Creating the Next Generation of Billionaires - Part II
(During the Pandemic Lockdown: Online Teaching and Learning in Computer Programming for the Next Generation)

EuroPython Talk 2020 (Online-Dublin)

CLNandi (Dr)

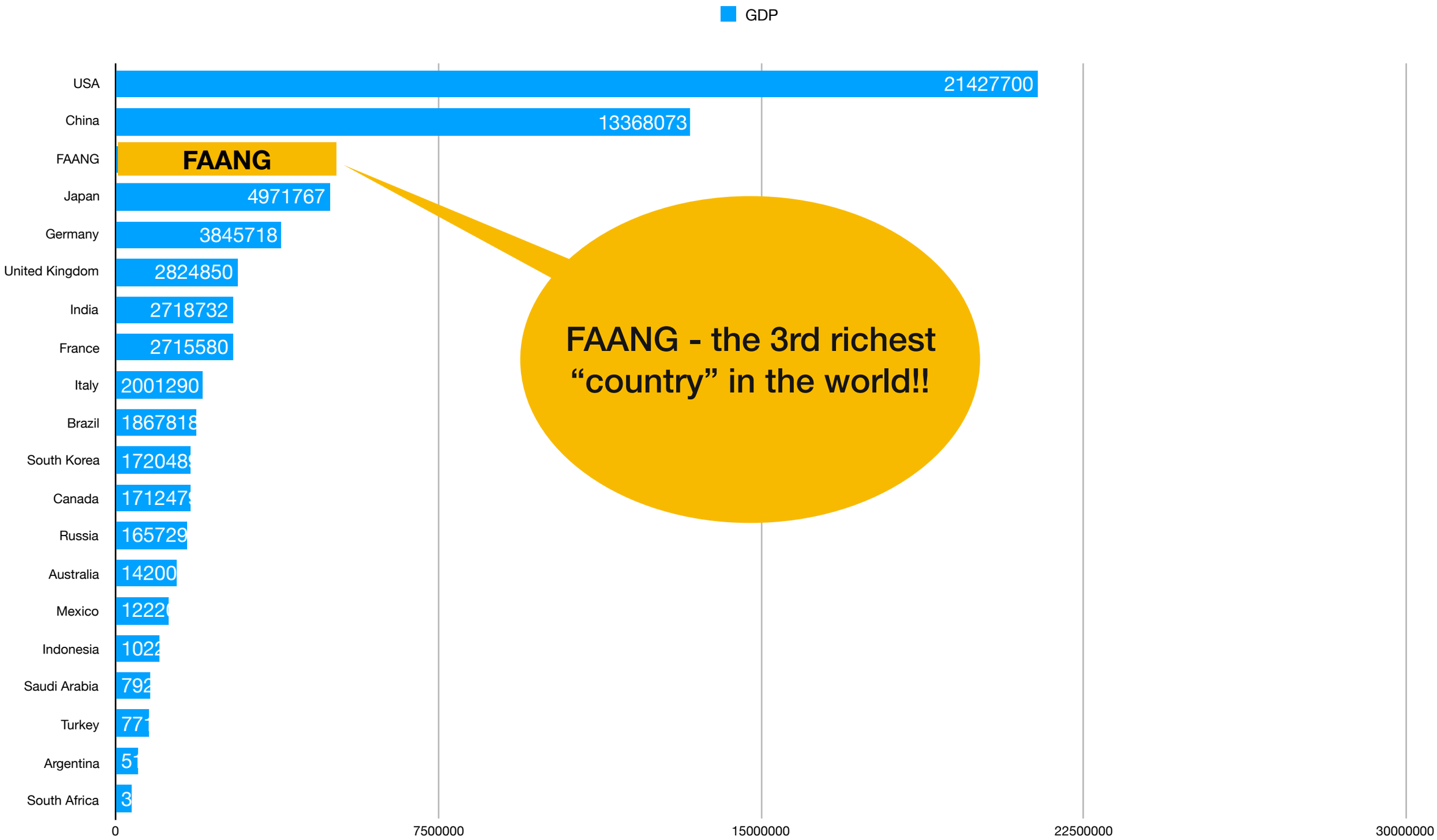
A Bit of Background

Computer Science is now regarded as one of the leading disciplines of the 21st century.

Computers are ubiquitous and prevalent in most, if not all, sectors in our global society - medicine, arts, sciences, commerce, etc.

Current Pandemic has highlighted to all of the world, the critical nature of computers/ technology and it is now recognised as critical infrastructure.

FAANGs' are the 3rd richest "nation" in the world!!



And it could occupy a seat in the G20!!

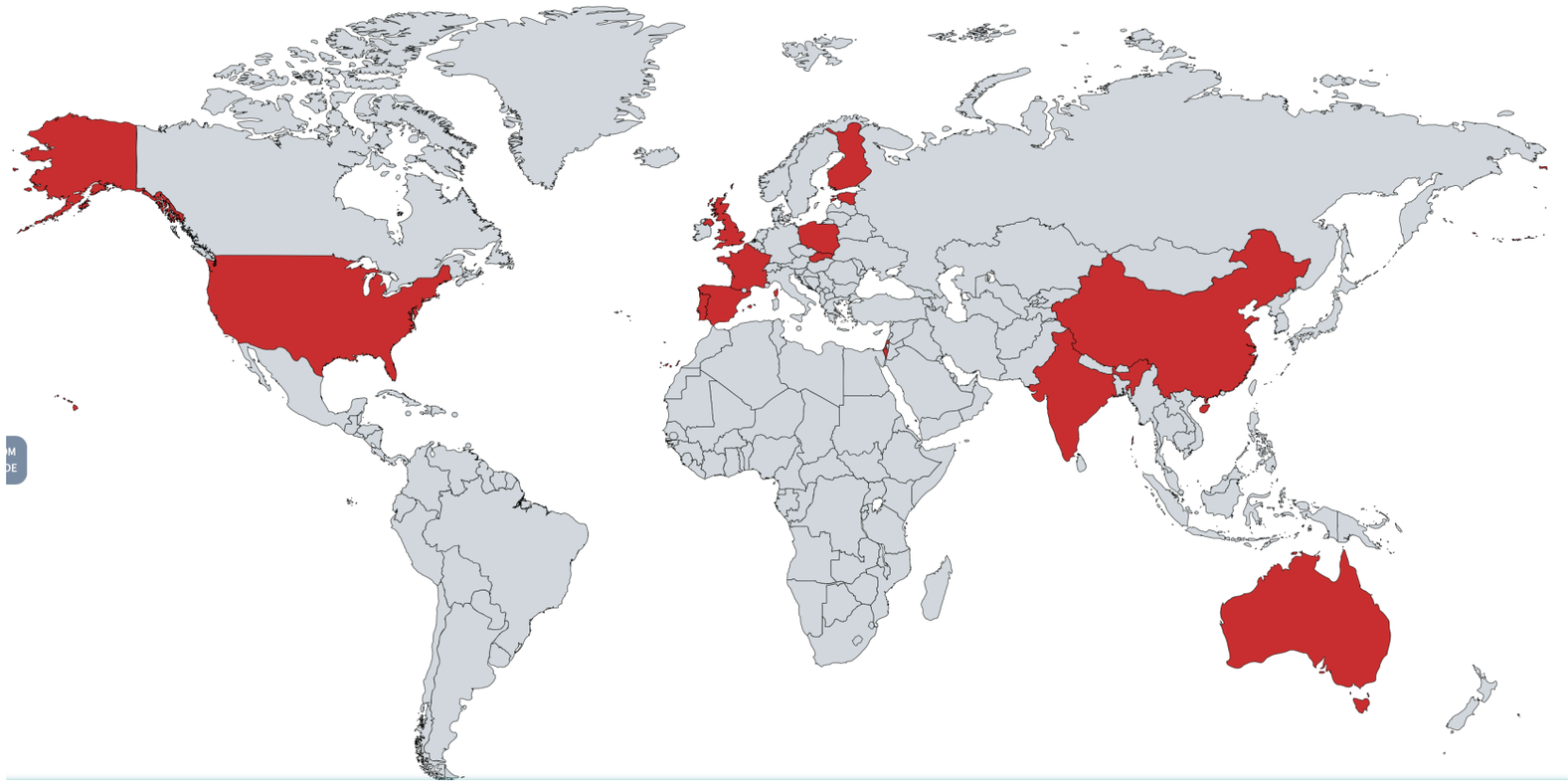
https://countryeconomy.com/gdp

https://finance.yahoo.com

A Bit of Background

Computer pRogramming has been dubbed the ‘4th R’ along with Reading, wRiting and aRithmetic.

Introducing to Children Worldwide from Kindergarten



https://bulldogjob.com/news/82-how-computer-science-classes-are-conducted-around-the-world-5-key-conclusions

https://mapchart.net/world.html

Challenges

"The subject is so young that teachers and curriculum designers have little pedagogical research to guide them"

(Economist)

https://www.economist.com/international/2014/04/26/a-is-for-algorithm

The Task

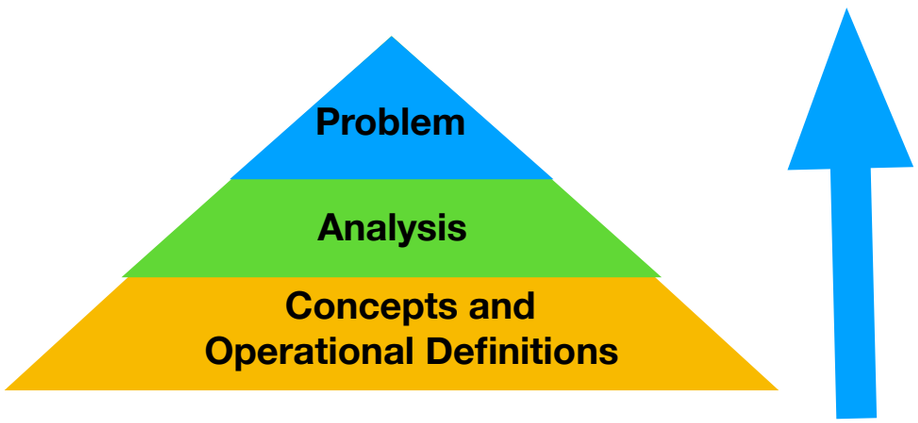
Introducing Computer Programming to High School Students (aged 11-18) in the UK.

With little collective experience of this sort of thing - devised my own framework.

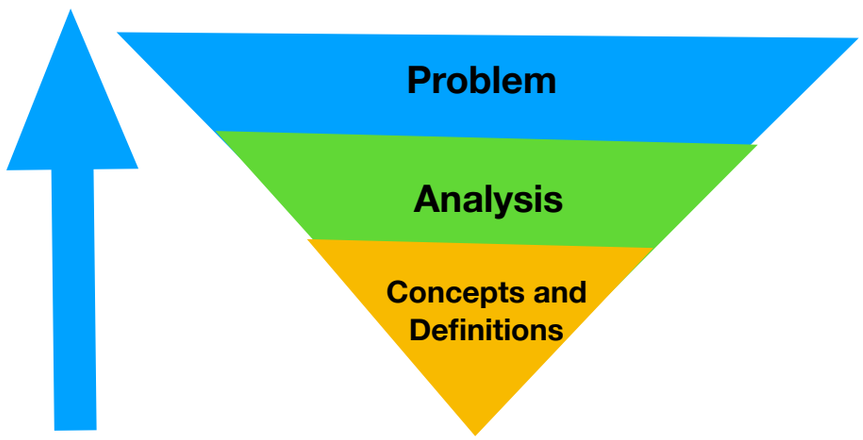
Framework

(1) Adopt a Bottom-Up Approach (as opposed to the ever popular Top-Down Approach Method of Teaching)

Bottom-Up Approach



Top-Down Approach



We found that children/young people/students embraced the Bottom-Up Approach.

Framework

(2) Treat the teaching/learning of Computer Programming Languages in a similar fashion to teaching/learning Human Programming Languages.

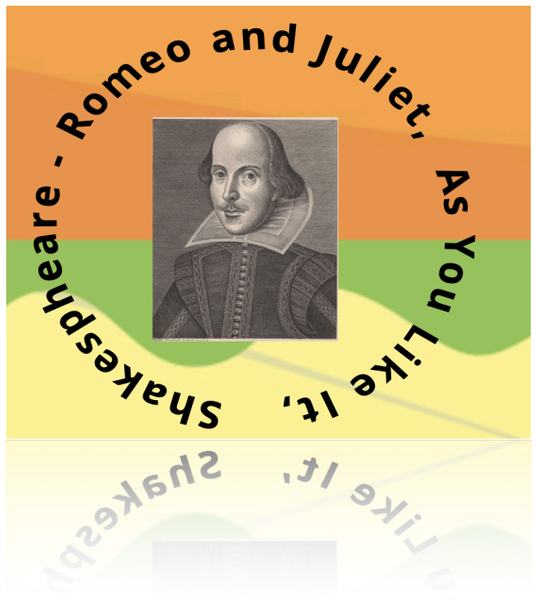
Human Languages		Computer Programming Languages
Word	→	KeyWord
Sentence	→	Statement
Paragraph	→	Module
Essay	→	Program

This approach is to strengthen the grammar and fundamental building blocks

Framework

(3) Introduce Textual Programming Languages such as Python from the Very Beginning & as Early as Possible (as Opposed to Block-based Languages)

English



Maths

$$x = y + 3$$

Geography

Discuss the advantages and disadvantages of Brexit? (8 marks)

Children are accustomed to processing complex textual data in a proficient manner.

Positive Outcomes

(1) A good degree of success and enjoyment with this approach as per the output and the comments from both students and their parents.

(2) Year 7 students found Computer Programming easier than the Year 8 who found it easier than Year 9 who found it easier than Year 10 who found it easier than Year 11 - starting properly from the beginning is better.

(3) Introduce these concepts as young as possible.

(4) Students felt happier with this teacher-led approach rather than student-led approach or independent learning, at this beginning stage.

(5) The best students were the ones who are motivated to do well in the subject.

The Overnight Switch to Lockdown Online/Virtual Learning!!

With sudden announcement of Lockdown we joined the worldwide online learning and teaching forum

Over 900 million children in over 100 countries were being educated online/virtually.

A New Set of Questions & Challenges Emerged

Lockdown Questions arising for Online Teaching during the Pandemic

QUESTION 1

How does this online/virtual medium of instruction compare with the established, well-respected face-to-face medium of instruction?

QUESTION 2

Is it possible to engender a sense of competence, confidence and independence to the students using this medium?

QUESTION 3

Is it possible for the students to enjoy the subject via this medium and produce something even more useful?

Question 1 - Online Medium vs In-Person Face-to-Face Instruction

Mindset is the key

"We should figure out what we want before we calculate what we can afford, not the reverse"

Irving Kristol

"The medium is the message"

Professor McLuhan

- Each medium of instruction has its own signature

- with its own strengths and advantages

- We need to discover them and capitalise on them.

Question 2 - Continue to Build Competence, Confidence and Independence

Imperative that students have Working Programs, if they are to feel confident and happy.

Priority was given to teaching students to be able to correct their own errors especially the Syntax error

There was a new emphasis to this in the framework

Syntax error introduced as a "necessary evil" & in an apologetic fashion

Surprisingly, the young students embraced the syntax error!

"To me the most interesting part was the mistakes. When we made them they could have been minor but made such a difference. It was interesting to see how that counted and how intricate a system really is". (Nikhita, age 12).

Question 2 - Continue to Build Confidence, Competence and Independence

"I have enjoyed learning how to create a code that generates a random password. I liked working on this partly because, ***when I wrote it out it had a syntax error; this made me experiment which was very fun.*** *After fixing it, I decided to improve it as well, which made another problem: …"* (Alex, age 11).

Harry (aged 12) - Program with Syntax Error

```
29
30  def Playing Cards():
31      Playing Cards = ['AH','2H','3H','4H','5H','6H','7H',
        '8H','9H','10H','JH','QH','KH','AS','2S','3S','4S',
        '5S','6S','7S','8S','9S','10S','JS','QS','KS','AD',
        '2D','3D','4D','5D','6D','7D','8D','9D','10D','JD',
        'QD','KD','AC','2C','3C','4C','5C','6C','7C','8C',
        '9C','10C','JC','QC','KC']
32      Sampling = random.sample(Playing Cards, k=1)
33      print(Sampling)
34
35
36  Playing Cards()
```

Harry's Syntax Error
Harry's variable names & function names have spaces in them

Question 3 - Making it Fun, Promoting Meaningful and Interesting Concepts/ Programs whilst remaining true to fundamentals

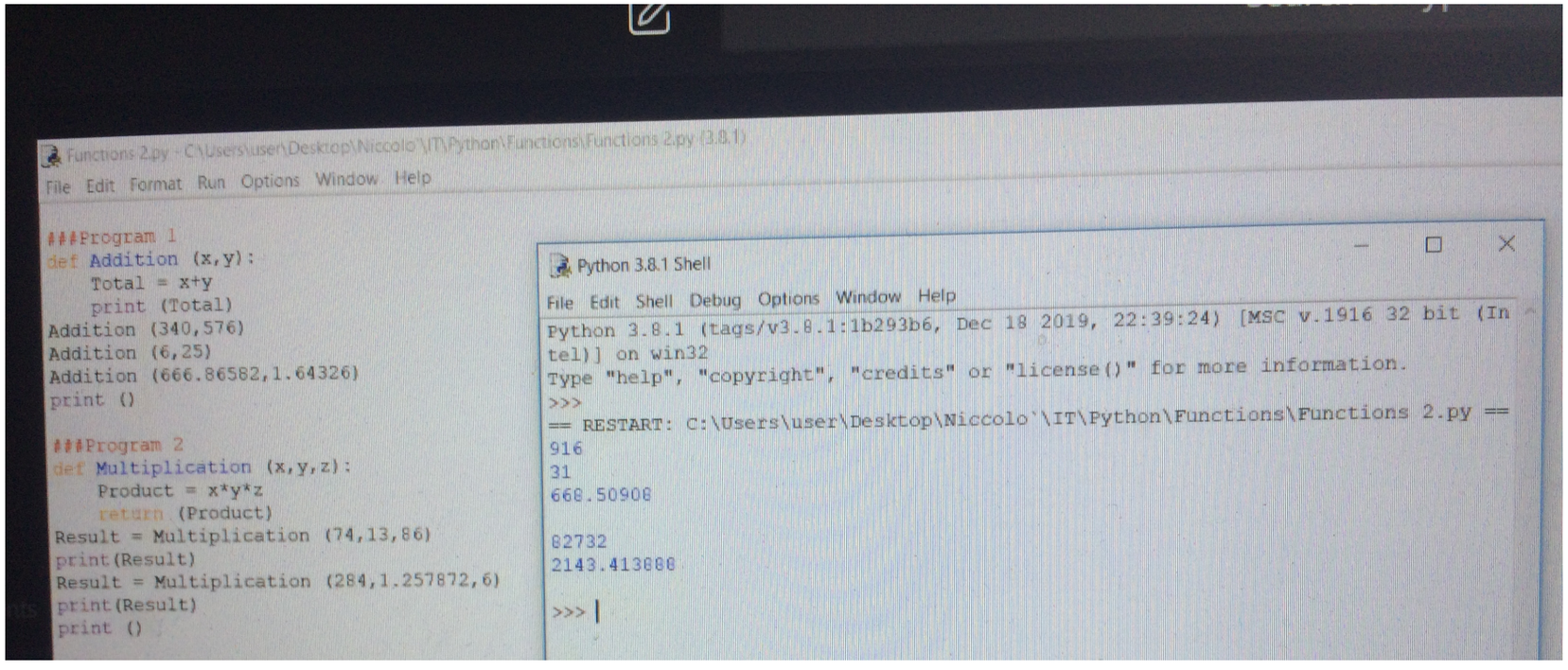
Necessitates students learning about modules/functions early on

Question 3 - Making it Fun, Promoting Meaningful and Interesting Concepts/ Programs whilst remaining true to fundamentals

Starter Program with Functions

```
main.py                                    saved
1   ### Progran 2
2   def Addition (a,b) :
3       Total = a + b
4       print (Total)
5
6   Addition (10,12)
7   Addition (6,3)
8   Addition (5,5)
9
```

Alex's Programs with Functions (aged 11)



"I enjoyed learning about functions (i.e modules) and how to define them so you could access them at any moment". (Alex, aged 11).

Question 3 - Making it Fun, Promoting Meaningful and Interesting Concepts/ Programs whilst remaining true to fundamentals

Starter Program with Functions

```
main.py                                saved
1   ### Progran 2
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5
6   Addition (10,12)
7   Addition (6,3)
8   Addition (5,5)
9
```

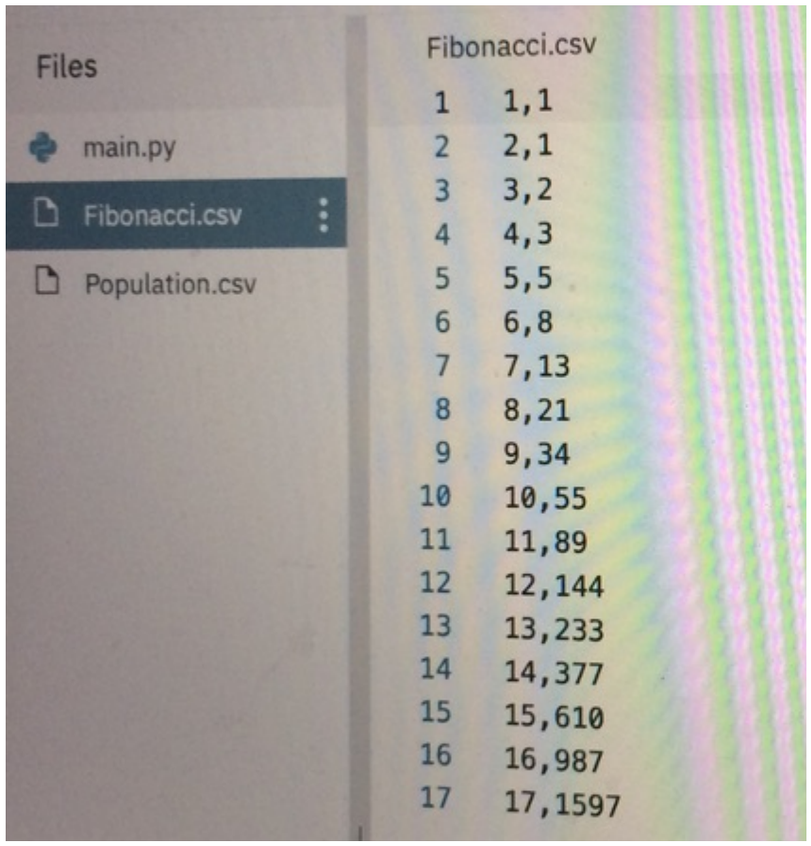
Dipu's Programs with Functions (aged 12)

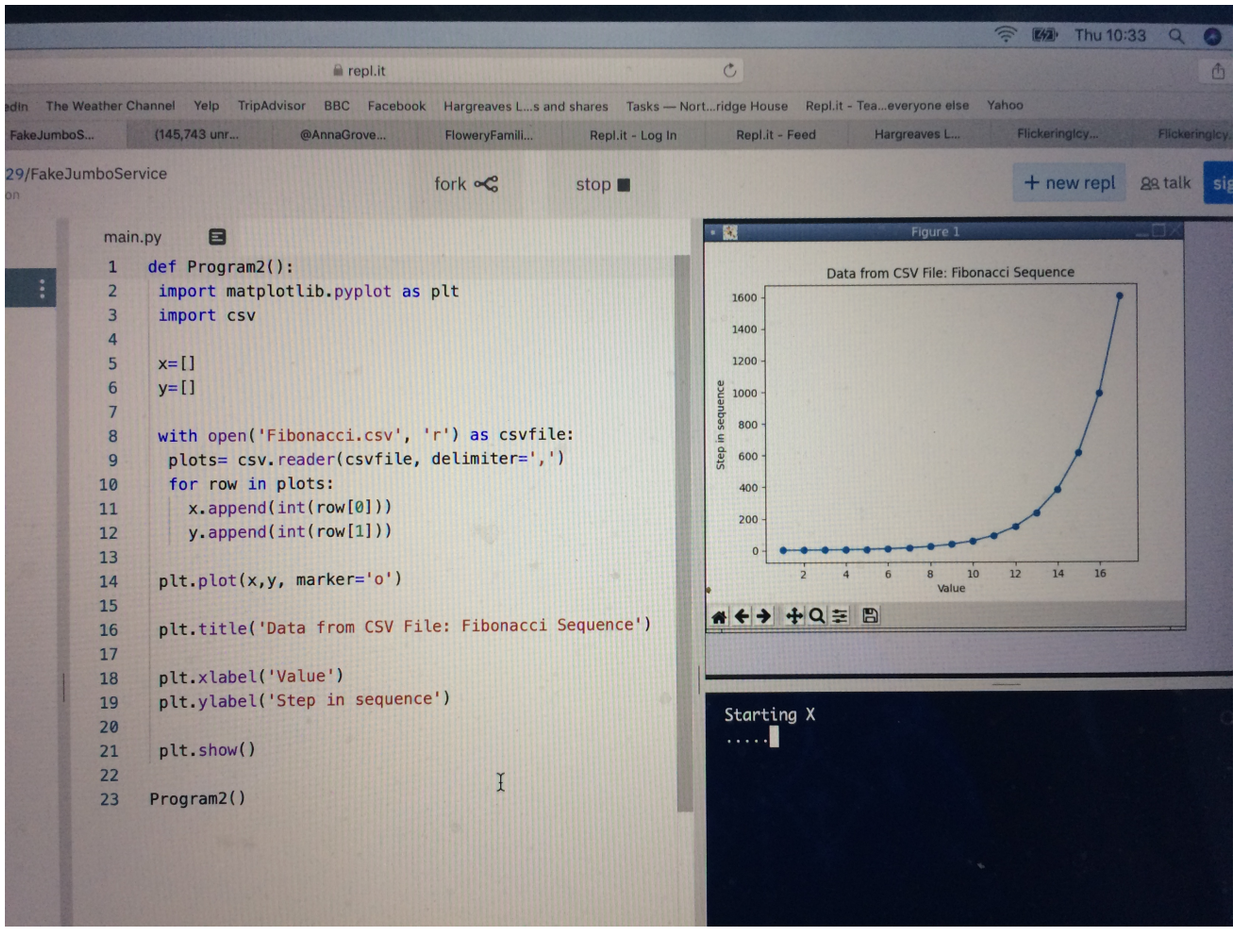
```
main.py                                saved
1   def Addition (a,b):
2       Total = a+b
3       print (Total)
4
5   Addition (15,11)
6
7   def Subtraction (a,b):
8       Total = a-b
9       print (Total)
10
11  Subtraction (20,4)
12
13  def Multiplication(a,b,c):
14      Product = a*b*c
15      return(Product)
16
17  Result = Multiplication(2,3,6)
18  print(Result)
19
20  def Division (a,b):
21      Total = a/b
22      print (Total)
23
24  Division (8,2)
25
26  def Phrase (word):
27      print ("I love", word)
28
29  Phrase ("food")
```

```
26
16
36
4.0
I love food
>
```

Question 3 - Making it Fun, Promoting Meaningful and Interesting Concepts/ Programs whilst remaining true to fundamentals

Shivonne's Programs with Functions with Matplotlib Library (aged 13) - Modelling and Simulation





Helpful Tools Discovered

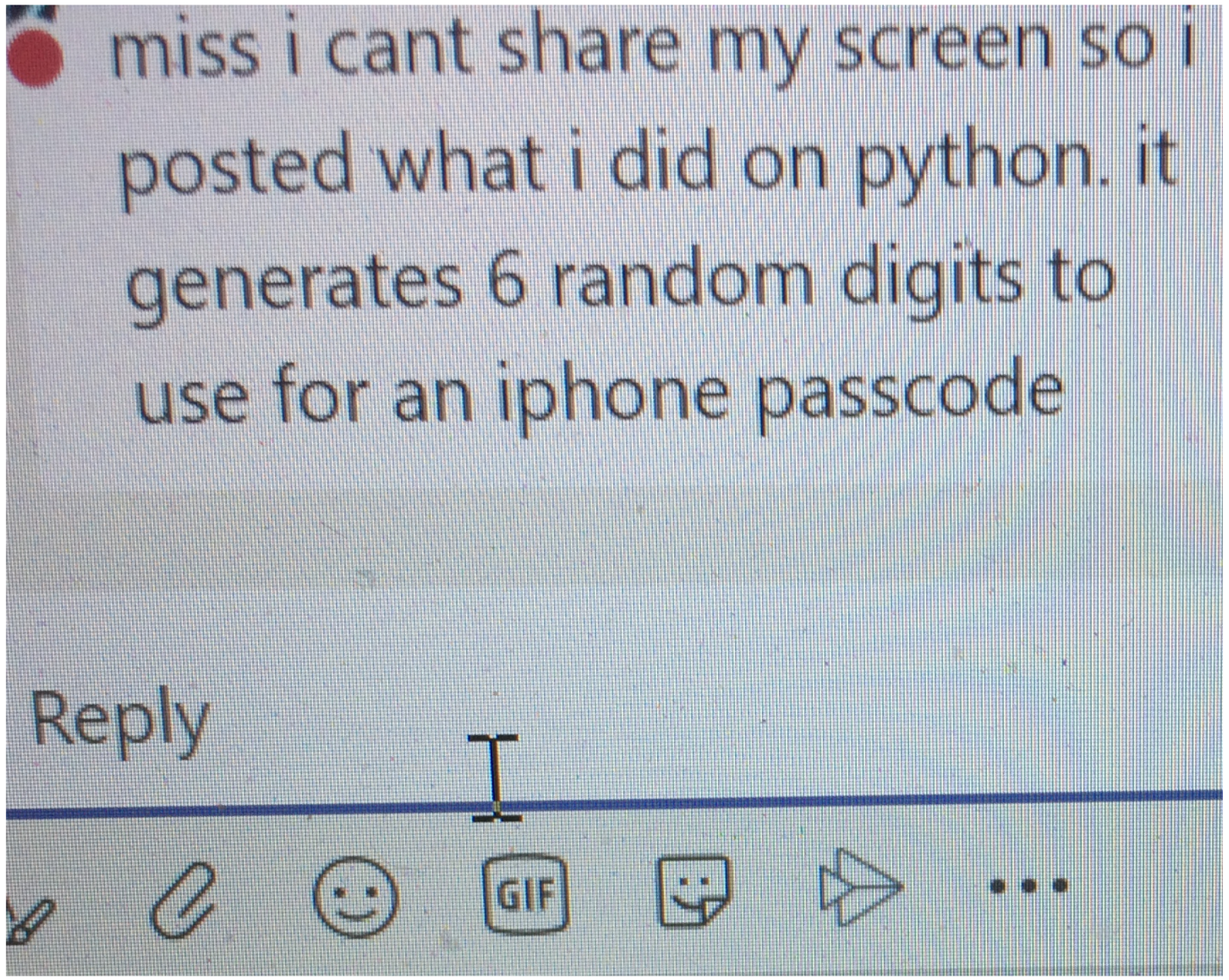
(1) Online Editors where you can both share code and edit students'code.
www.repl.it

(2) Chat functionality in Microsoft Teams for both chatting and passing of code from student to teacher and vice versa.

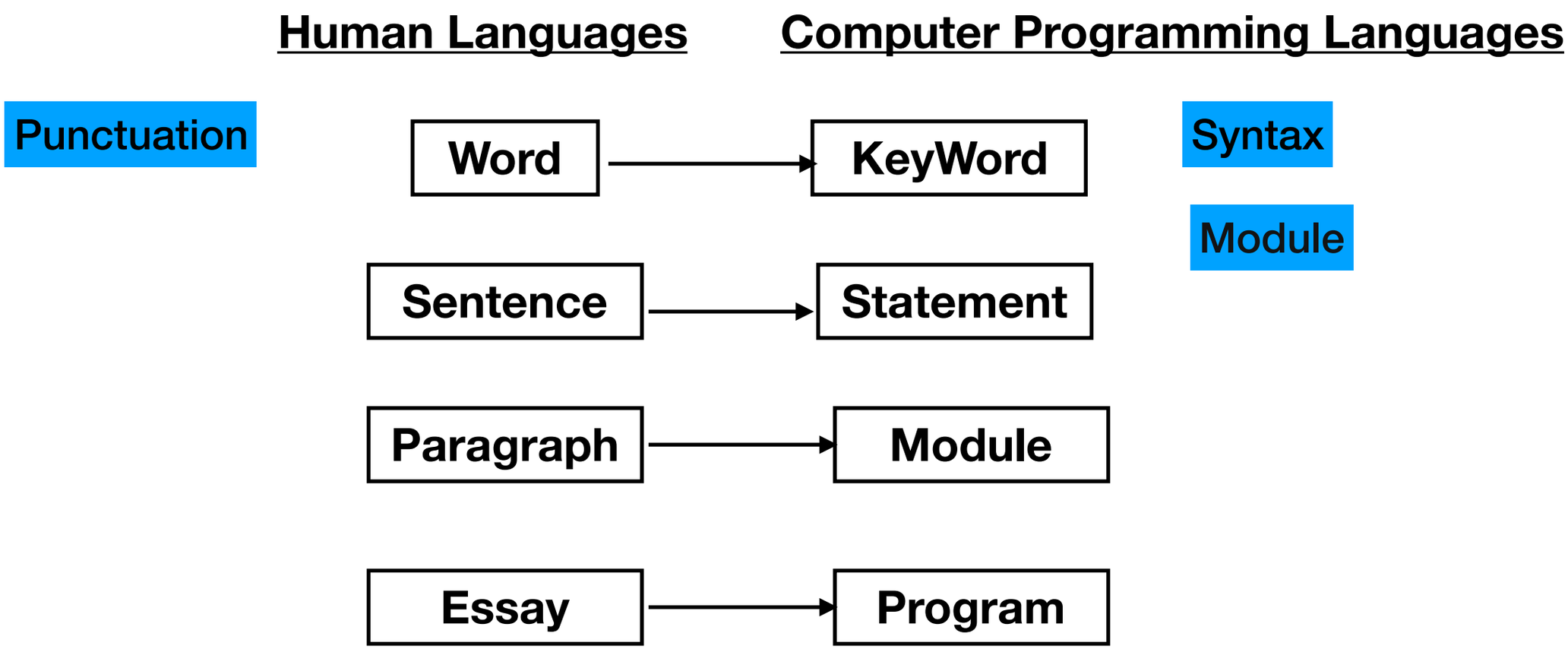
(3) Online Editors where you can set up classrooms and assignments.

www.repl.it

Peter, aged 12



Revisiting the Framework



Conclusion & Way Ahead

(1) Some of the Strengths of the Online Medium of Instruction

(i) Online Medium promotes Good Listening which led to Better Understanding.

(ii) Online Medium unleashed a Healthy Creativity from Children/Students.

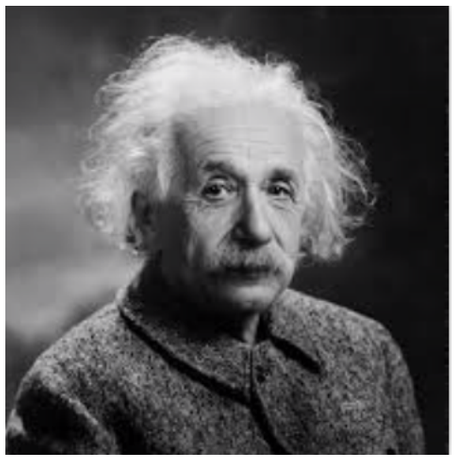
(iii) Online Medium promotes Structure.

(2) In Future we can Import some of the Practices of the Online Medium of Instruction into In-Person Face-to-Face Teaching.

(3)Many, many developments in Online Teaching in the Next Few Years.

In years to come, the scale of the venture will surely be considered as one of the greatest experiments in online teaching in the history of mankind.

A Quote



“I never teach my pupils, I only attempt to provide the conditions in which they can learn”

(Albert Einstein)

Thank you

- Any Questions?
- Thank you for your time.

- (My) YouTube Channel: lil anonymous
- Website: https://computersciencegcealevel.wordpress.com
- Email: demo999@yahoo.com