TEACHER TRAINING ON:
PROGRAMMING & COMPUTATIONAL THINKING

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CT Definition

Computational thinking was firstly introduced by Papert (1980) and more recently rejuvenated by Wing (2006).

CT Definition

There are some variations on defining computational thinking since it was initially introduced.

Papert's (1980) work emphasized thinking skills and "objects-to-think-with" (p. 11) that arise from working with computers.

He argues that "learning consists of building up a set of materials and tools that one can handle and manipulate" (p. 173).

COMPUTATIONAL THINKING

In line with Wing (2006), International Society for Technology in Education (ISTE, 2011), formulates computational thinking as a problem-solving process that involves identifying patterns, making abstractions, developing algorithms and formulating procedures for computers to use to find solutions.

CT

Computational thinking (CT) can take various forms:

- It can be screen-based computer programming
- It can be used to control digital circuits and robots, and
- It can more generally be the design of algorithmic solutions to problems that can be carried out by a computer (Gadanidis et.al,2017 p.458)

CT

“Computing is concerned with answering 'How would I get a computer to solve this problem?' where the computer could be a machine, a human, the combination of a machine and a human, or recursively, the combination” (Wing, 2008 p.3719)

CT

ISTE (2011) has formulated Computational thinking (CT) as a problem-solving process with characteristics (not limited to this):

1. Formulating problems in a way that enables us to use a computer and other tools to help solve them
2. Logically organizing and analysing data
3. Representing data through abstractions such as models and simulations
4. Automating solutions through algorithmic thinking (a series of ordered steps)
5. Identifying, analysing, and implementing possible solutions with the goal of achieving the most efficient and effective combination of steps and resources
6. Generalizing and transferring this problem solving process to a wide variety of problems

CT

Cognitive Processes involved in CT (Csizmadia et.al, 2016 p.6):

1. the ability to think algorithmically;
2. the ability to think in terms of decomposition;
3. the ability to think in generalisations, identifying and making use of patterns;
4. the ability to think in abstractions, choosing good representations; and
5. the ability to think in terms of evaluation.

Teachers' CT

According to Barr and Stephenson (2011), teacher professional development and the education of Teacher Colleges are critical elements to successful implementation of CT in K-12 education.

They argue that the process of increasing student exposure to computational thinking in K-12 is complex, requiring systemic change, teacher engagement, and development of significant resources

Teachers Professional Development

In Singapore, CT for teachers has been introduced in NIE.

This program is to:

- introduce them with basic computing, programming for the purpose of mathematics problem solving
- expose them to the use of common IT tool in performing mathematical computations and solving mathematical problems, including problems involving mathematical modelling, and
- develop the ability to construct solutions to problems on a common platform using the concepts and tools learnt (Ho & Ang, 2015)

PD in Singapore

The were various software and platform used for teachers in the course, but in 2014, it was decided to use Microsoft Excel's Visual Basic Applications (VBA) due to the availability and readily accessibility of the program (Ho,2015).

This would be similar in Indonesia and maybe in other SEAMEO countries, many teachers will have issues on the licence and accessibility.

SEAQIM's PROGRAMS

In 2019, SEAMES mandated SEAQiM to mentor students and teachers about Game Education Development for SEA-Creative Camp Batch 4.

SEAQiM utilized **Thunkable** and **Scratch** for developing the game-education.

SEAQIM's PROGRAMS

Prof. Masami Isoda has granted SEAQiM 10 sets of robot programming and trained the teacher trainers about how to use it.

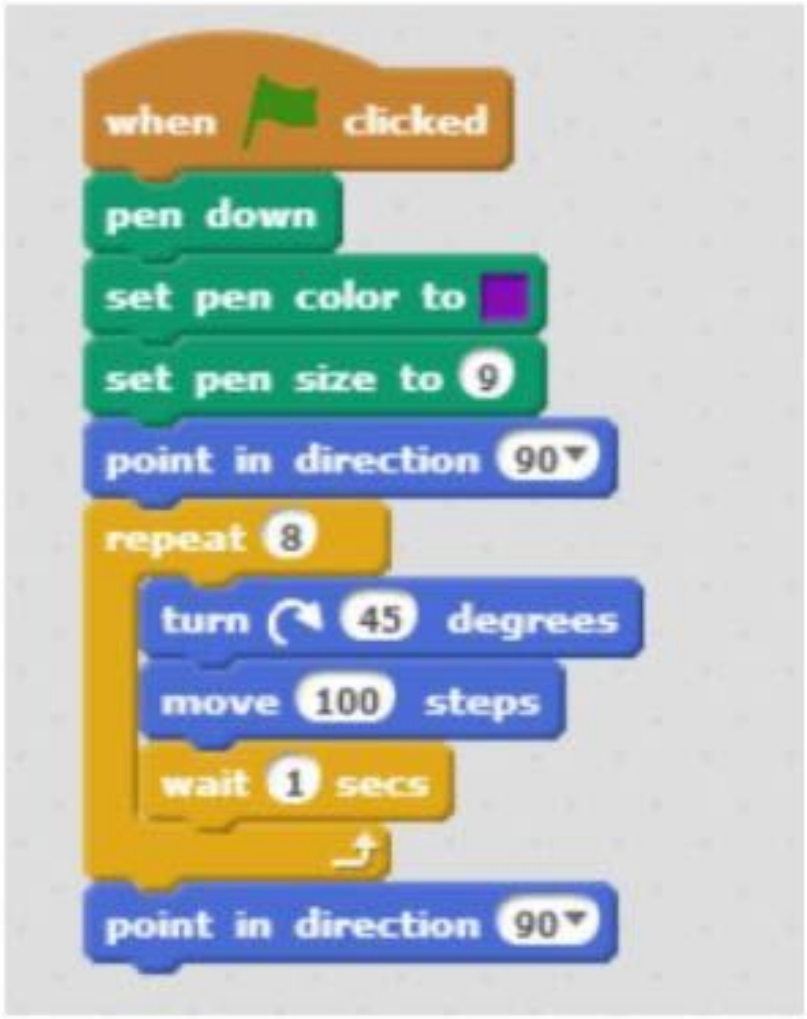
He suggested to include such activity in SEAQiM training program. Therefore, it was first time introduced to SH mathematics teachers for ICT course in 2019.

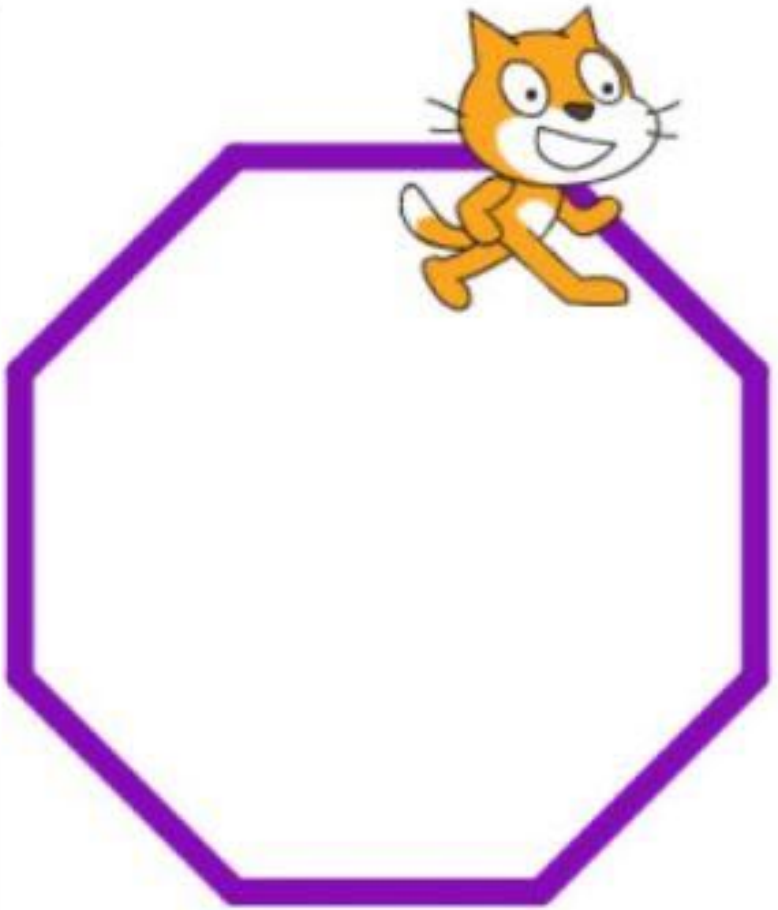
SEAQIM PROGRAMS

ICT Utilization course for senior high school mathematics teachers

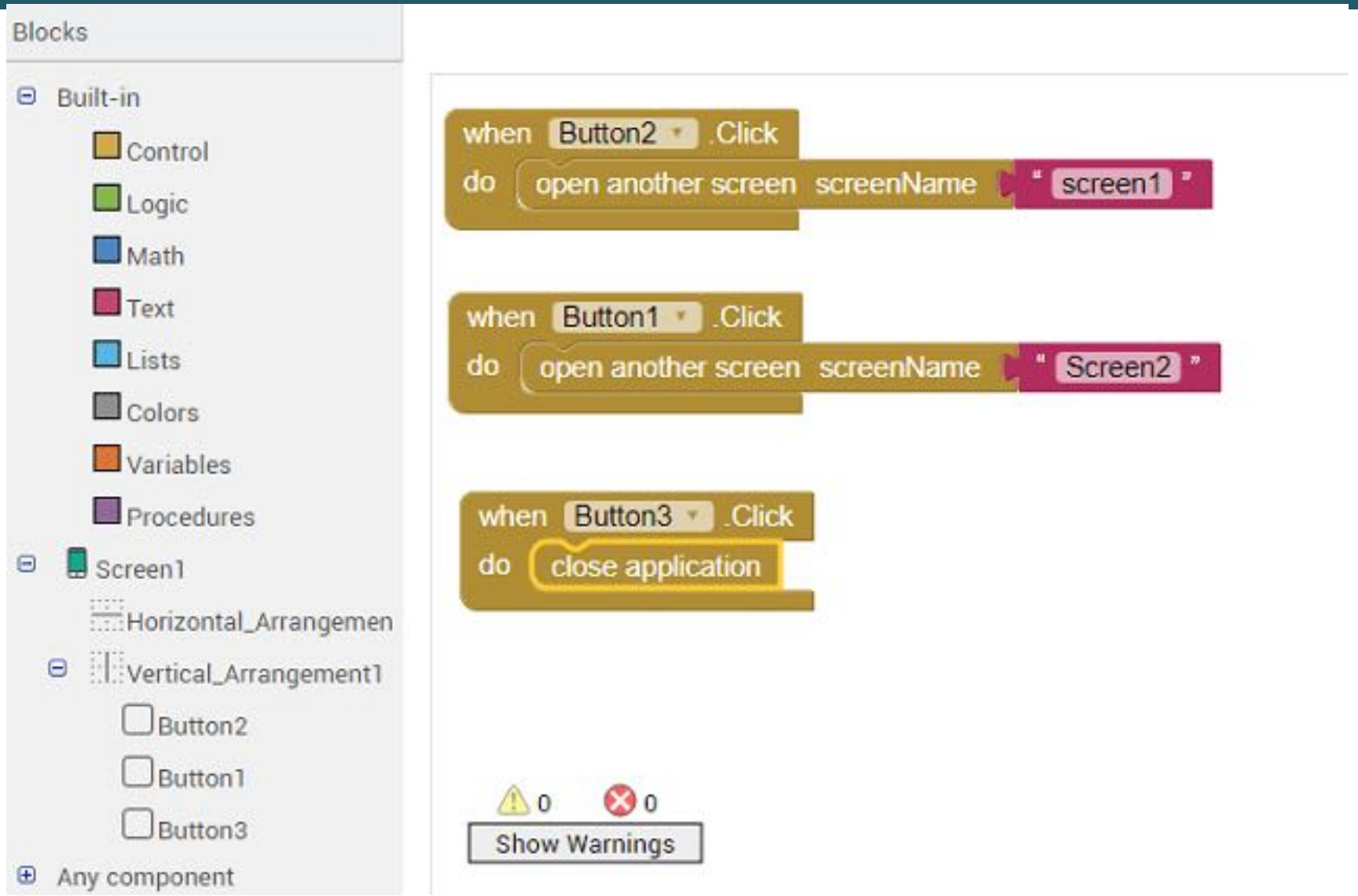
1. **Program for Building**
2. **Scratch**
3. **Robot Programming**

SCRATCH


when clicked
pen down
set pen color to
set pen size to 9
point in direction 90
repeat 8
turn 45 degrees
move 100 steps
wait 1 secs
point in direction 90

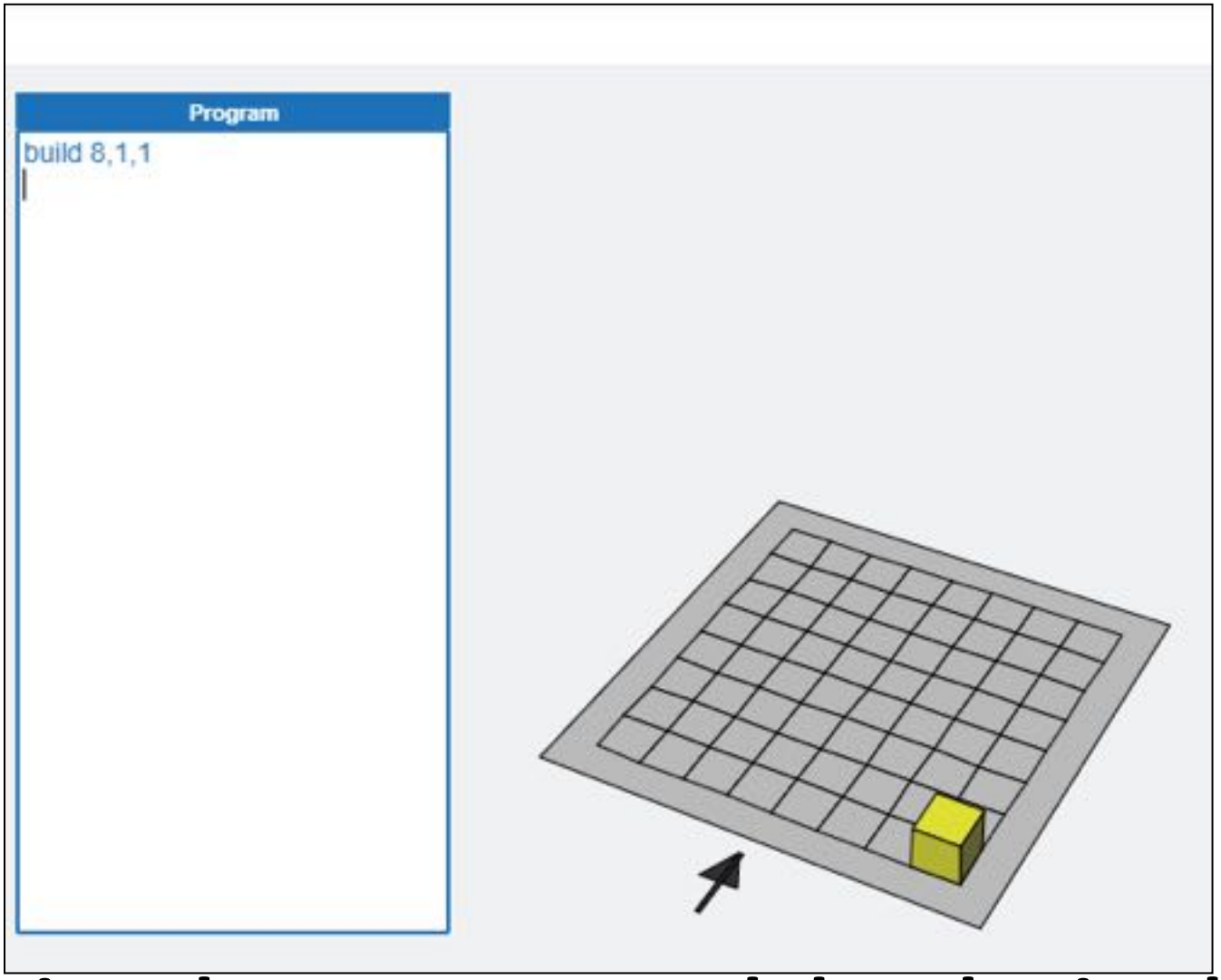


Thunkable



For app in mobile phones

Program for Building



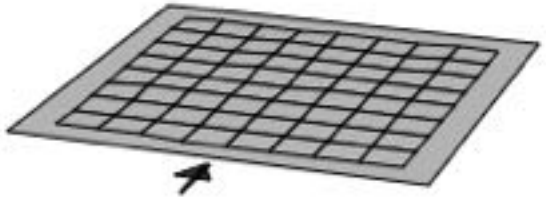
Observing the patterns and developing logic

Program for Building

LESSON

Programs for building

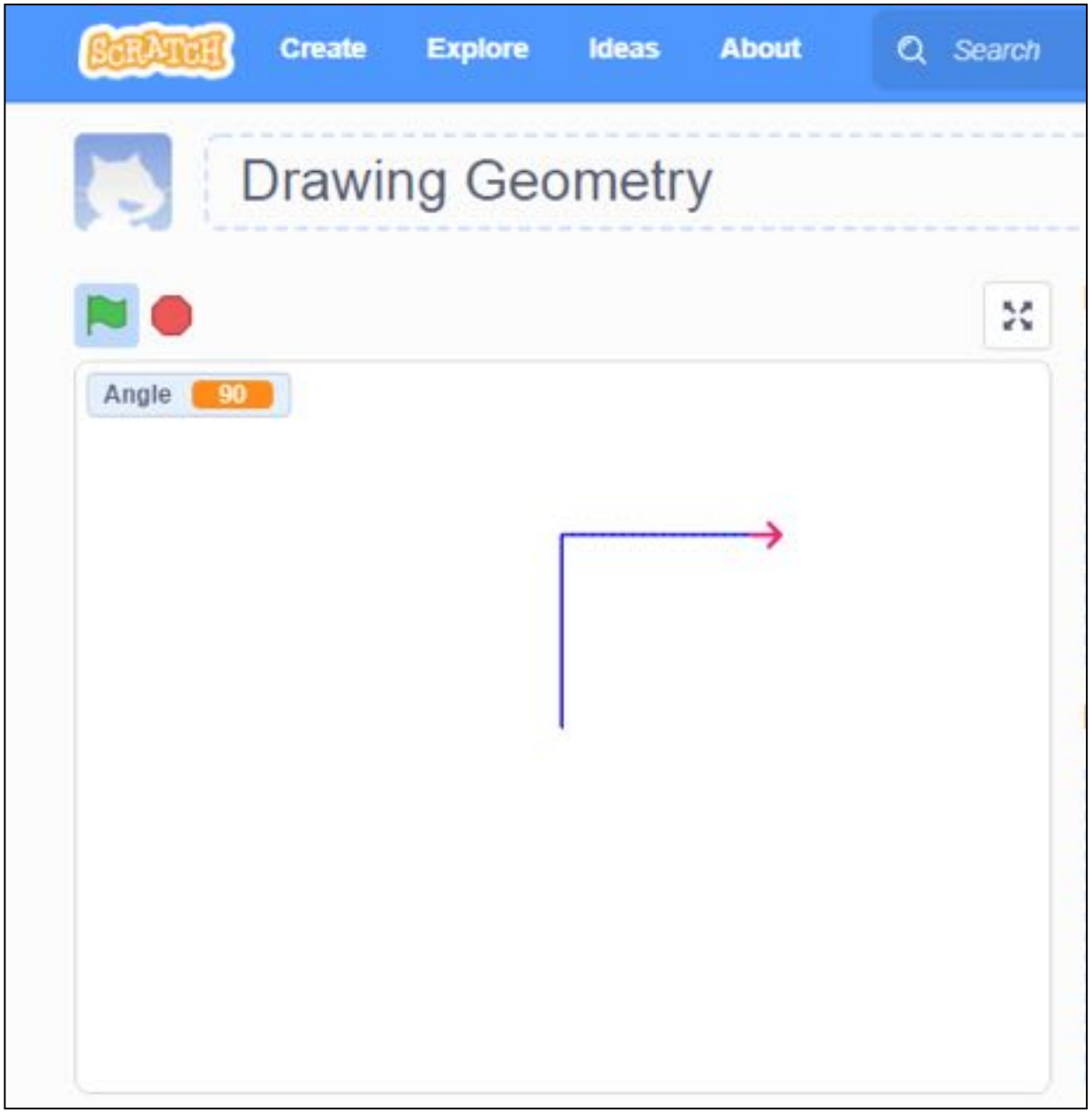
With the help of extra building commands, make not only the block of "build 4,5,6", but also all six blocks that are neighbors (that have one side in common).



Program

Execute

SCRATCH


SCRATCH
Create
Explore
Ideas
About
Search
Drawing Geometry
Angle
90

SCRATCH and Logic

ROBOT PROGRAMMING

- **Using block Programming**
- **Integrated with a robot**

ROBOT PROGRAMMING

- **Using block Programming**
- **Integrated with a robot**

Online Training

Geogebra: they learn how to program

It is still limited and simple script

Button, on click, input box and etc

SEAMEO QITEP in Mathematics 2020

Conducts 5 regular courses every year.
This year Courses:

1. RME for Junior High MT
2. JL for Primary School Teachers
3. LS for Senior High MT
4. ICT for Junior High MT
5. STEM for Primary School Teachers

The Computational Thinking topic is inserted as enrichment topic in the structure programme.

SEAMEO QITEP in Mathematics

PROGRAM STRUCTURE
COURSE SEA-RME

	TOPICS	HOURS	PERCENTAGE
GENERAL COMPONENTS			
	Introduction to SEAMEO	1	
	Current Issues and Trends in Mathematics Education	3	
CORE COMPONENTS			
	Realistic Mathematics Education	36	
a.	Introduction to RME	2	
b.	Concepts and Principles of RME	4	
c.	Mathematics in Contexts	8	
d.	Mathematical Modelling	6	
e.	Practical Mathematics	8	
f.	HLT	4	
g.	Assessment in RME	4	
	Enrichment	29	
a.	Socio-Mathematical Norms	4	
b.	Mathematical Literacy	4	
c.	Computational Thinking	4	
d.	STEM Education	6	
e.	Joyful and Meaningful Learning	2	
f.	Problem Solving	4	
g.	Digital Mathematics Environment	5	
	Mathematics Lesson in Schools	24	
a.	Developing Lesson Plan	8	
b.	Peer-teaching	4	
c.	Real-teaching	4	
d.	Reflection	4	
e.	Writing report	4	
	Supporting Components	7	
a.	Pre- and Post-test	2	
b.	Course Orientation	1	
c.	Designing Action plan	4	
	TOTAL	**100**	

The Computational Thinking topic is inserted as enrichment topic in the program structure.

Learning Material for CT

A module on CT has been developed in 2019

Considering the experience from NIE Singapore, non-computer activities and CT using spreadsheet would be used.

EXAMPLES with Excel

PRIMARY SCHOOL TEACHER

JH Mathematics Teachers

SH Mathematics Teachers

EXAMPLES

Recipe to make a cake

Component	Main Recipe (Gram)	New Ammount (Gram)
A	15	
B	20	
C	40	
D	25	75

To maintain the taste of the cake, we can see if the chart ingredient remains still.
So how many gram of A,B,C if D becomes 75 gram?
What will you do next? Can you determine any other amounts?

EXAMPLES

Addition and Subtraction

Odd + Odd = ?

Odd + Even = ?

Even + Even = ?

What would be the result?

Use formula:

=EVEN(RANDBETWEEN(number1;number2))

=ODD(RANDBETWEEN(number1;number2))

Or fill any even and odd numbers

EXAMPLES

Compare two fractions

$$\frac{5}{6} \text{ vs } \frac{6}{7}$$

What do you think about:

$$\frac{7}{8} \text{ vs } \frac{8}{9}$$

$$\frac{a}{a+1} \text{ vs } \frac{a+1}{a+2}$$

Is it always true? How would ms. Excel help you?

EXAMPLES

Given data math scores

6	5	9
7	8	8
6	7	9
5	10	8
8	6	6
9	5	6
6	7	8
5	7	6
7	10	9
8	9	10

Does this class have a good math scores? How do you know?
How many students do need remedial?
How many students do need to improve the grade to make the class average score is 7.5?

EXAMPLES

Extinction: Predator and Prey Model

THANK YOU