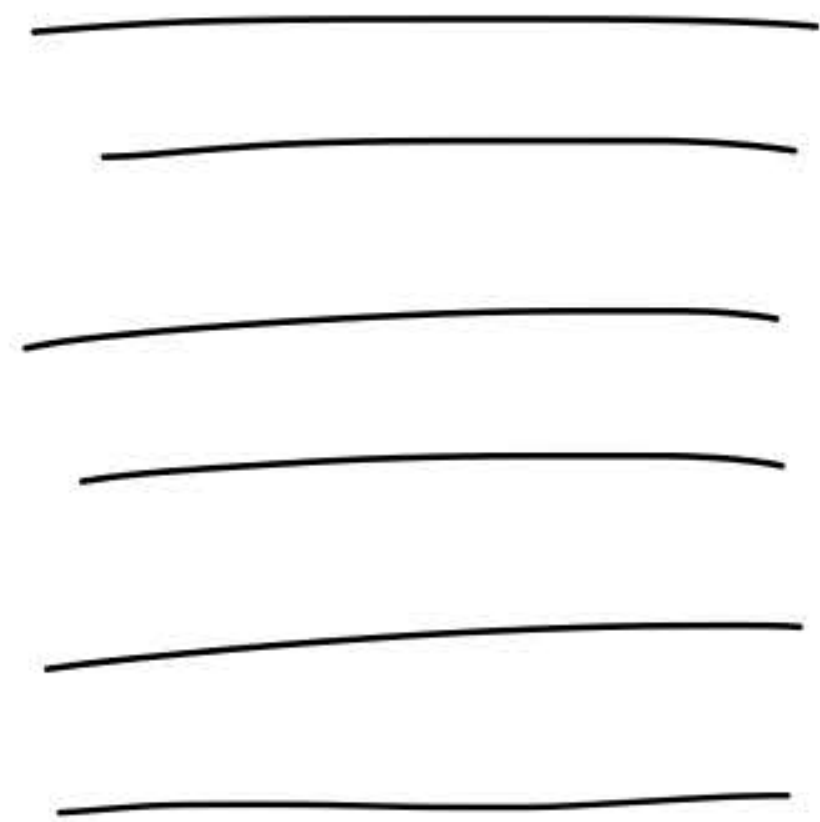
Phonics

Instruction

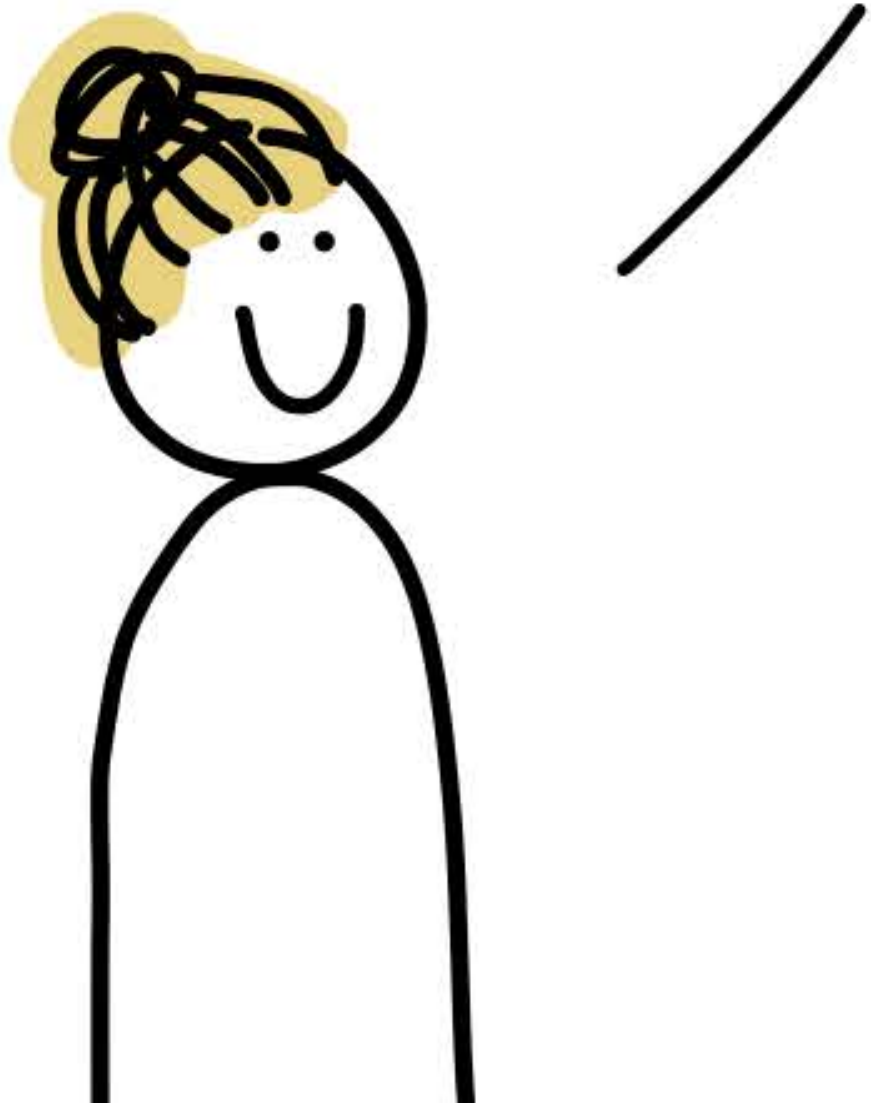
Explaining



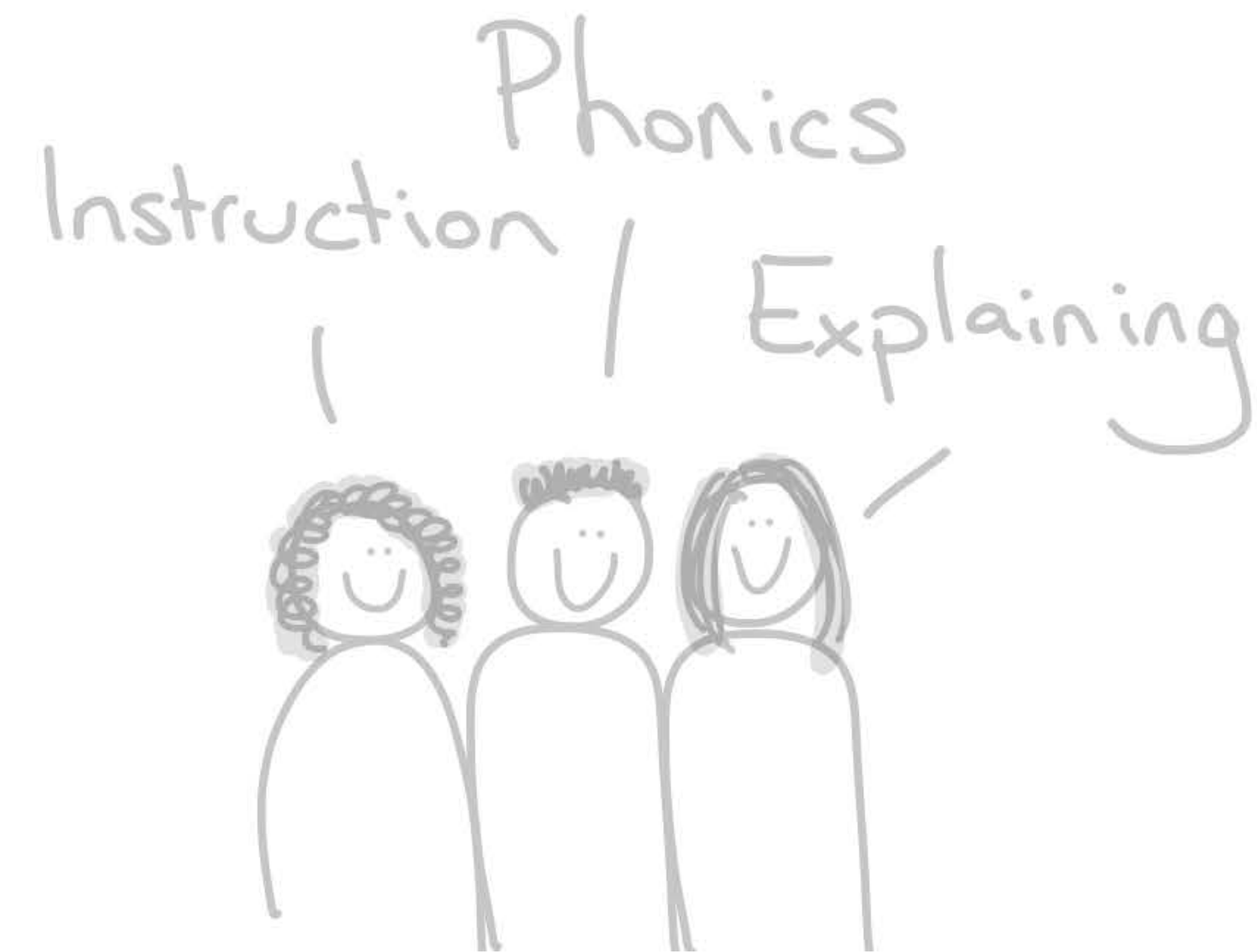
Why minimal guidance
does not work
Kirschner et al.



You don't become
an expert by
doing expert things

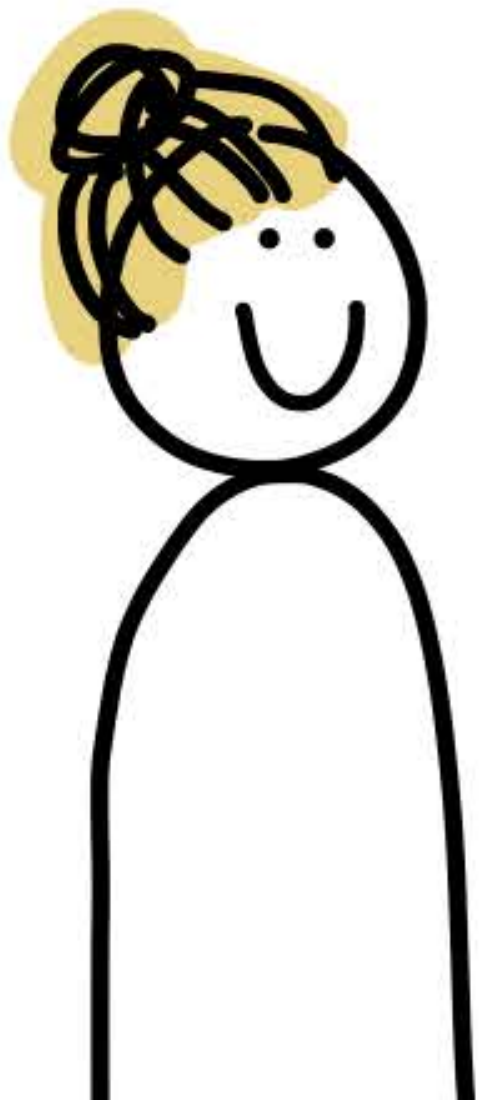


How to teach programming?



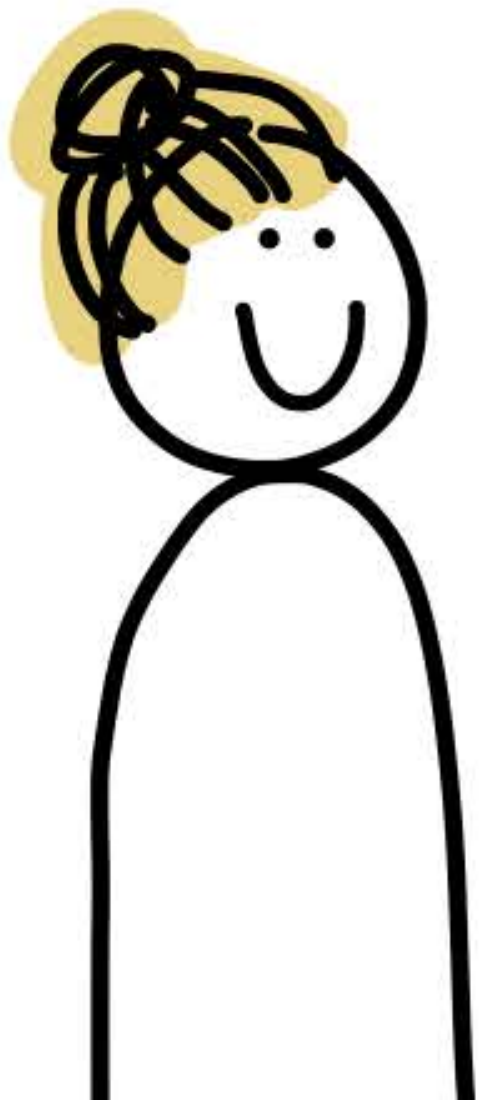
How to teach programming?

What would direct instruction
for programming look like?

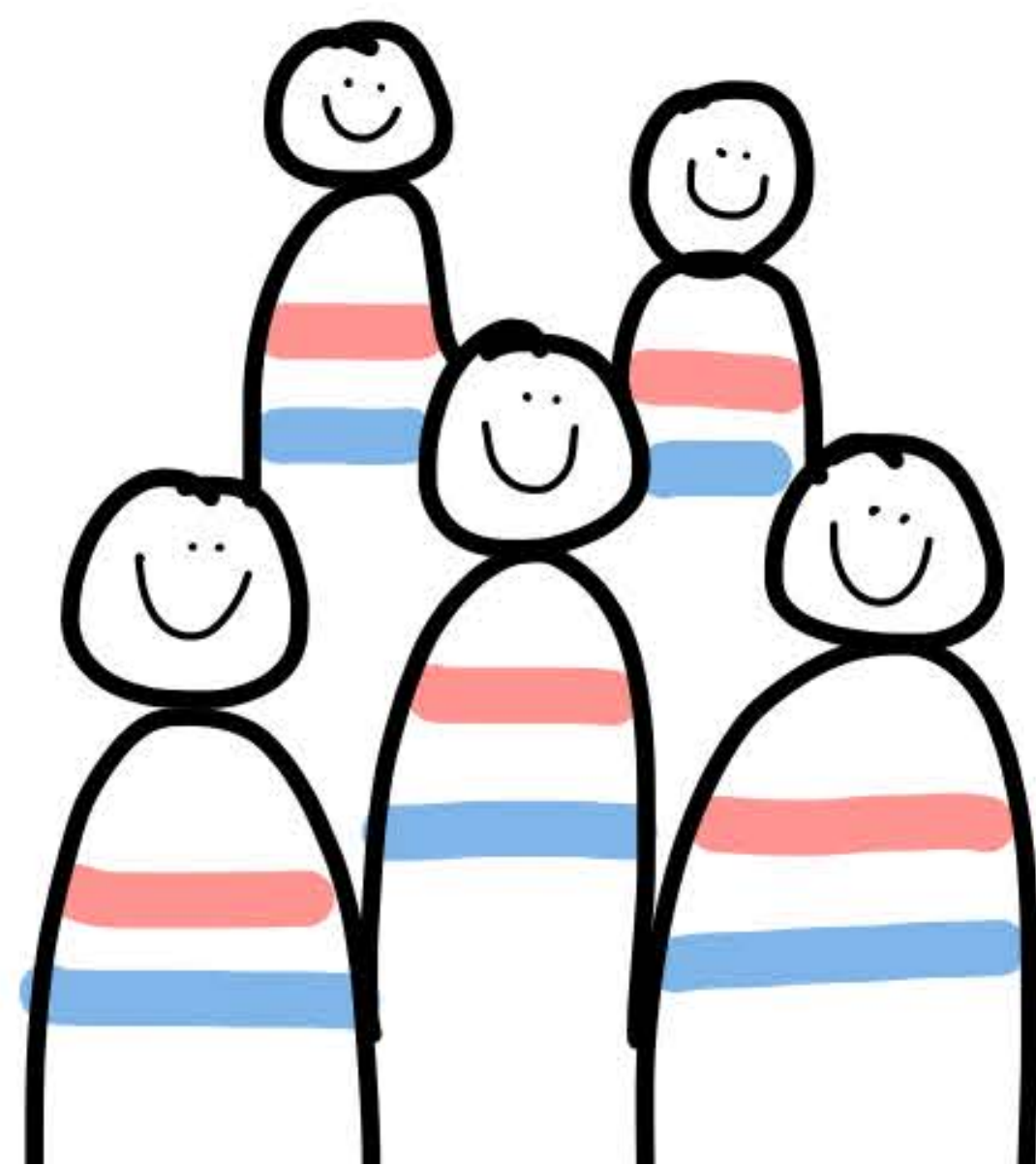


How to teach programming?

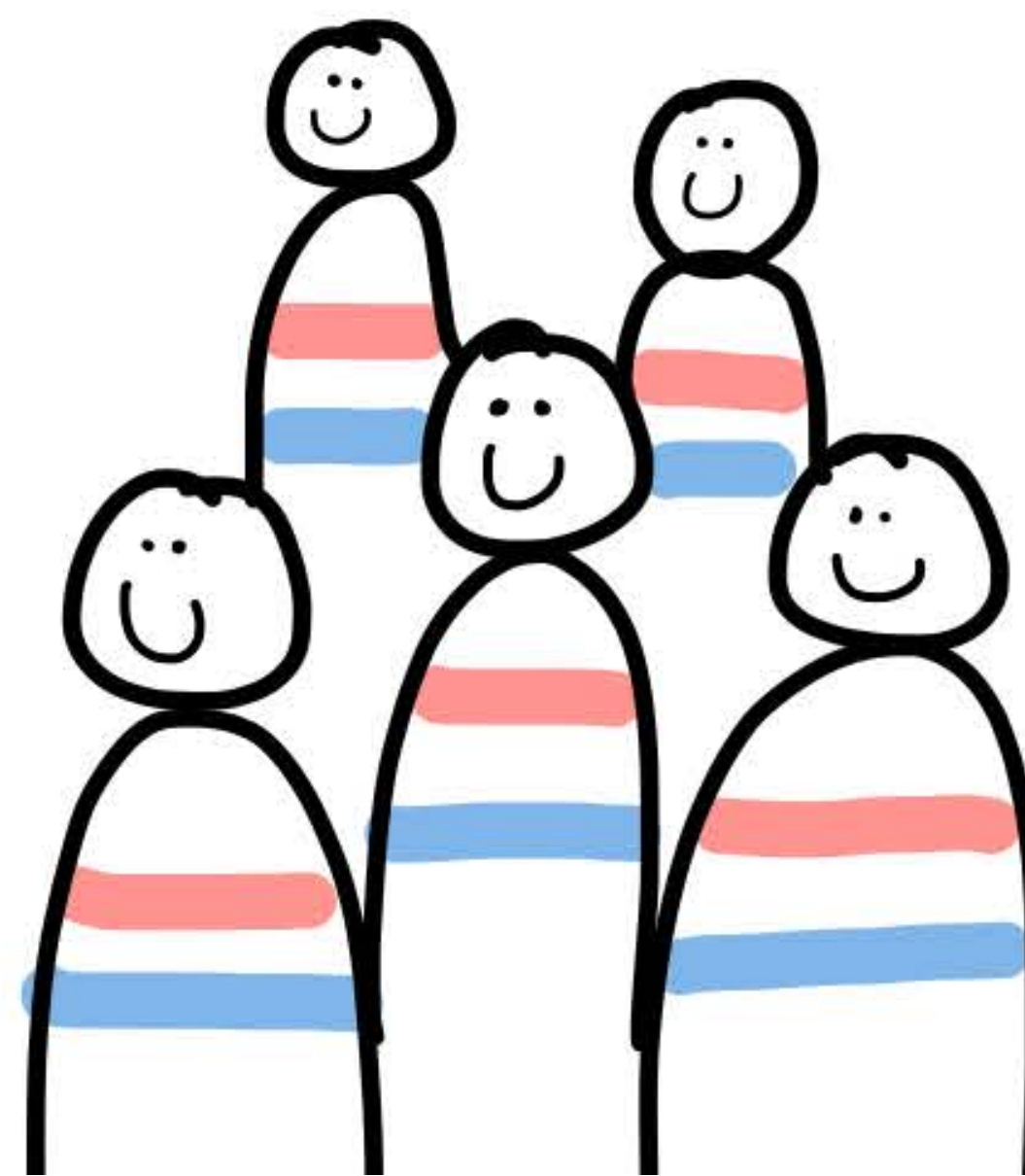
Vocalise syntax

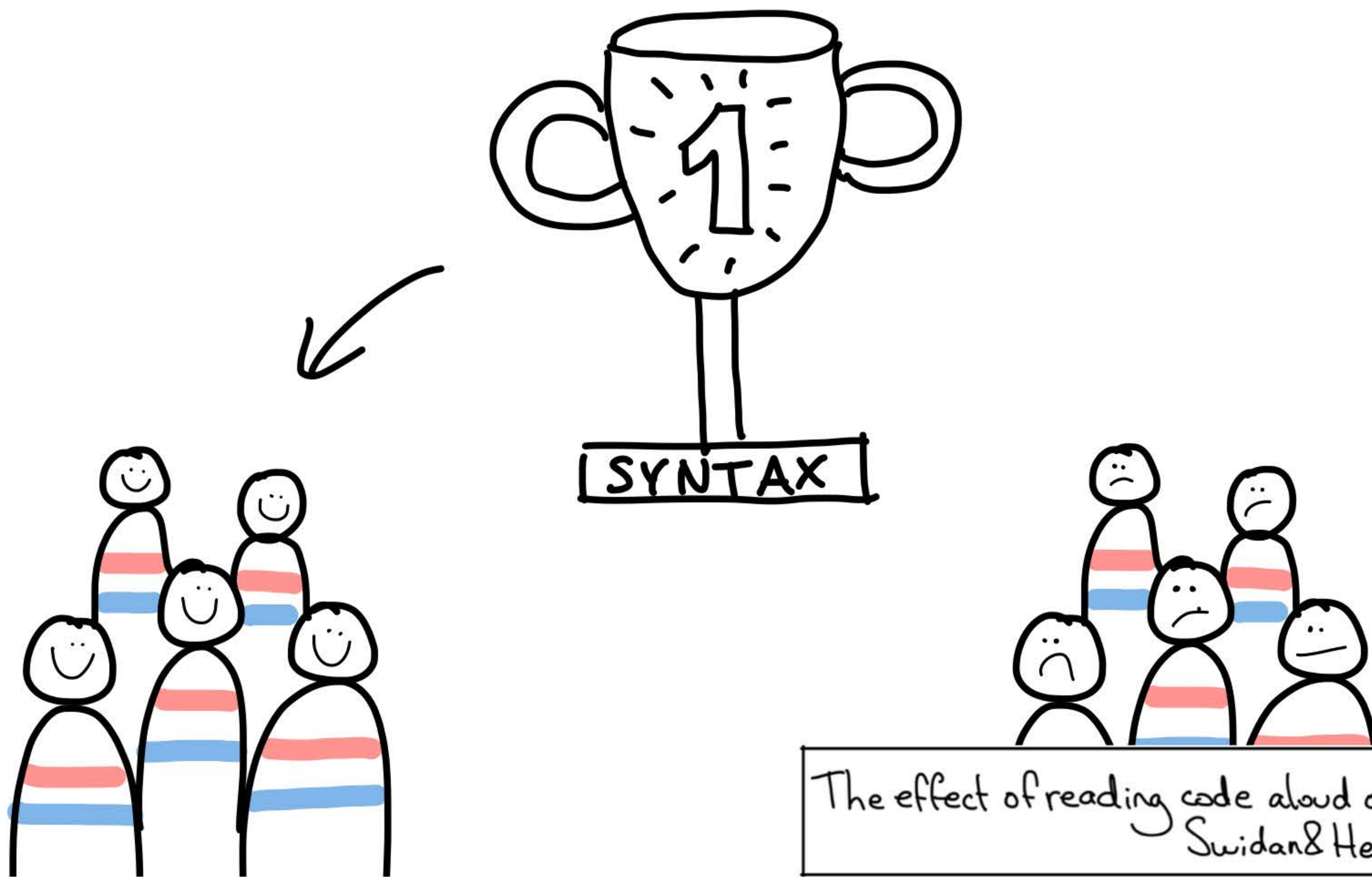


Read code aloud
every week



Control group

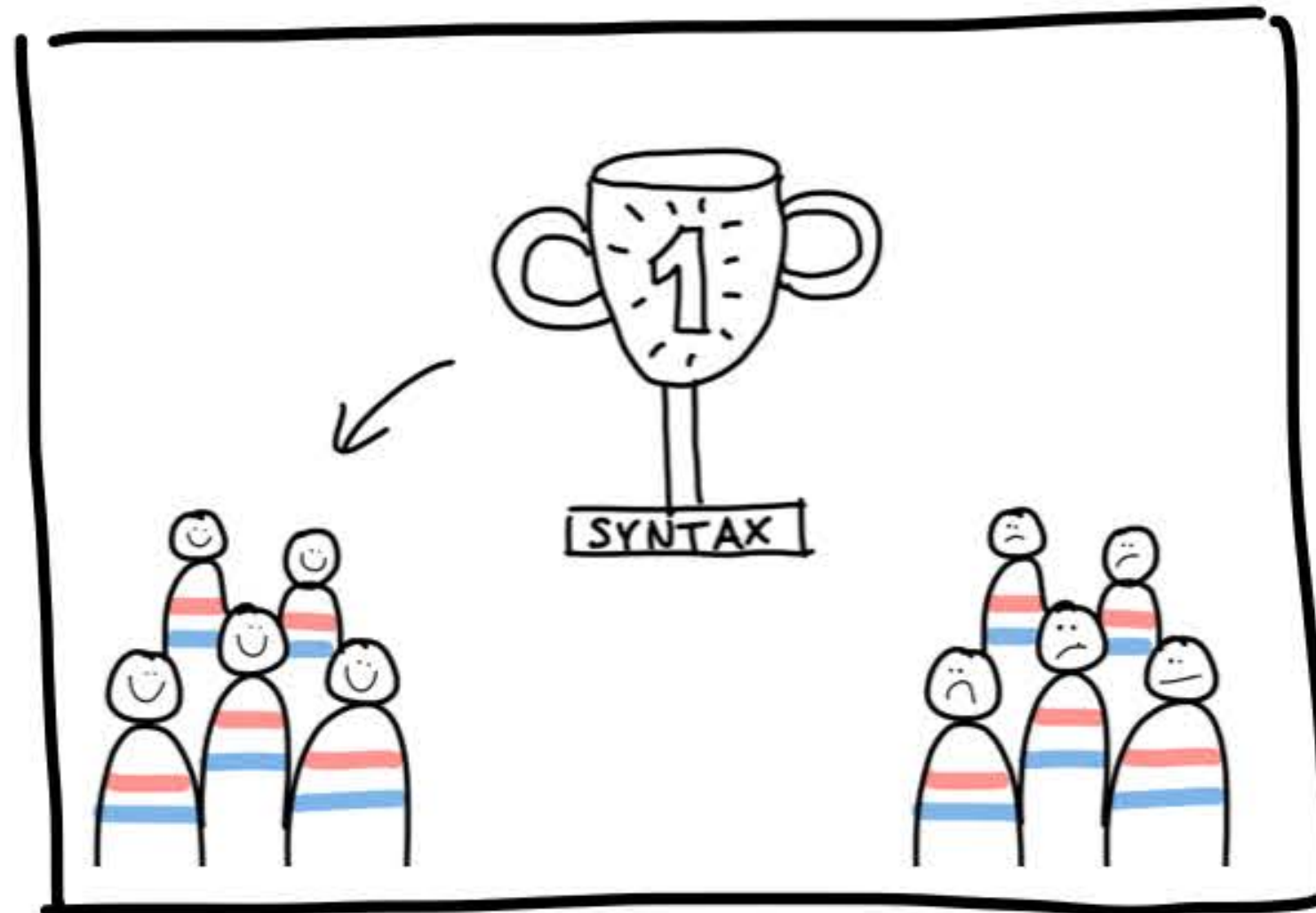
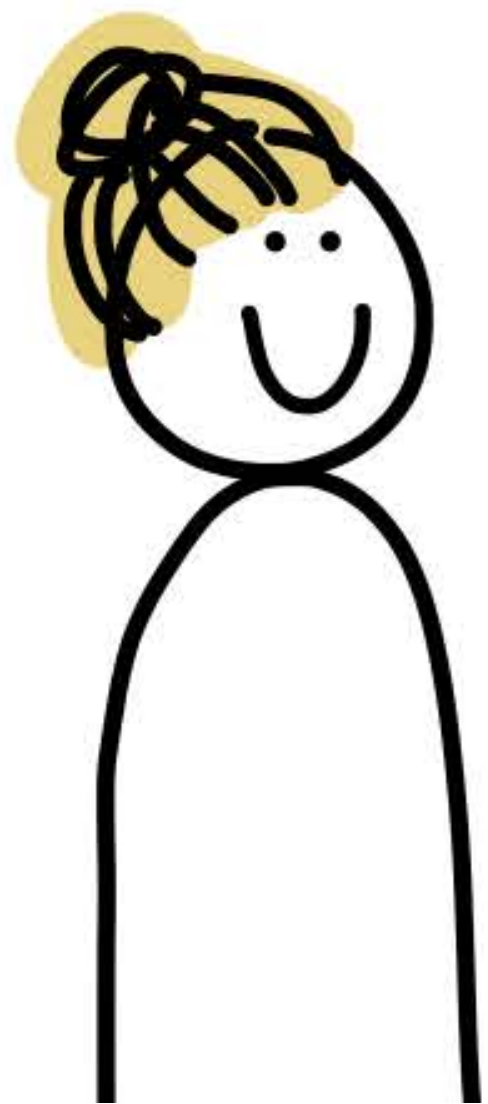




The effect of reading code aloud on comprehension
Swidan & Hermans 2019

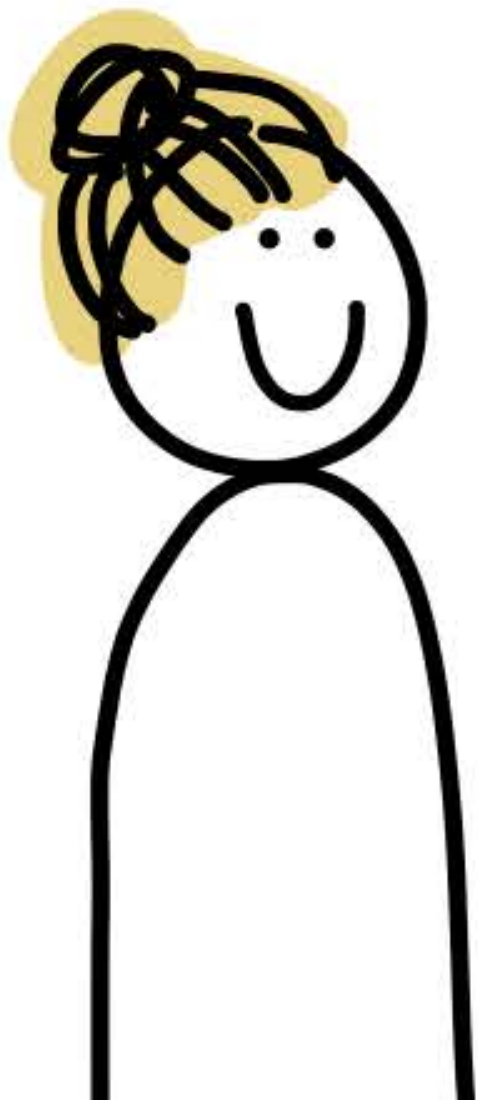
How to teach programming?

Vocalise syntax



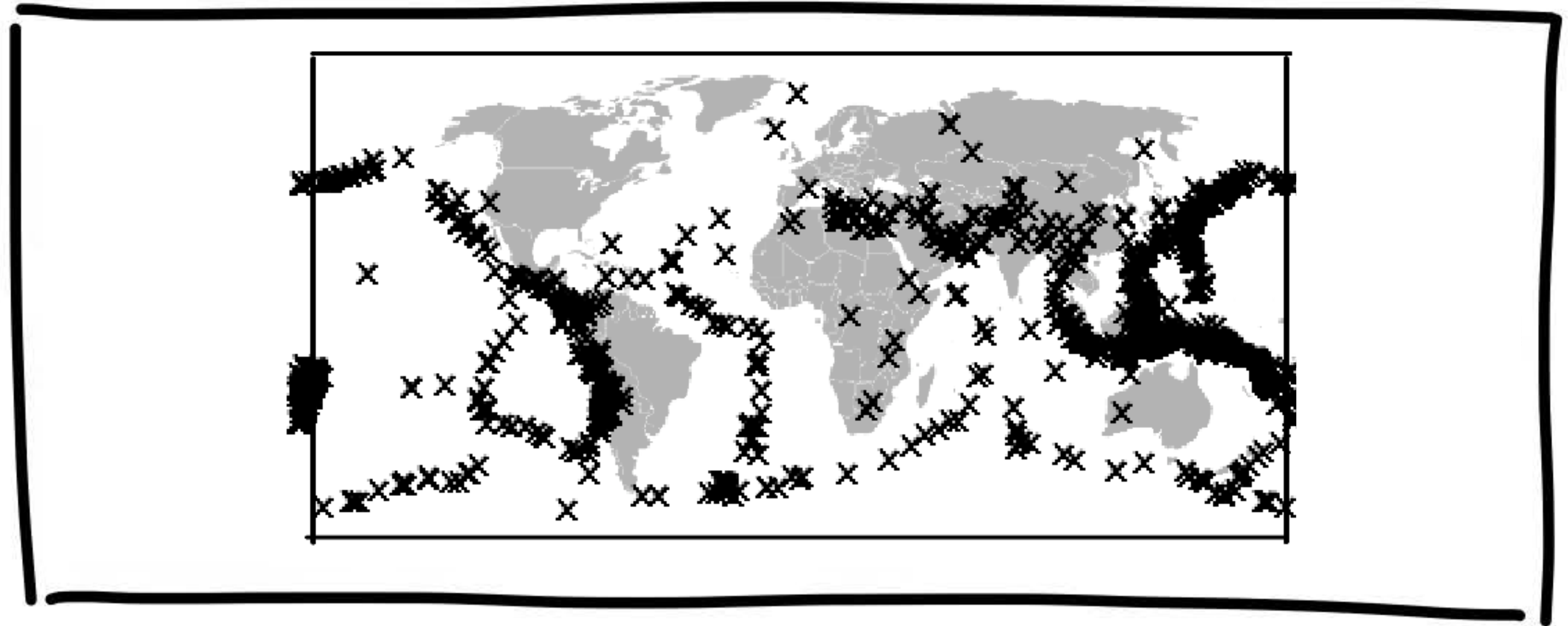
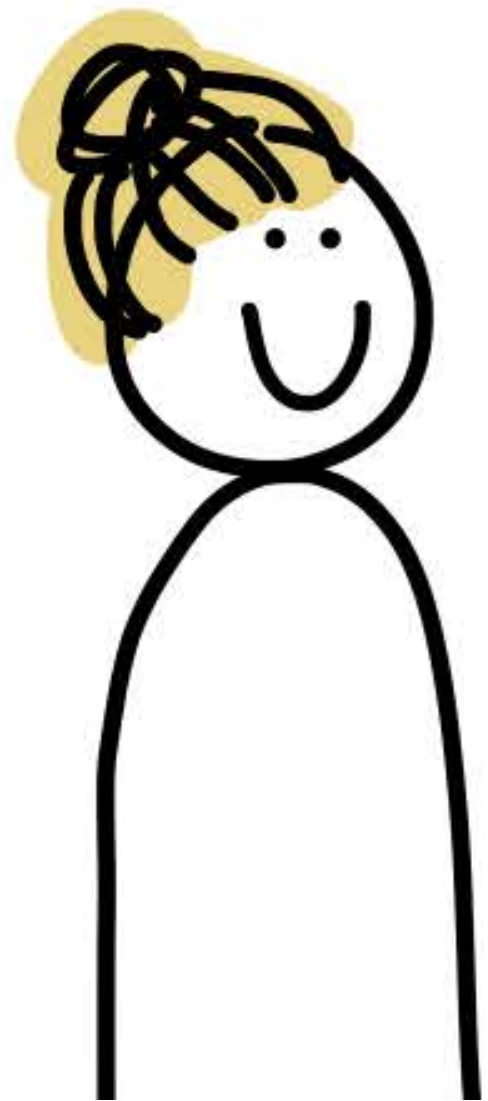
How to teach programming?

✓ Course integration



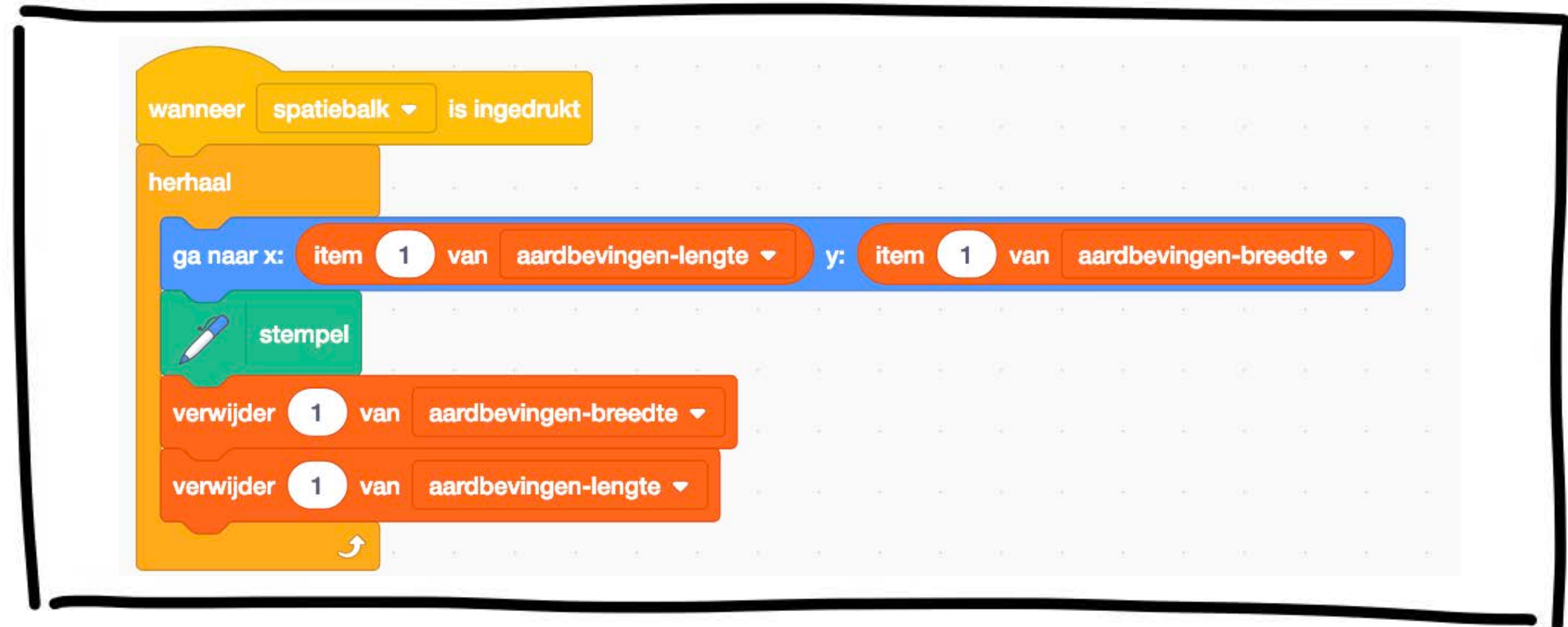
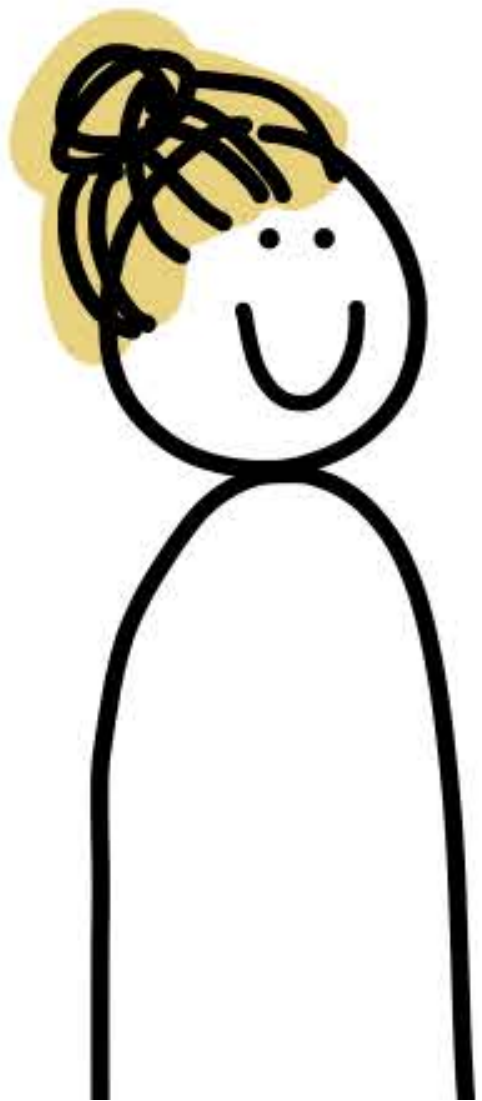
How to teach programming?

Course integration



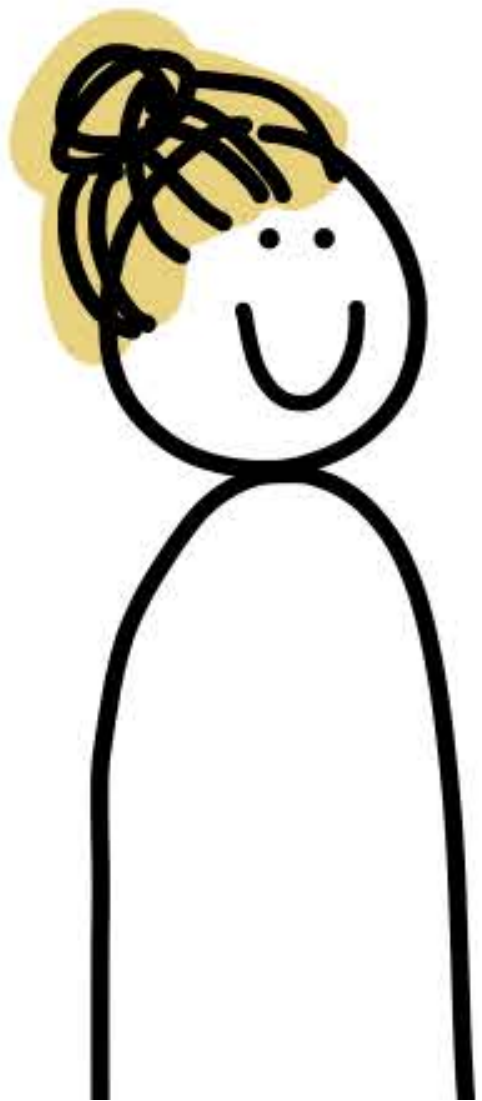
How to teach programming?

Course integration



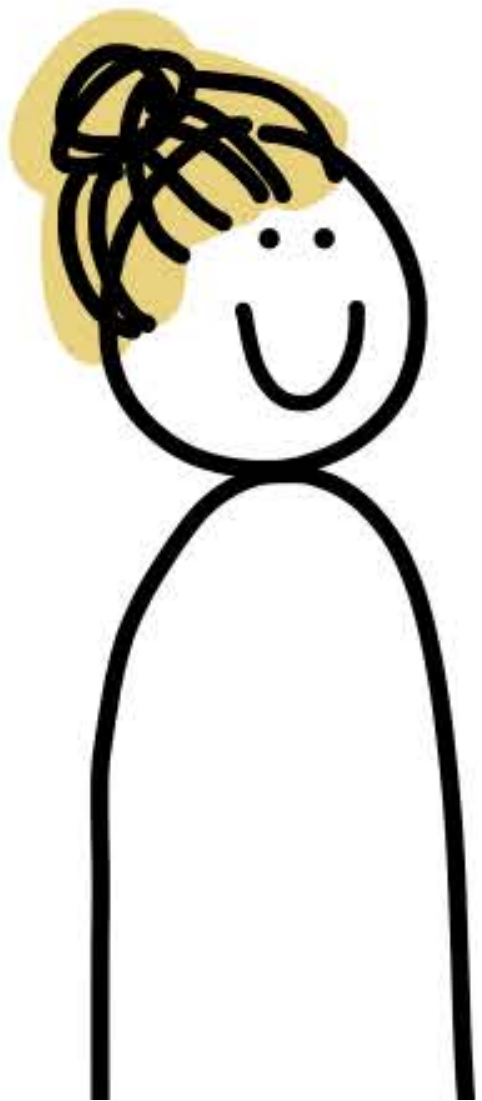
How to teach programming?

Explicit strategies



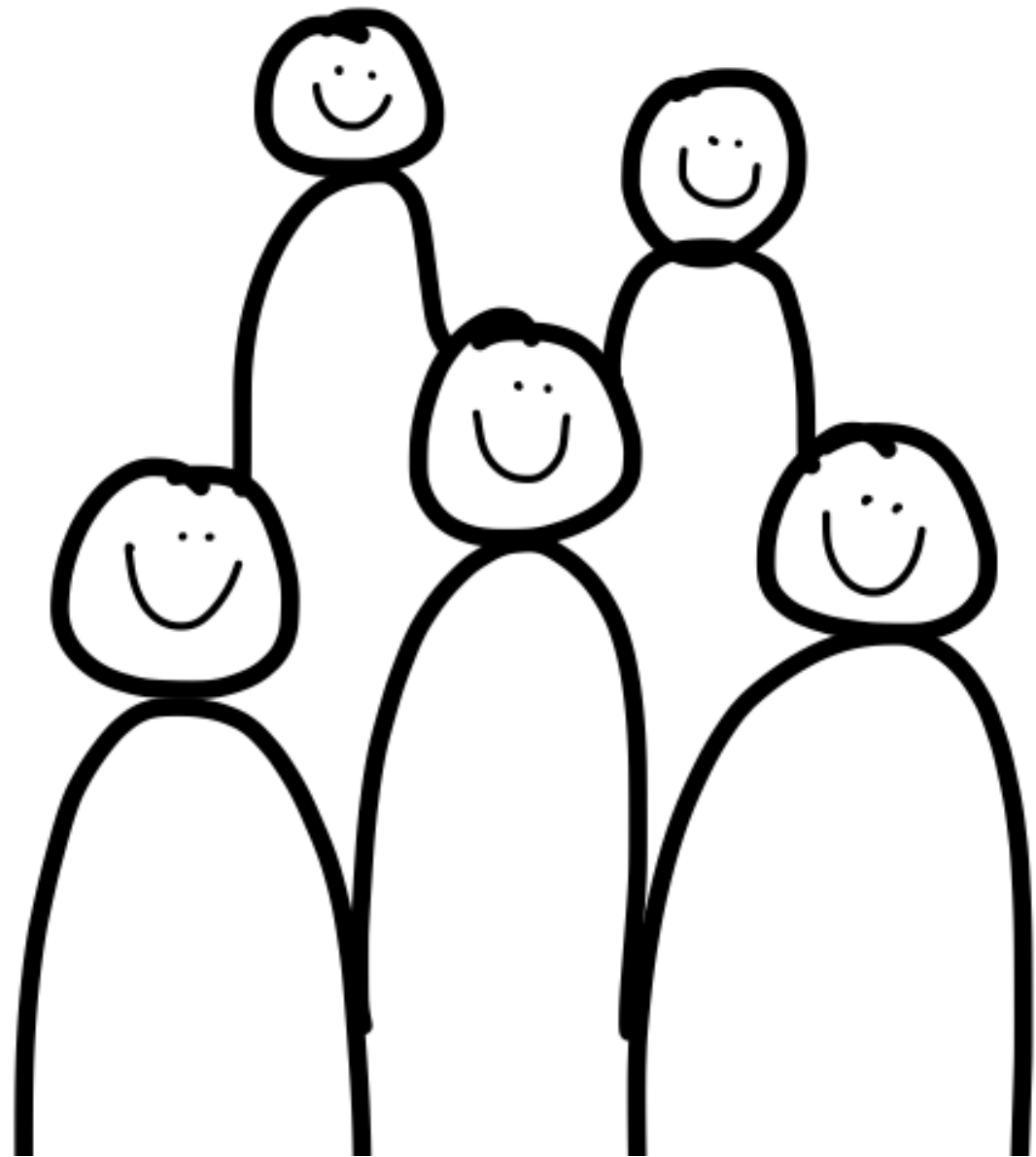
How to teach programming?

Explicit strategies

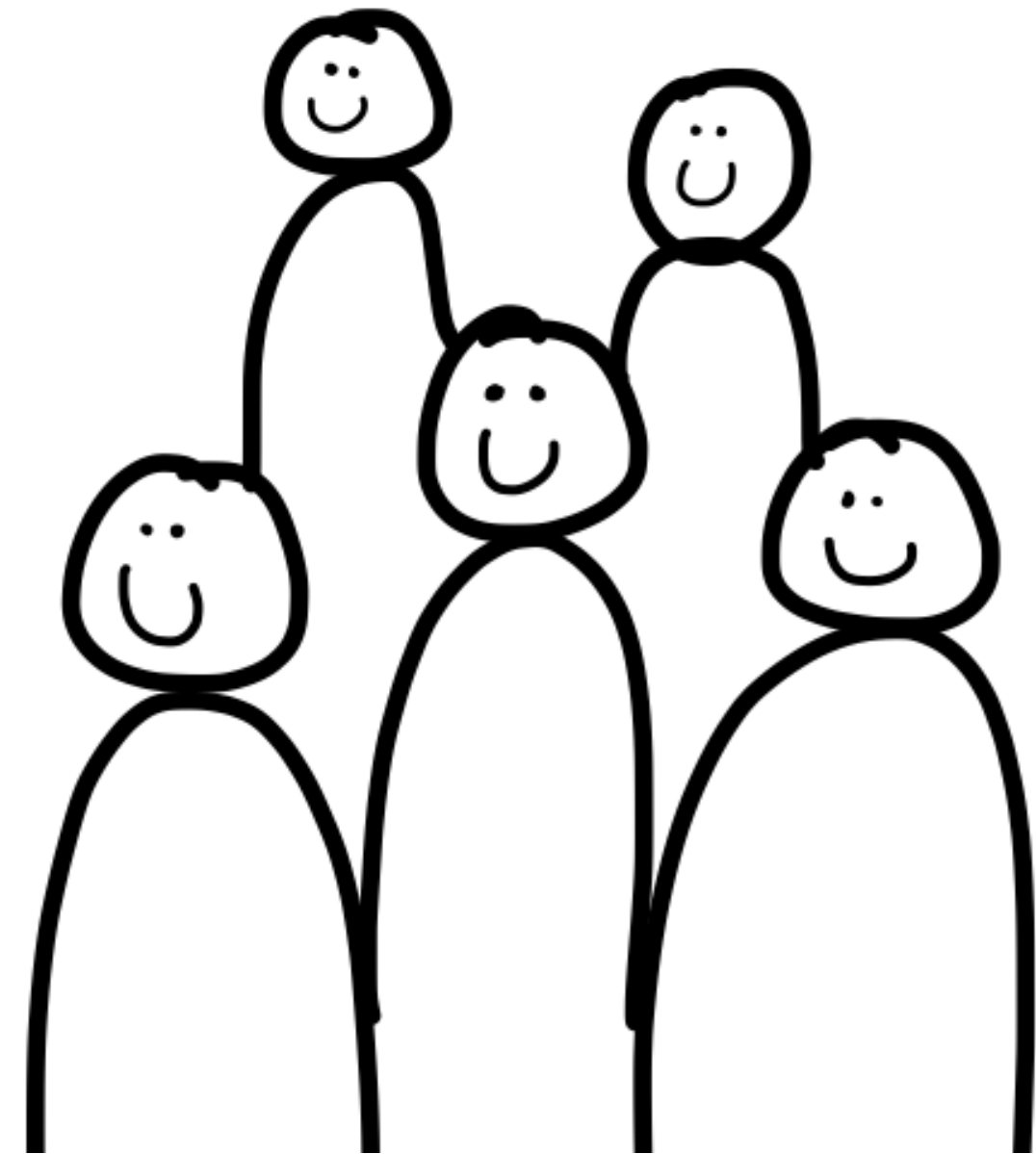


Item	Strategy
GLOB1	Setting a purpose for reading
GLOB3	Using prior knowledge
GLOB4	Previewing text before reading in detail
GLOB7	Evaluating how text contents fits reading purpose
GLOB10	Skimming the text before reading to see length and organisation
GLOB14	Skipping parts of text though unimportant
GLOB17	Using text features, e.g.: tables, figures, and pictures for better understanding
GLOB19	Using context clues to help better understanding

Training in strategies
every week

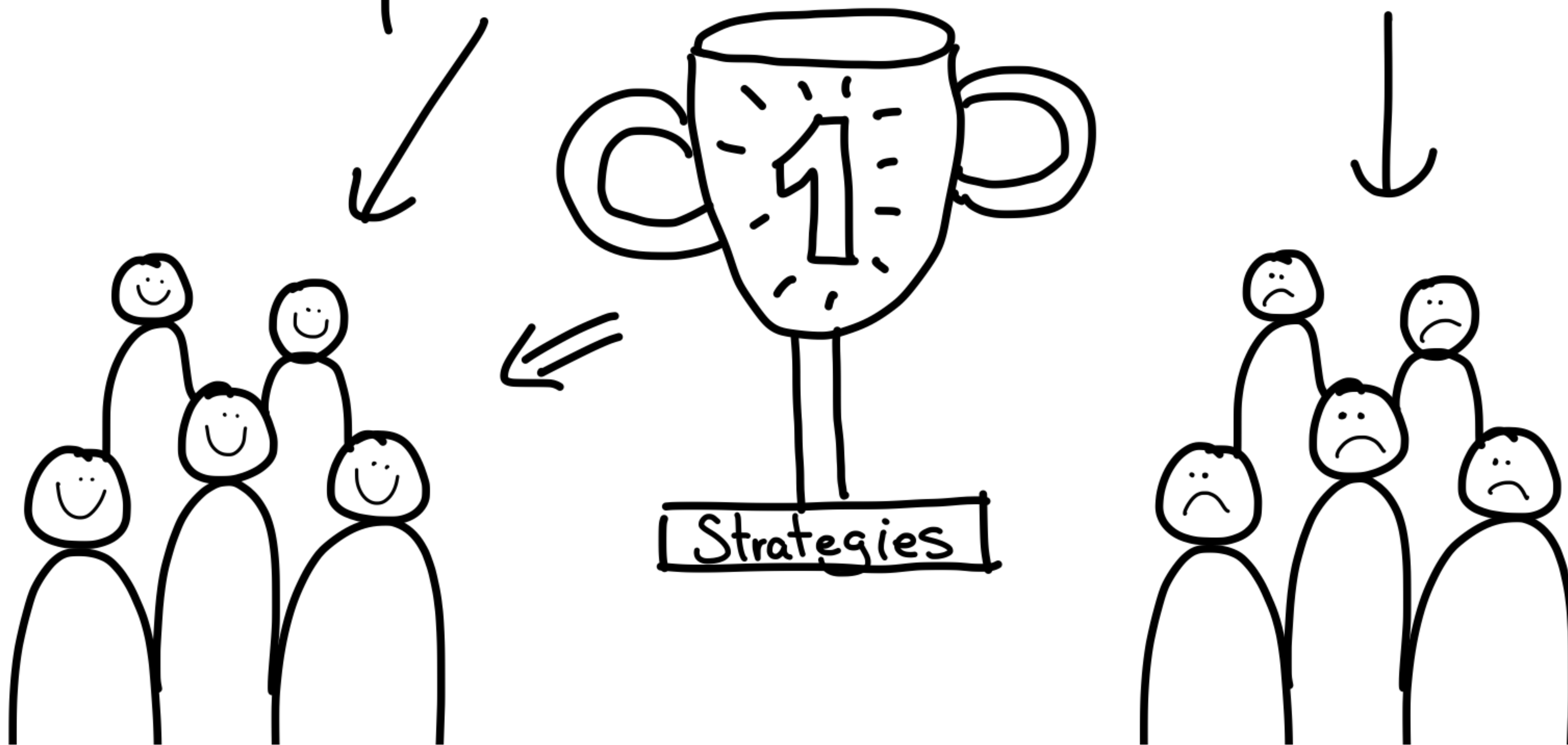


Control group



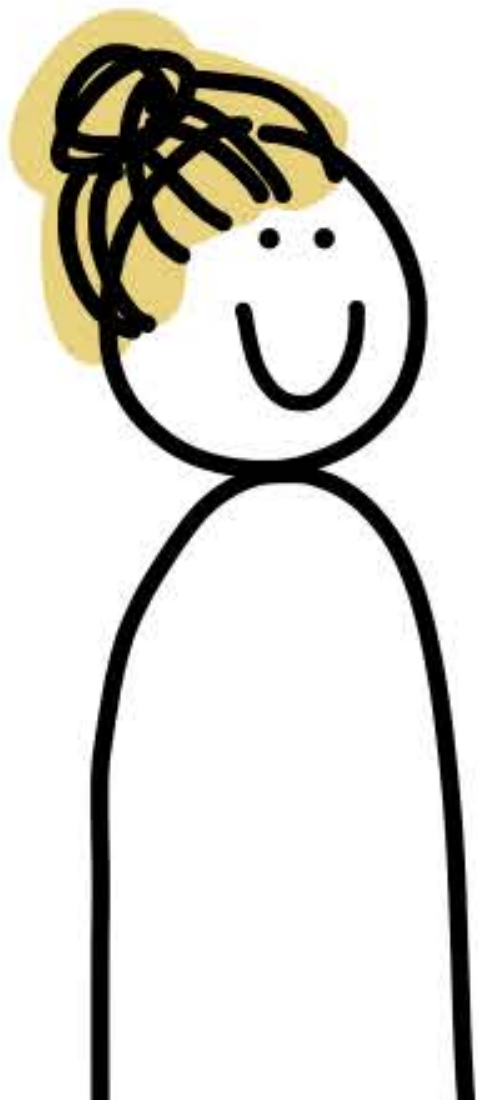
Training in strategies
every week

Control group



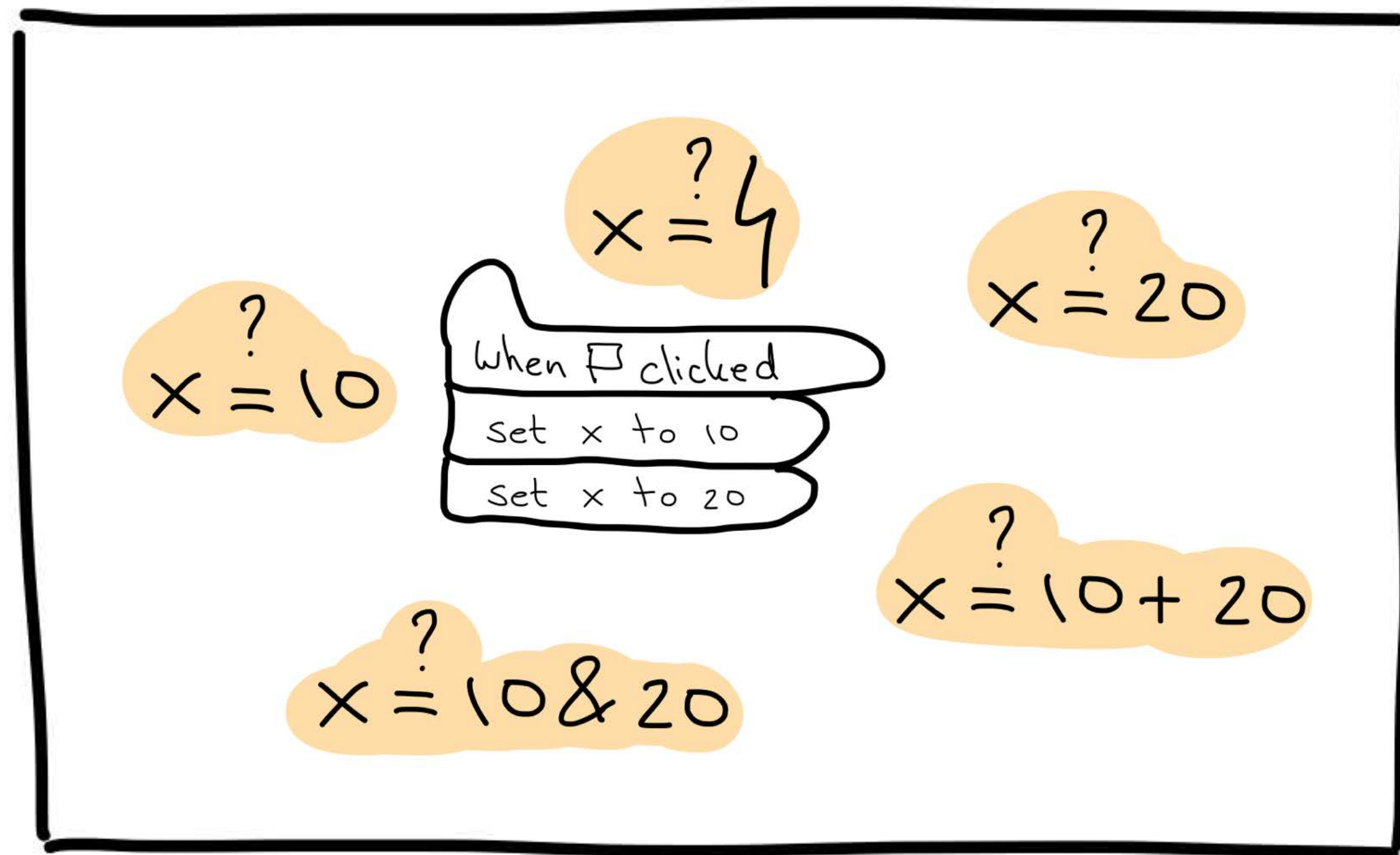
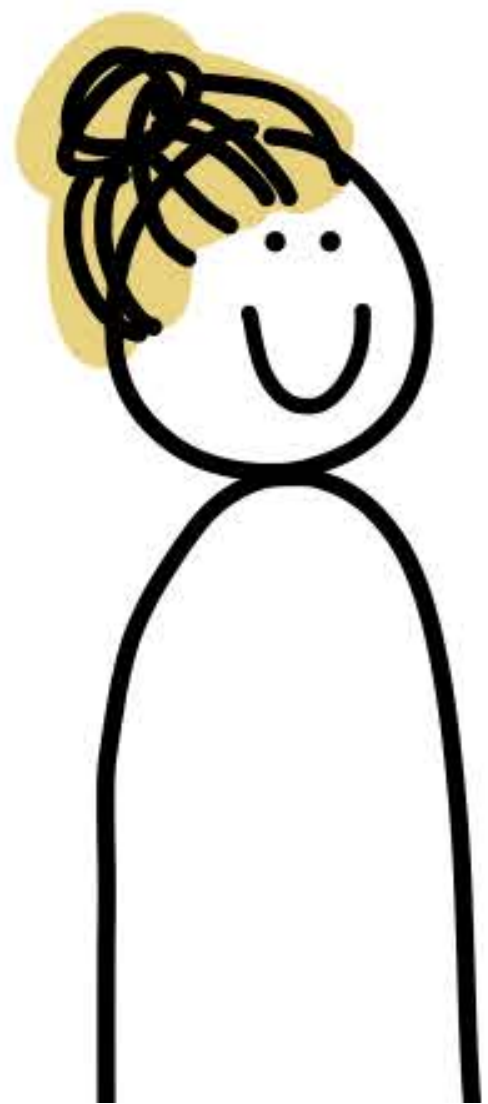
How to teach programming?

Misconceptions



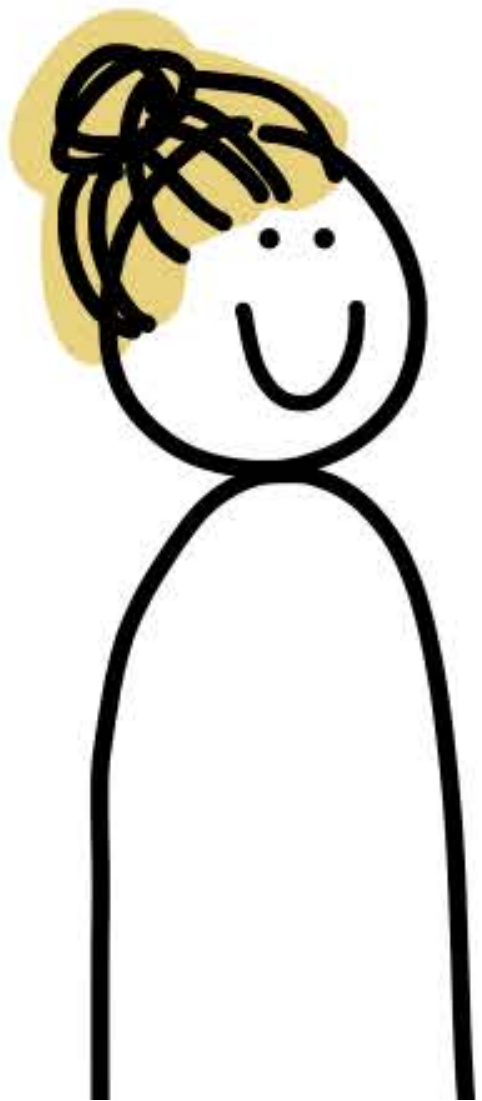
How to teach programming?

Misconceptions



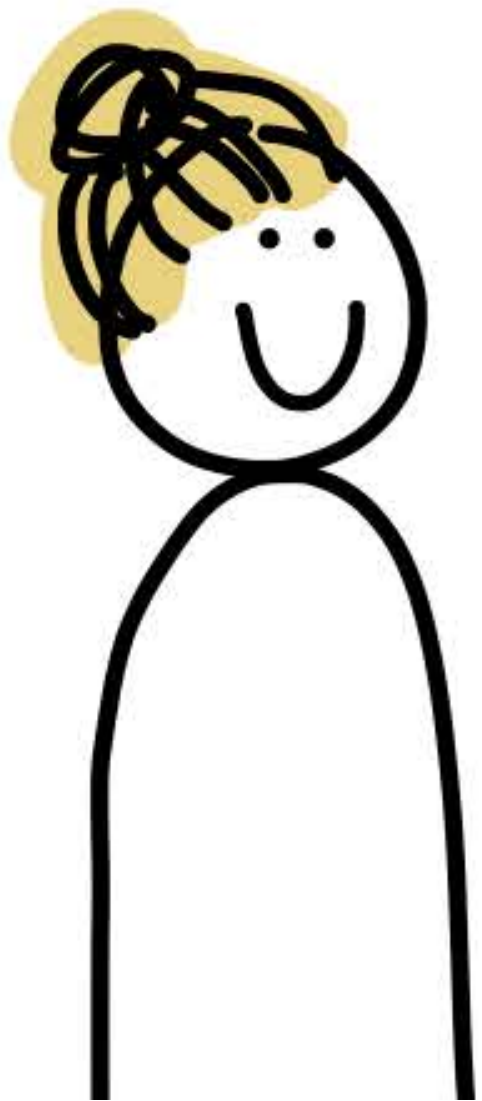
How to teach programming?

Assessment



How to teach programming?

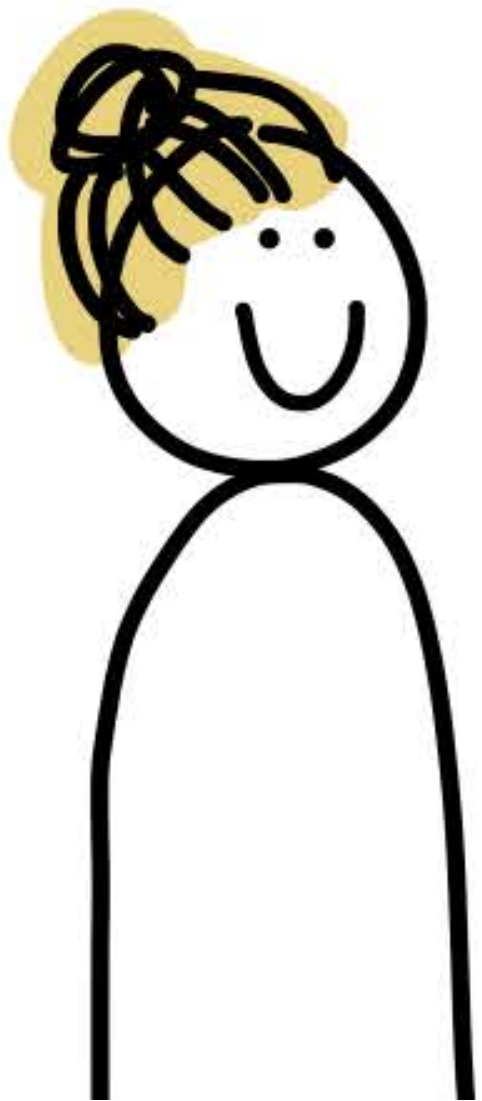
Assessment



Goed of fout?

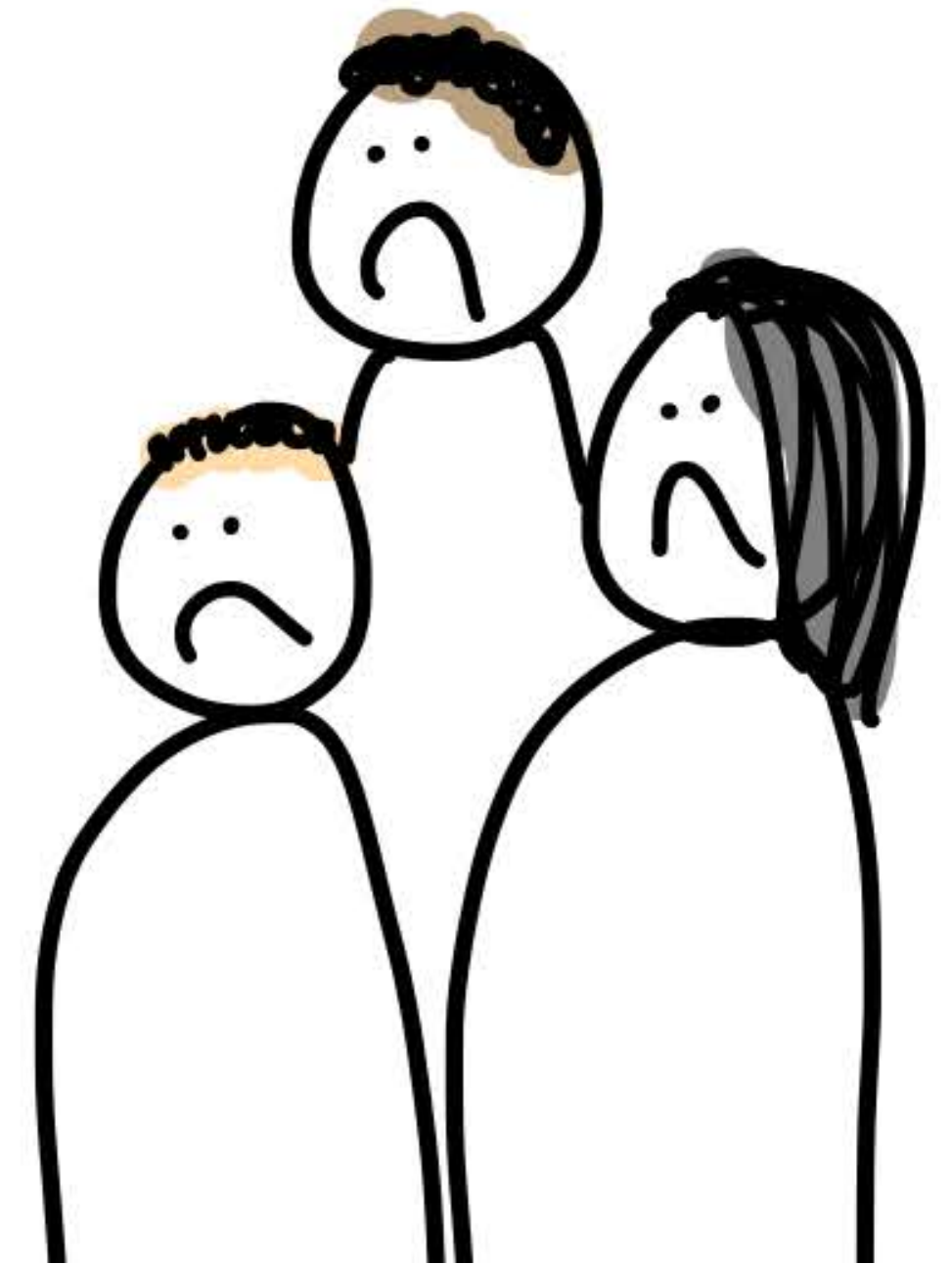
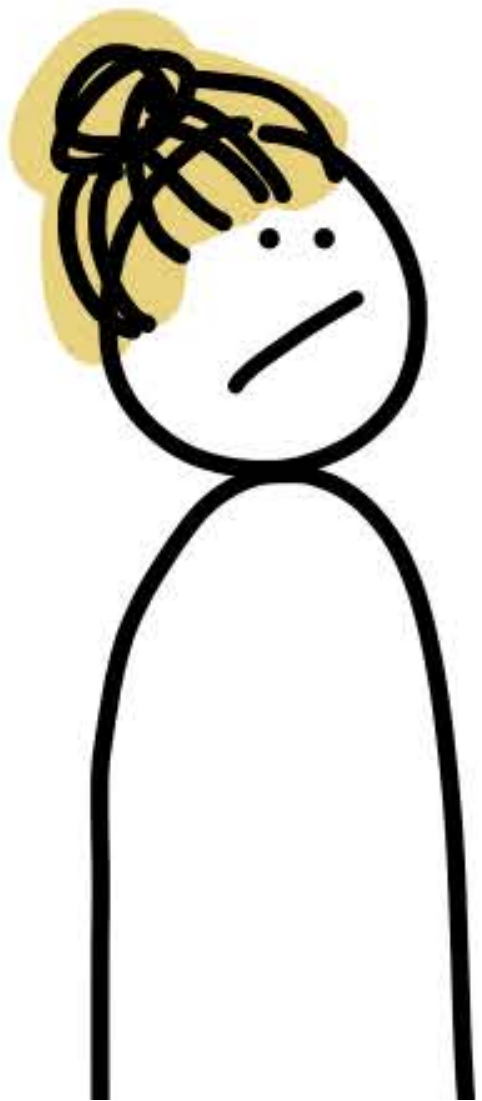
1. `hobbies = ['dansen', 'voetballen', 'zingen']`
`print('Zullen', 'we', 'gaan', hobbies[1], 'morgen')`
2. `namen = ['Jan', 'Robin', 'Samir']`
`print('Mijn', 'beste', 'vriend', 'heet', namen[0])`
3. `talen = ['Python', 'JavaScript', 'HTML']`
`print('De', 'beste', 'programmeertaal', 'is', taal[1])`

How to teach programming?



How to teach programming?

That doesn't
seem fun!

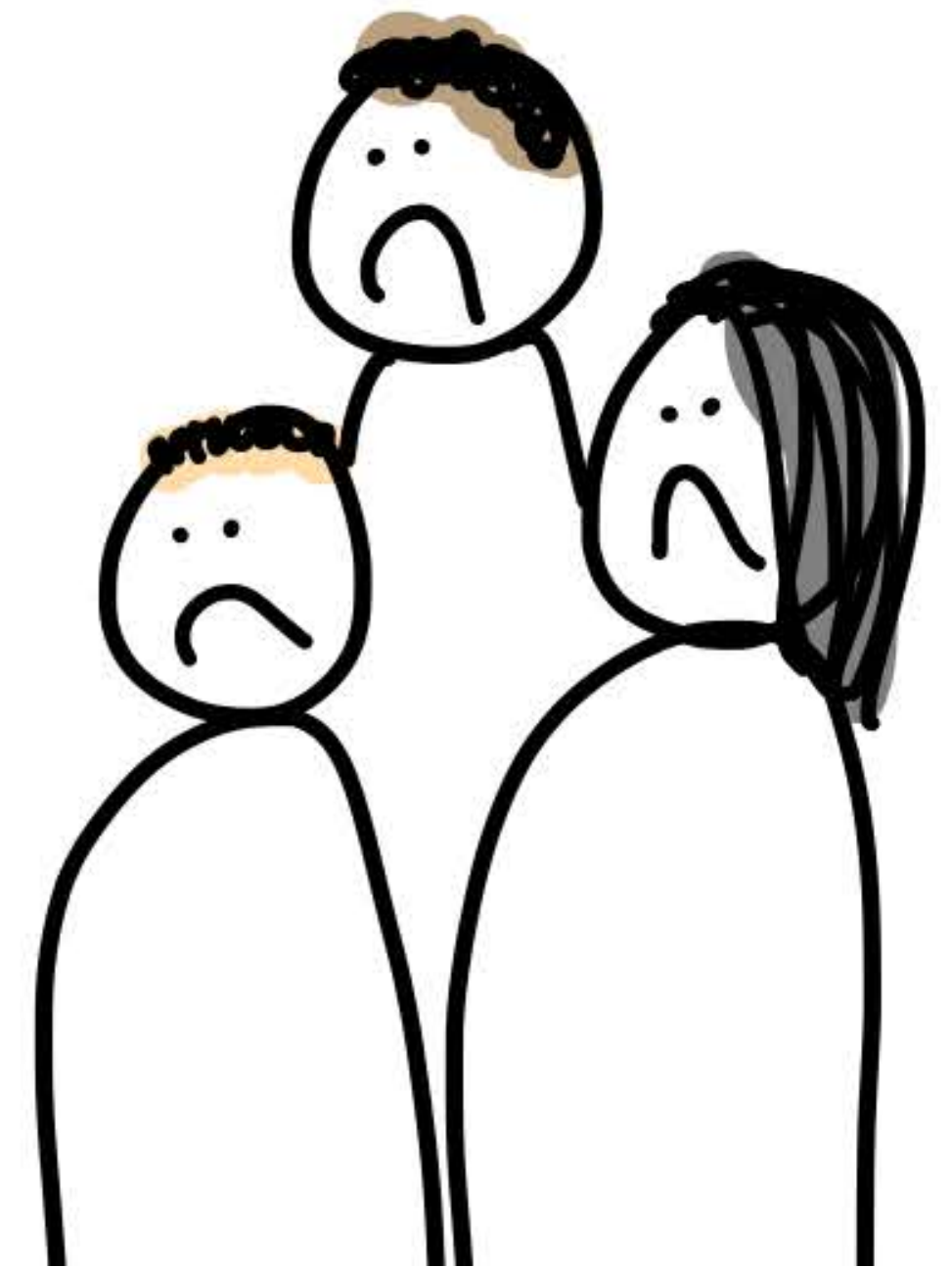


How to teach programming?

That doesn't
matter!



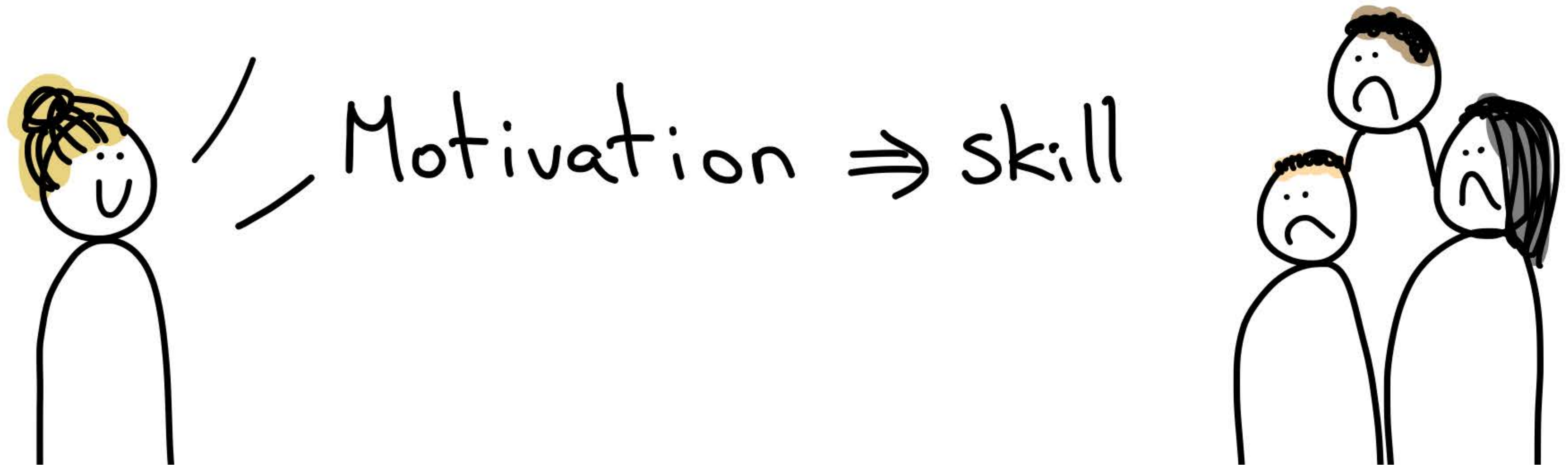
That doesn't
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How to teach programming?

That doesn't
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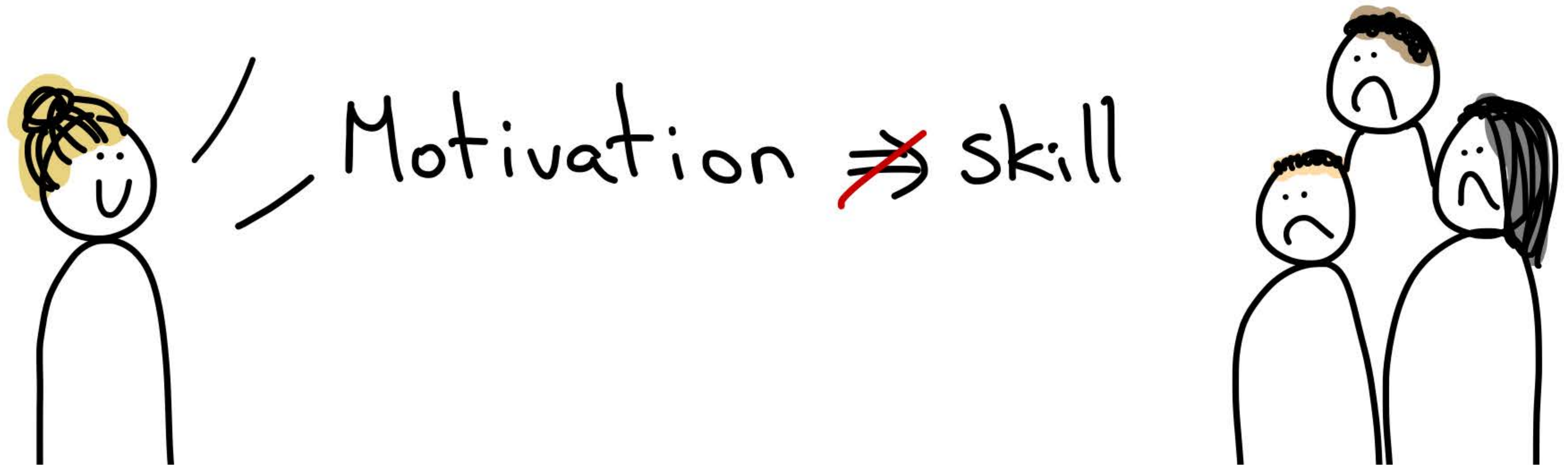
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How to teach programming?

That doesn't
matter!

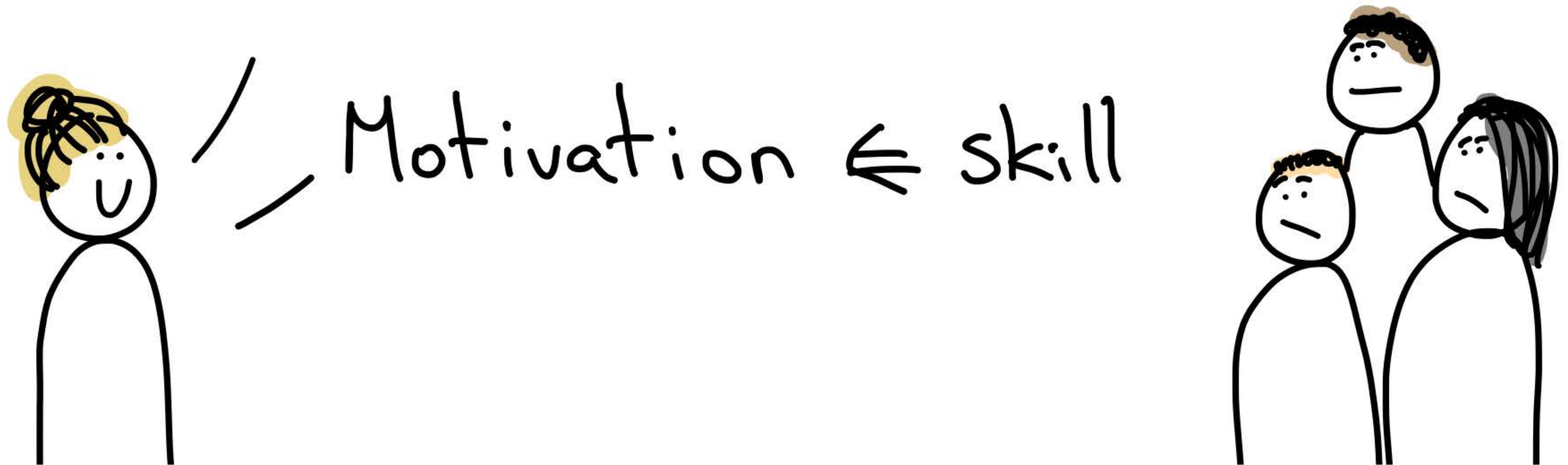
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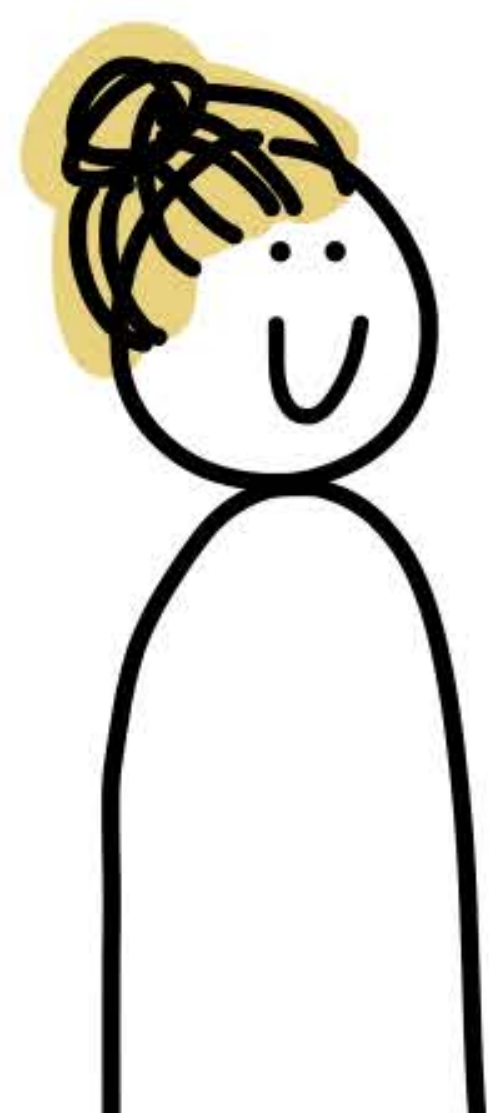
How to teach programming?

That doesn't
matter!

That doesn't
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THE END



Explicit Direct Instruction in Programming Education

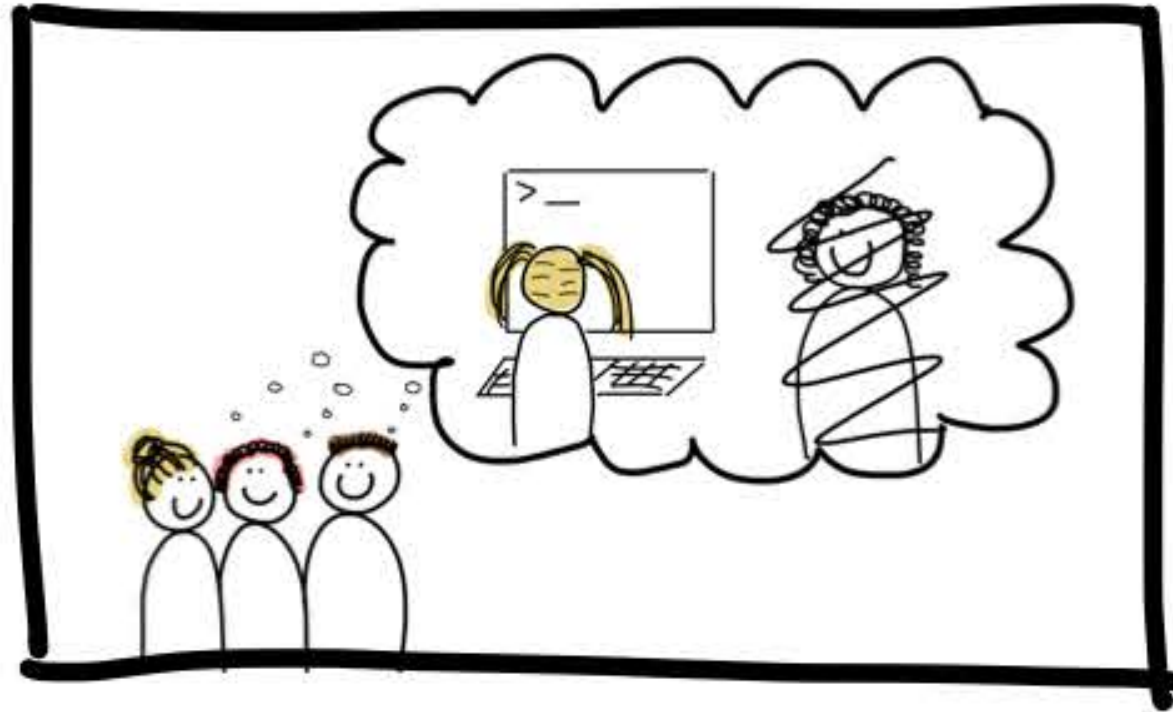


@Felicie

Explicit Direct Instruction in Programming Education



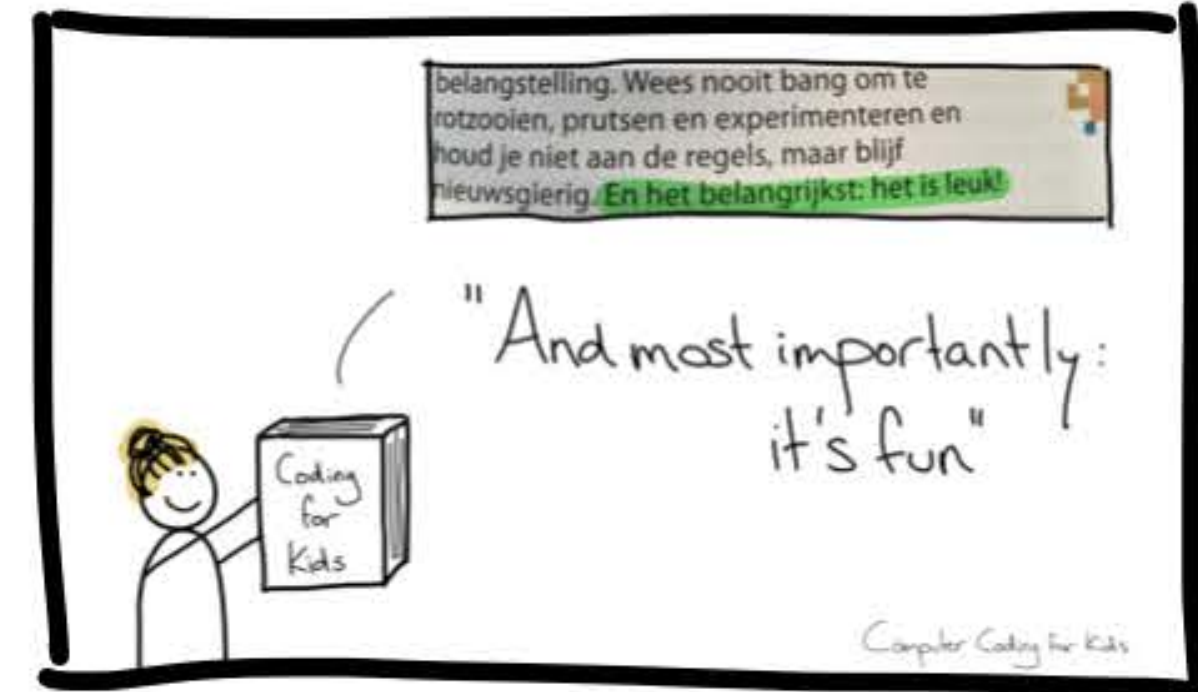
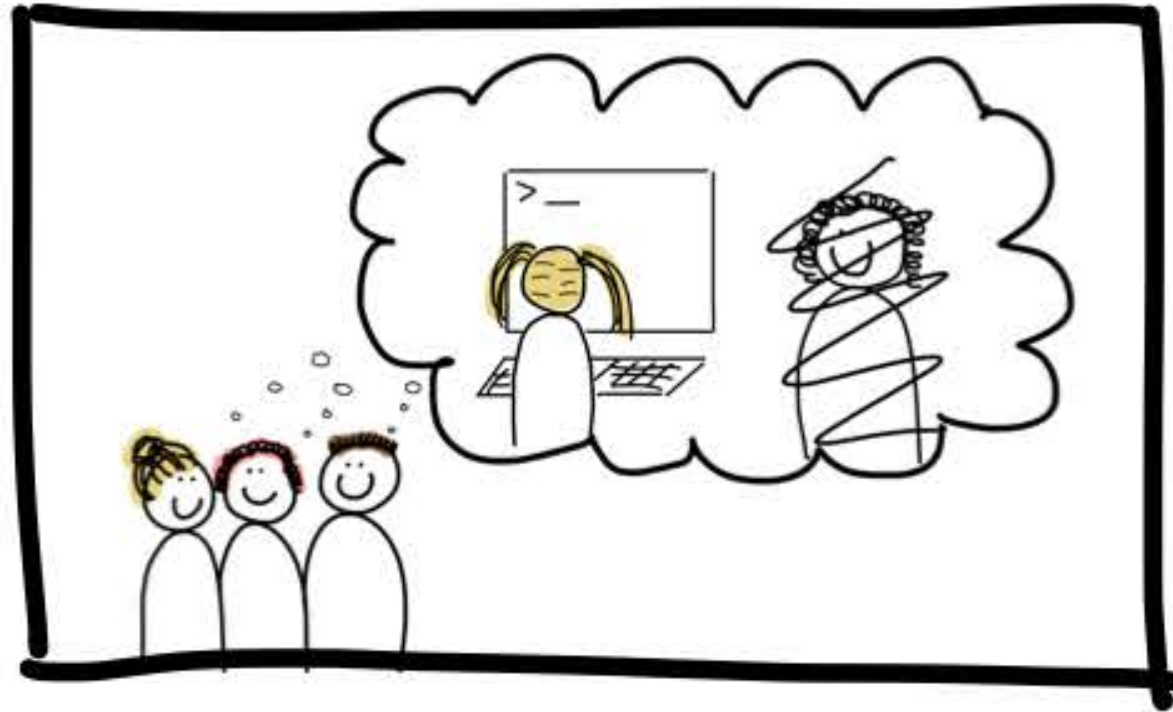
@Felicie



Explicit Direct Instruction in Programming Education



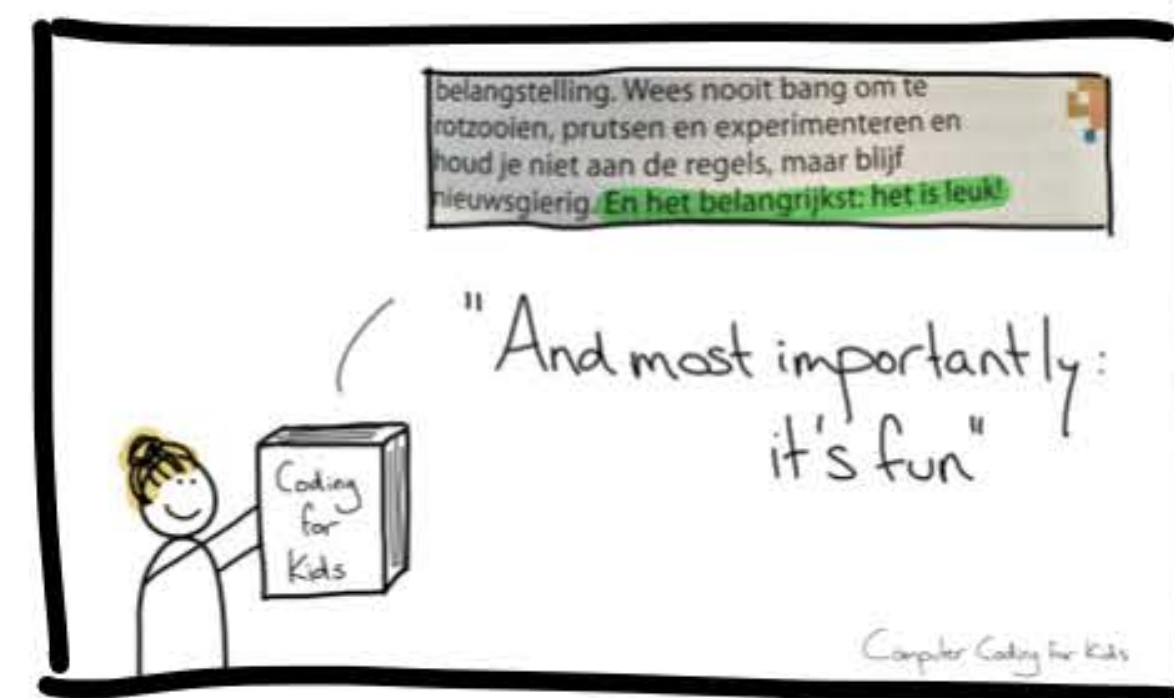
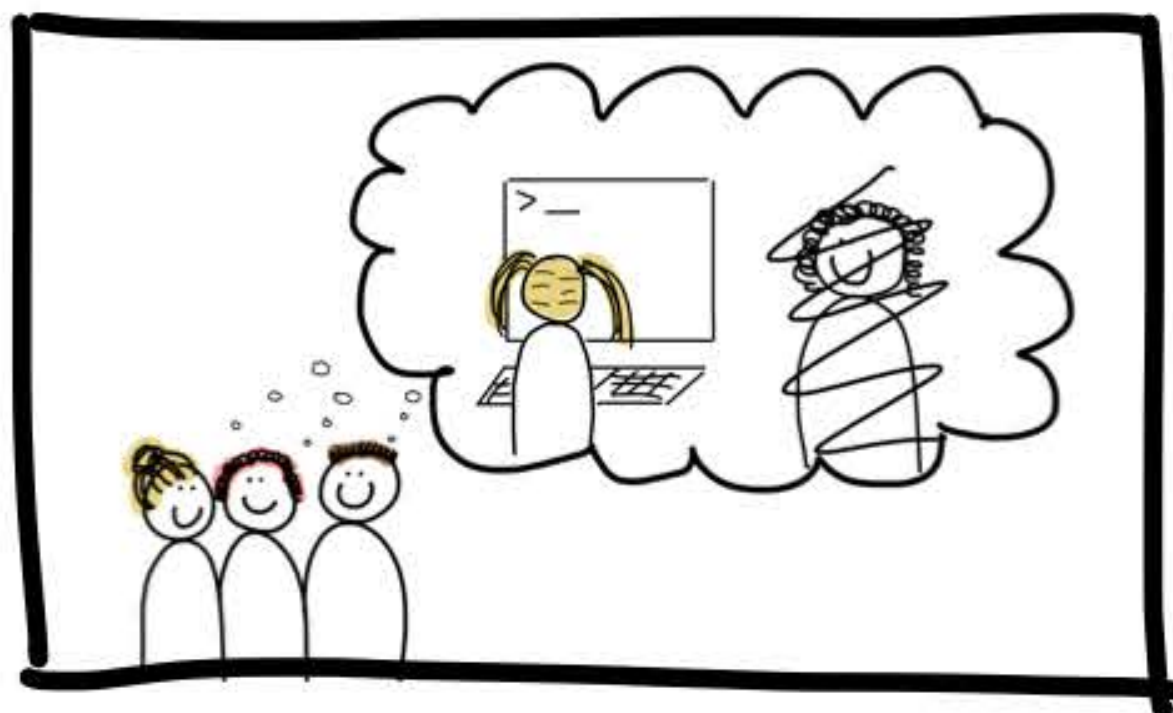
@Felienne



Explicit Direct Instruction in Programming Education



@Felienne



How to teach programming?

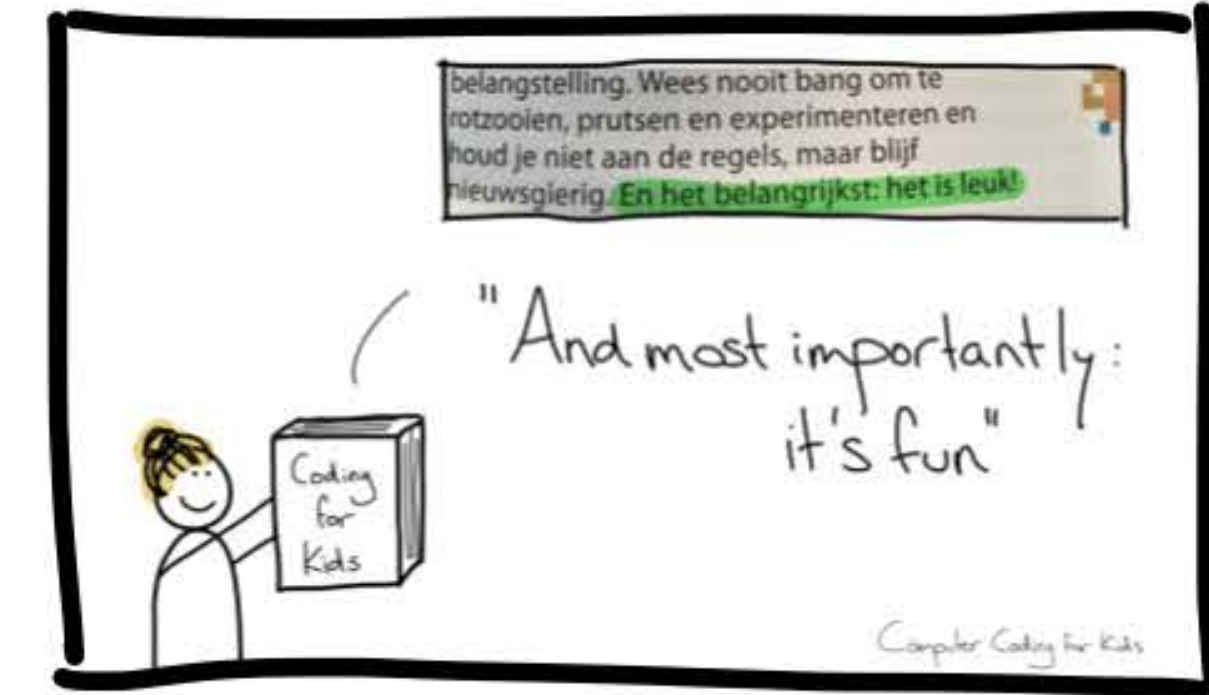
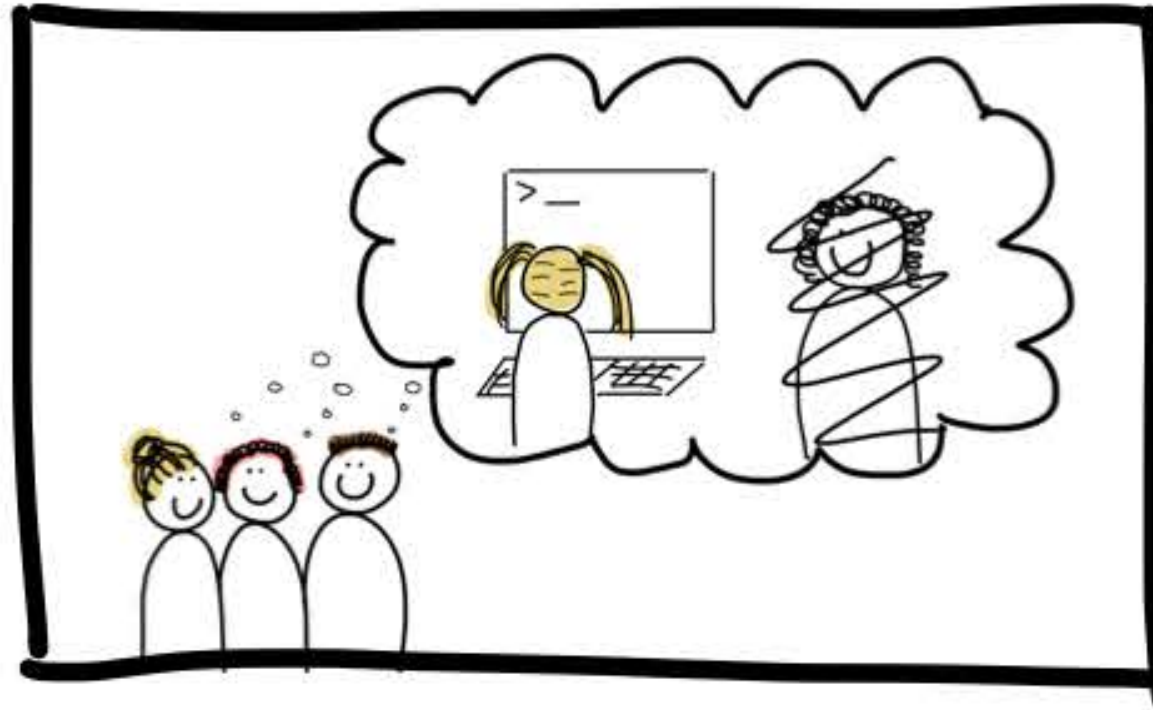
"By explaining something
you take away the
opportunity for a
child to discover it"



Explicit Direct Instruction in Programming Education



@Felienne

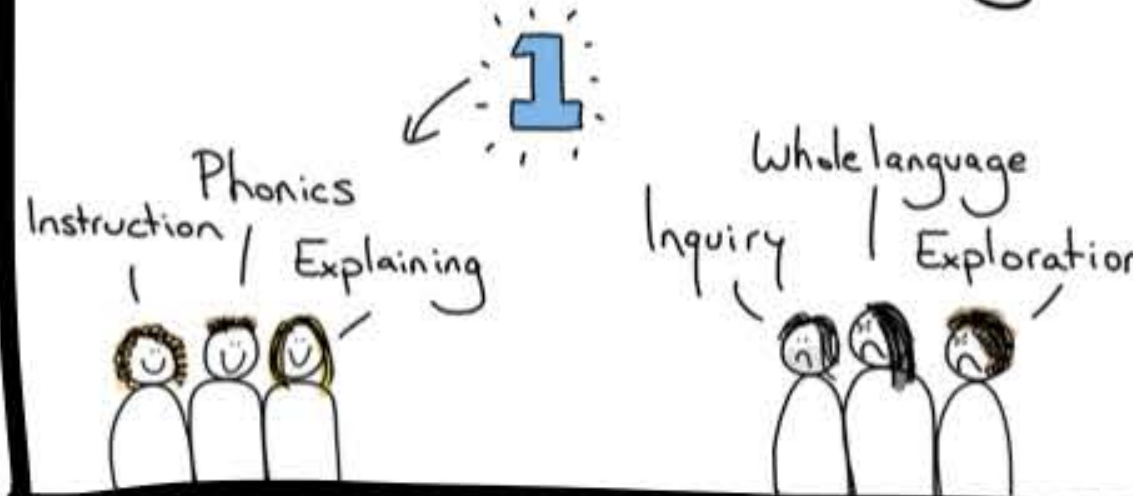


How to teach programming?

"By explaining something
you take away the
opportunity for a
child to discover it"



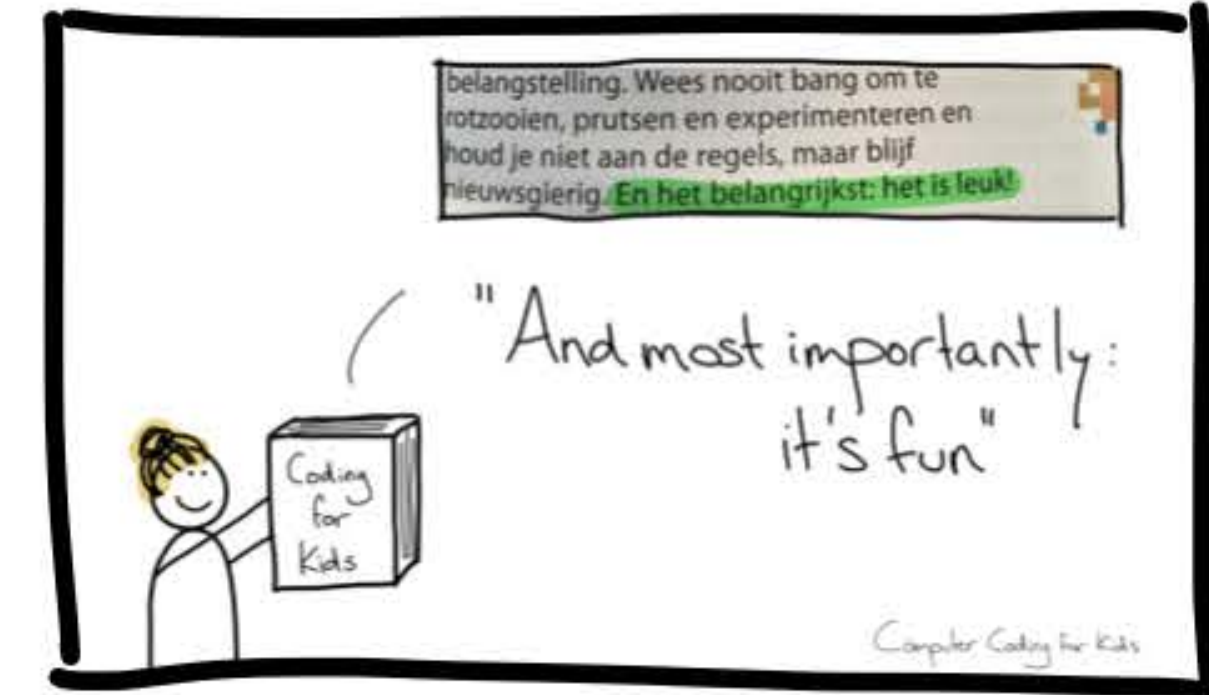
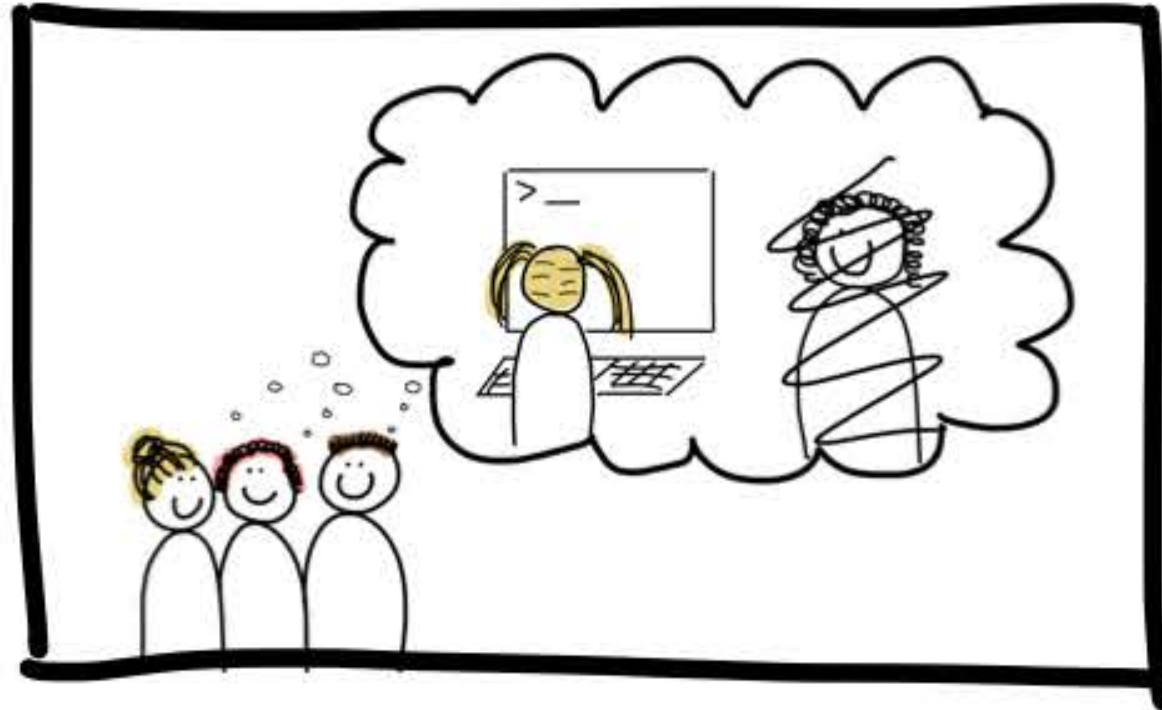
How to teach other things?



Explicit Direct Instruction in Programming Education



@Felienne

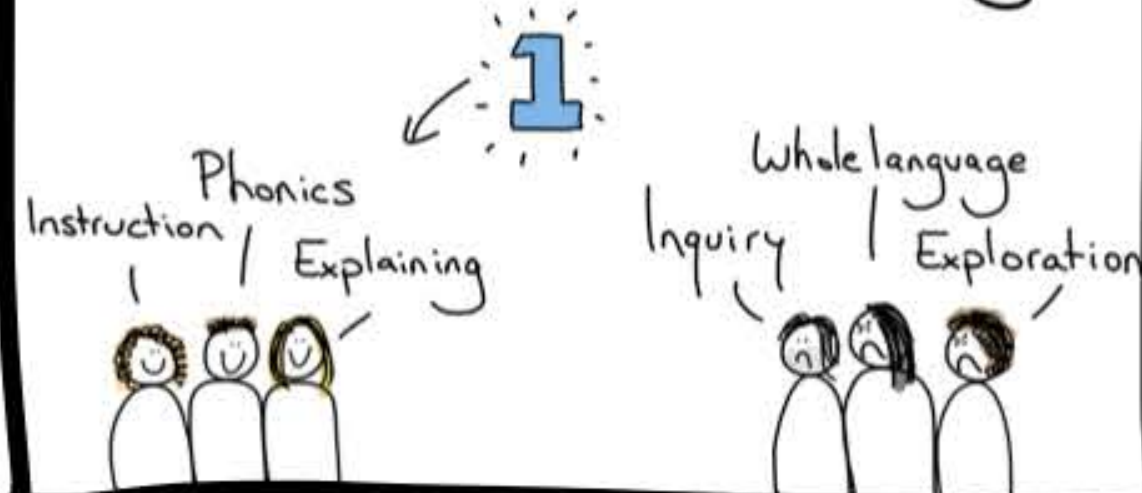


How to teach programming?

"By explaining something
you take away the
opportunity for a
child to discover it"



How to teach other things?

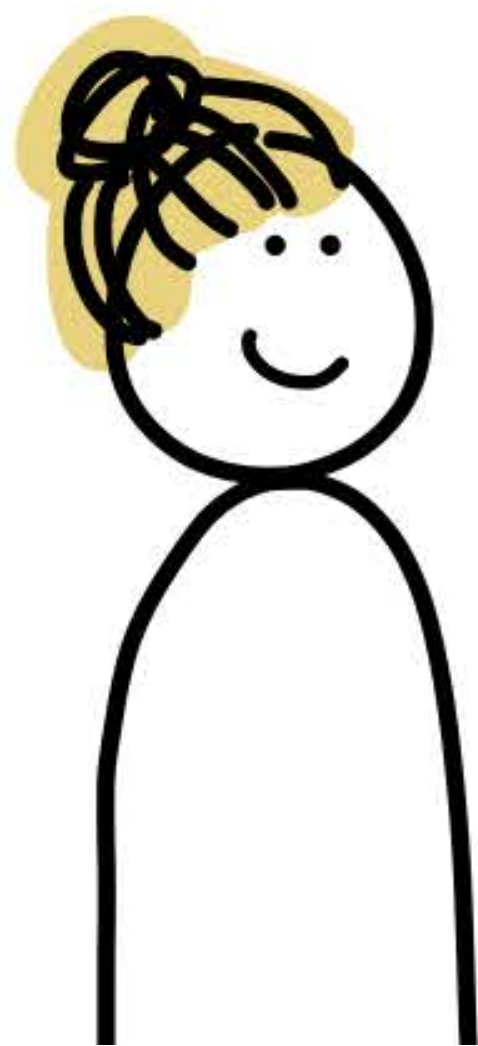


How to teach programming?

- Vocalise syntax
- Course Integration
- Explicit strategies
- Misconceptions
- Assessment

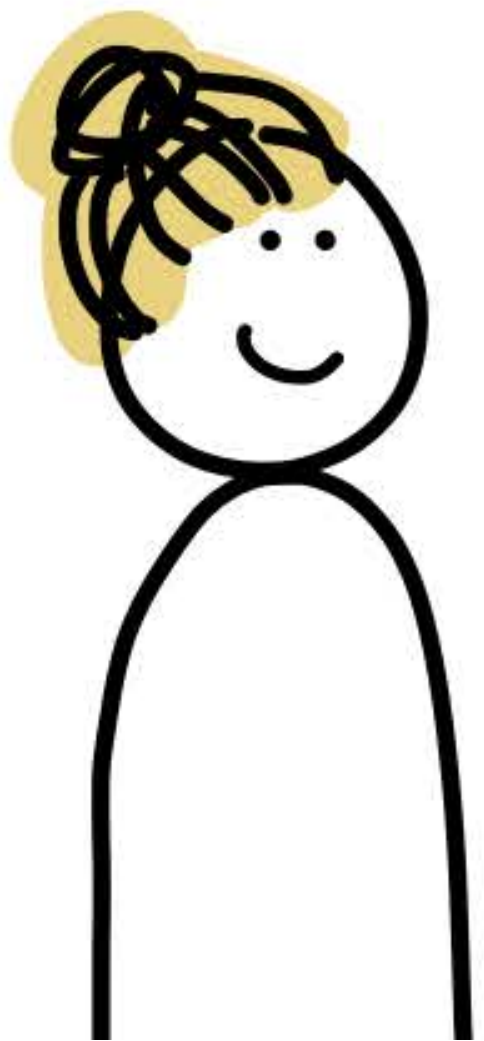


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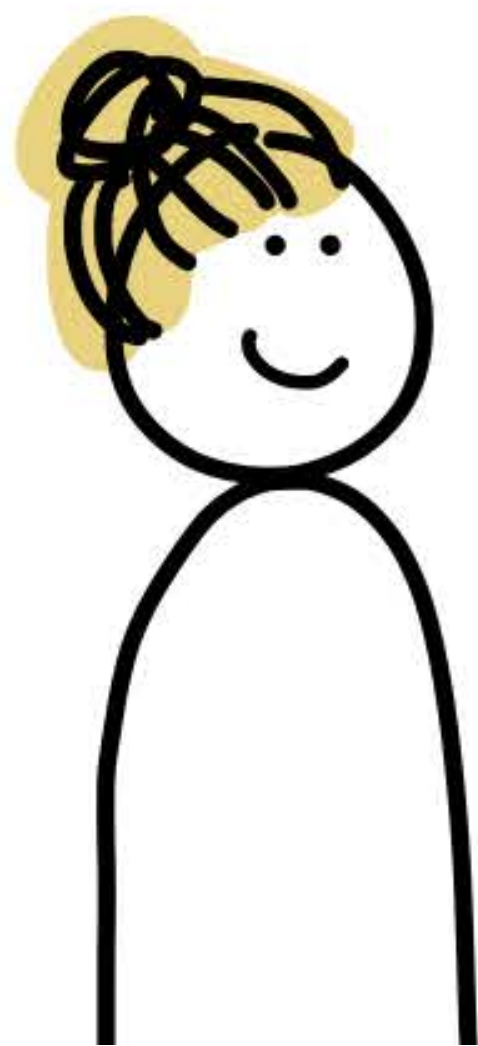
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