KaiBot's Number Line Challenge

In this activity students represent addition and subtraction story problems using KaiBot programming cards to code movements on number lines. Students code the KaiBot to physically demonstrate the solution to a worded problem. This process helps them break down word problems and create step-by-step solutions, which are known as algorithms.

This lesson is developed by combining and adapting ideas from the following resources from ***Kai Education.*** *Please note that access to the original documents require free registration.*

- *a snippet from the First Steps in Coding through Mathematical Thinking and Game-Based Learning – Grades K to 8*
- *Grade 2 Adding and Subtracting Numbers to 20*

Curriculum links

This activity is aligned with elements of the following learning areas. We encourage teachers to adapt the content and focus to suit the needs of their students. It can be adapted for students between **Year 1 to Year 2.** More curriculum details are provided in the supporting documents.

Digital Technologies	Mathematics

Required resources

You will need the following materials:

CSER Lending library kit (KaiBot)

- KaiBot robot, KaiBotTiles (1-20) and KaiBot cards
- Kai's Coding cards – Print edition (Optional)
- Example A4 laminated cards (set of 7)
- Access to digital online tool – Interactive Number line. For example: Math Learning Center Number line or Cool4Maths Number line

Pre-requisite knowledge

Prior to this session, students should have experience with:

- Number lines to 20
- Partitioning and combining collections up to 20

Suggested steps

We will be using KaiBot to practise our maths skills. We will be able to see maths in action, as we work through story problems that involve the addition and/or subtraction of up to three numbers whose sum or difference will be less than or equal to 20.

Students will program the KaiBot to move forward a given number of tiles (using the FORWARD arrow cards and the green 'number' cards) and/or move backward a given number of tiles (using the BACKWARD arrow cards and the green 'number' cards) based on the context of a story problem.

Conduct a whole class lesson session demonstrating the process including the use of the KaiBot and then students work in groups to apply the knowledge in different story scenarios and in differing challenges. Teachers will need to have practised running code on a KaiBot prior to this lesson.

Whole group

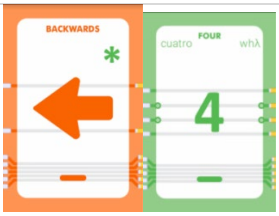
- Model the following story problem for students using physical or virtual materials such as images, toy dogs or blocks.
- Decompose the problem and remove the unnecessary information and identify the key points (abstraction). For example, it doesn't matter what breed the dogs are or where the dog park is located. See Supporting documents for more details on Computational thinking.

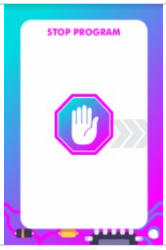
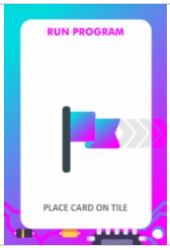
Pets at the park

There are 12 dogs at the park.
Then, 7 more dogs came to play. Finally, 3 dogs went home.

How many dogs are left at the park? **16 dogs**

- Using a physical number line (1-20 marks on the floor), have students act out the story problem using themselves or physical materials (blocks, toys). Identify the starting value. In this case, there are 12 dogs at the pet park – so that is a starting point. Discuss the key points and identify the other numbers that are relevant to solving the problem. (+ 7 and – 3).
- Discuss the language that forward on the number line is adding numbers and backwards is subtracting.
- Introduce the KaiBot programming cards and number line Large printable KaiBot card deck. Practise with the cards (without the KaiBot) to explain the purpose of each card.
- Discuss and model that each card has a purpose and will program KaiBot to 'do' something.

When a green number card follows a FORWARD arrow card, the KaiBot will move forward the number of tiles (spaces) identified on the number card.	
When a green number card follows a BACKWARD arrow card, the KaiBot will move backward the number of tiles (spaces) identified on the number card.	

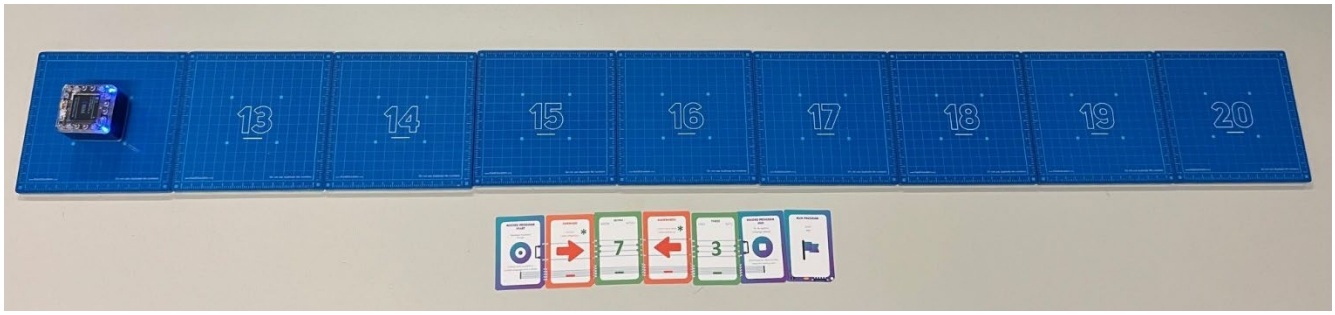
Identify **RECORD PROGRAM START** card		Identify **RECORD PROGRAM END** card	
Identify **STOP PROGRAM** card		Identify **RUN PROGRAM** card	

- Introduce the movement concepts by having the students act out the card instructions (human robots). Take one step backward. Kai-Bot will move backward the same distance each time.
- They need to then use a FORWARD code card along with the value they want to move forward, which in this case should be 7.
- Then, after coding the KaiBot to go FORWARD 7, they use the BACKWARDS 3 to represent the dogs that left the park. Have students work with you to arrive at the following program.
  We have provided 7 laminated cards in the CSER Kit to use as you sequence the algorithm. Seven students can hold a card each and be instructed by the group to move into the correct sequence.

- Align the 1-20 KaiBot tiles on the floor, beginning with 1 and ending with 20. There are up to 30 KaiBot tiles in our CSER kits, so this lesson could be modified to incorporate numbers up to 30.

- Finally, prepare the coding cards and program the Kai Bot. Ensure that the students place the front of the KaiBot on Tile 12 facing toward the number 20 (Note: starting point at 12 as 12 dogs were in the park). The yellow power switch is on the back of the KaiBot.
- Run the program. Debug the algorithm if required.

- Note the image below demonstrates Tiles 12 -20.

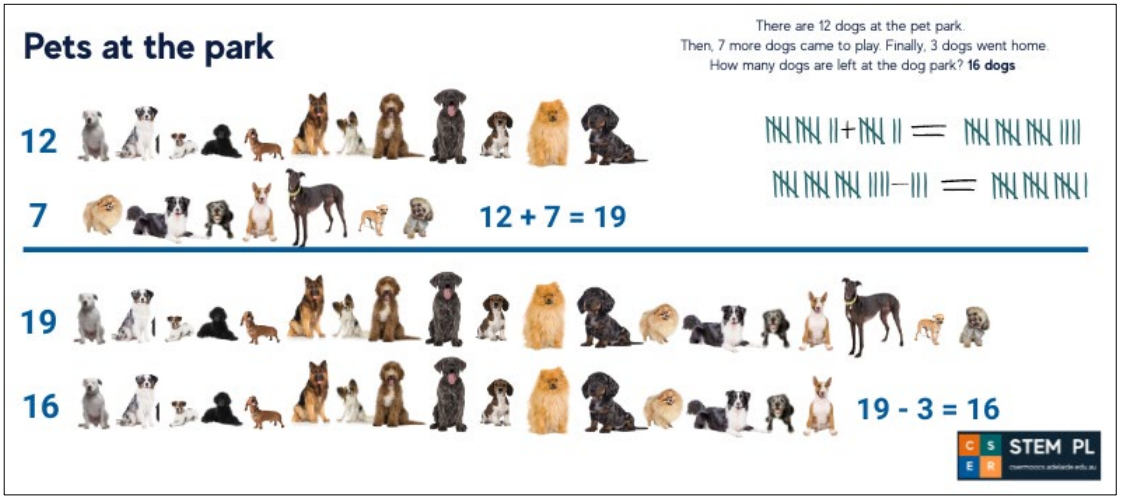


Small group activities

After the whole class demonstration - use the attached suggested story problems provided in supporting documents, or students' own examples and have groups rotate through the following activities. Adapt for the needs and skills of your students:

Digital Technologies Group – Following the same process used in the whole group activity, use KaiBot robot, cards and tiles to demonstrate the solution to their new story problem. Have students sequence the tiles to represent an algorithm for each new story problem.

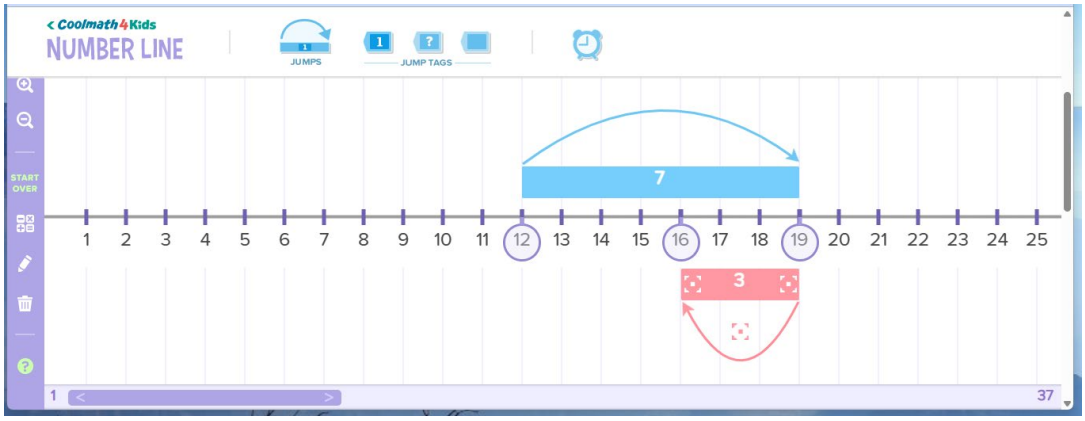
Maths Group - Write the solutions to their story problems as equations or diagrams, for example 12 + 7 = 19 and then 19 – 3 = 16



Literacy Group – Students write their own story problems for other groups to develop a solution. They could use picture books as context and a suggested sentence structure could be provided if required.

Digital tools and Maths Group - Explore number lines that will help demonstrate or represent the calculation strategies required to solve the problem. Students could use digital tools such as, Math Learning Center Number line or Cool4Maths Number line

If using a physical number line, students could develop an algorithm to instruct a 'human robot' to represent the story problem.



Pose questions

Use these example open-ended questions to prompt student reflection, check for understanding, and encourage discussion to help students explain their thinking and build on each other's ideas.

- What happened when you used the BACKWARD/FORWARD card?
- What action does the BACKWARD card do when combined with a green card?
- What clue is there on the orange card that reminds you to use the green cards?
- Which card is the _____ card?
- What action does the _____ card do?
- What does your algorithm or tile sequence tell the KaiBot to do?
- When the KaiBot moved forward on the number line, did the number get larger or smaller?
- What strategy did you use to solve the story problem? (count on, doubles, near doubles)
- How do you know your answer makes sense?
- Can you show me how to solve the story problem using a different strategy?

Why is this relevant? (Real world connections)

Learning to decipher worded maths problems and use tools such as number lines helps students translate everyday situations into solvable mathematical equations. These skills are essential for making sense of real-world scenarios like interpreting data or managing time and money by breaking them into manageable numerical relationships. Introducing algorithms alongside these strategies supports students in thinking logically and sequentially. Whether solving a maths problem, programming a robot, or following a real-life procedure, algorithms help students plan, organise, and carry out steps effectively. Together, these skills equip students to visualise and solve practical problems, making mathematics and computational thinking powerful tools in everyday life.

Assessment

Observation can be used to check students' ability to carry out tasks aligned to the Australian Curriculum. We have included some suggested questions for teachers to reflect on and to guide these observations.

Checking for understanding

- Were the students able to identify (abstract) the key information required? e.g. starting point
- Were the students able to follow and describe the algorithm required to demonstrate the solution to the problem?
- Did they correctly sequence the cards to make the KaiBot perform in the correct manner?
- Were they able to debug their code if the robot didn't behave as expected?
- Did they successfully modify the code for another story problem scenario? Could they explain the code block used?
- Were the students able to represent the story problems with diagrams, physical and virtual materials?
- Were the students able to identify the operations required to provide a solution to the story problem?
- Did they identify forward on a number line as addition and backward as subtraction?

For more assessment resources we recommend the Assessment resources on the Digital Technologies Hub.

Teacher professional learning opportunities

We would like to thank the Australian Government Department of Education for funding our Lending Library and associated resource development.

We run a range of STEM programs for Australian teachers, including our online CSER MOOC courses, free professional learning events, and our National Lending Library.

Our free, self-paced online courses available from CSER and Maths in Schools in the following areas:

- Decoding Digital Technologies
- Digital Technologies + X
- Cyber Security and Awareness
- Teaching AI in the classroom
- Maths in Schools – Foundation – Year 2, Year 3 to 6 and Year 7 to 10

www.csermoocs.adelaide.edu.au

Supporting documents

Australian Curriculum

This activity is suitable for students in Years 1 & 2 **Digital Technologies and Mathematics:**

Digital Technologies

Students in Years 1 & 2 learn to:

- follow and describe algorithms involving a sequence of steps, branching (decisions) and iteration (repetition) (AC9TDI2P02).

By the end of Year 2, students follow and describe basic algorithms involving a sequence of steps.

Mathematics

Students in Years 1 learn to:

- add and subtract numbers within 20, using physical and virtual materials, part-part-whole knowledge to 10 and a variety of calculation strategies (AC9M1N04)
- use mathematical modelling to solve practical problems involving additive situations including simple money transactions; represent the situations with diagrams, physical and virtual materials, and use calculation strategies to solve the problem (AC9M1N05).

By the end of Year 1, students solve problems involving addition and subtraction of numbers to 20 and use mathematical modelling to solve practical problems involving addition, subtraction, using calculation strategies.

Students in Years 2 learn to:

- add and subtract one- and two-digit numbers, representing problems using number sentences, and solve using part-part-whole reasoning and a variety of calculation strategies (AC9M2N04)
- use mathematical modelling to solve practical problems involving additive and multiplicative situations, including money transactions; represent situations and choose calculation strategies; interpret and communicate solutions in terms of the situation (AC9M2N06).

By the end of Year 2, students use mathematical modelling to solve practical additive problems, representing the situation and choosing calculation strategies.

Computational thinking

Students develop computational thinking skills by applying its core components: decomposition, abstraction, pattern recognition, using models and simulations, and creating algorithms and generalisations. This approach involves experimental and logical analysis, reasoning, and computer-based simulations and is useful in Technologies and Mathematics. This activity incorporates computational thinking by engaging students in several key aspects:

Decomposition: Students break down complex story problems (e.g., "The robot moves forward 3 steps, then backwards 2 steps") into smaller, manageable steps. This involves identifying the individual movements and operations required.

Pattern recognition: As students work through multiple story problems, they will likely start to recognise patterns in how movements translate to addition or subtraction on a number line or grid. For instance, ‘forward’ correlates with addition, while ‘backward’ correlates with subtraction.

Abstraction: When developing a solution to the story problem students abstract the information that is not required to create the mathematical equation.

Algorithms: Students are actively designing and creating algorithms – step-by-step instructions (the sequence of programming cards) to solve a mathematical problem. They are thinking about the precise order of operations needed for the KaiBot.

For more details, you can refer to the Australian Curriculum: Mathematics.

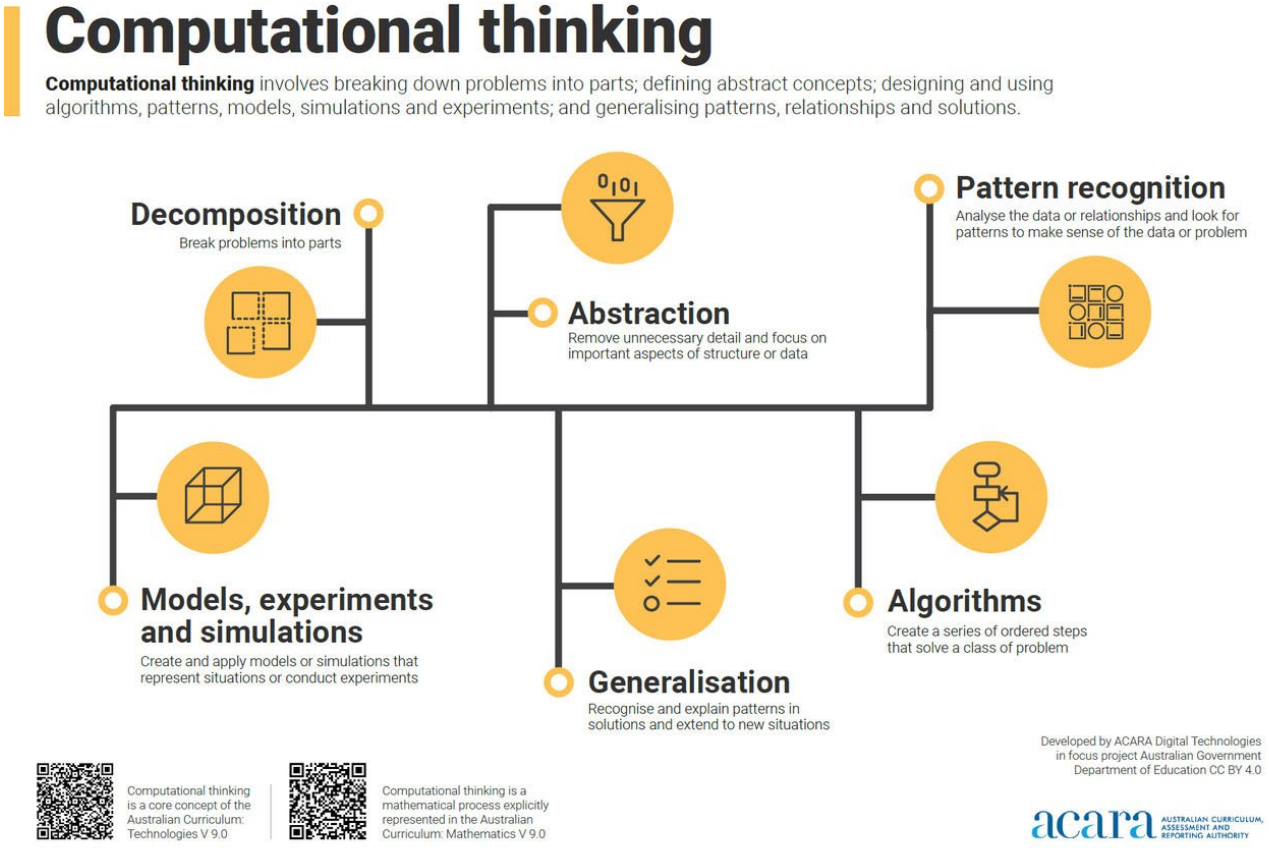


Image source: ACARA Understanding learning areas: Mathematics and Technologies

KaiBot Problem stories

Fish in the fishtrap

There was a fish trap in a river. 11 fish were caught but 2 jumped out. How many fish did they catch?

Answer: _____

Starting Number _____

Draw your coding cards below.

Pencils in the pencil case

Mia had 12 pencils in her pencil case. She lost 2 pencils on the way to school. Her teacher gave her 10 new pencils. How many pencils does Mia have now?

Answer: _____

Starting Number _____

Draw your coding cards below.

Adapted from: Kai Education https://docs.google.com/document/d/1JutblUZ_6EMHwnoMCKKFTPX8GXbabbKSPkXwbL24hgA/edit?pli=1&tab=t.0