Year 2 – Programming A – Robot algorithms

Unit introduction

This unit develops learners' understanding of instructions in sequences and the use of logical reasoning to predict outcomes. Learners will use given commands in different orders to investigate how the order affects the outcome. They will also learn about design in programming. They will develop artwork and test it for use in a program. They will design algorithms and then test those algorithms as programs and debug them.

Software and Hardware requirements

This unit includes references relating to Bee-Bot robots, however, other educational floor robots are available. If access to floor robots will prevent you teaching this unit, your local hub may be able to support with a loan kit. Find out more by visiting Physical Computing Kits - Teach Computing

If you've adapted this unit to better suit your school, please share your adapted resources with fellow teachers in the STEM community. Alternatively, if this unit isn't quite right for your school, why not see if an adapted version which better suits has already been shared?

Overview of lessons

Lesson	Brief overview	Learning objectives
1 Giving instructions	Learners will follow instructions given to them and give instructions to others. They will consider the language used to give instructions, and	To describe a series of instructions as a sequence

	how that language needs to be clear and precise. Learners will combine several instructions into a sequence that can then be issued to another learner to complete. They will then consider a clear and precise set of instructions in relation to an algorithm, and will think about how computers can only follow clear and unambiguous instructions.	• I can follow instructions given by someone else • I can choose a series of words that can be acted out as a sequence • I can give clear instructions
2 Same but different	Learners will focus on sequences, and consider the importance of the order of instructions within a sequence. They will create sequences using the same instructions in different orders. They will then test these sequences to see how the different orders affect the outcome.	To explain what happens when we change the order of instructions • I can use the same instructions to create different algorithms • I can use an algorithm to program a sequence on a floor robot • I can show the difference in outcomes between two sequences that consist of the same instructions
3 Making predictions	Learners will use logical reasoning to make predictions. They will follow a program step by step and identify what the outcome will be. **Note:** Learners may need to be encouraged to think through their predictions and understand that they are reasoned decisions rather than guesses.	To use logical reasoning to predict the outcome of a program • I can follow a sequence • I can predict the outcome of a sequence • I can compare my prediction to the program outcome
4 Mats and routes	Learners will design, create, and test a mat for a floor robot. This will introduce the idea that design in programming not only includes code and algorithms, but also artefacts related to the project, such as artwork.	To explain that programming projects can have code and artwork • I can explain the choices that I made for my mat design • I can identify different routes around my mat

	Note: The designs in this lesson can be changed to suit a topic or theme that the class is learning about. The ideas included in the slides are examples.	• I can test my mat to make sure that it is usable
5 Algorithm design	Learners will design an algorithm to move their robot around the mat that they designed in Lesson 4. As part of the design process, learners will outline what their task is by identifying the starting and finishing points of a route. This outlining will ensure that learners clearly understand what they want their program to achieve.	To design an algorithm • I can explain what my algorithm should achieve • I can create an algorithm to meet my goal • I can use my algorithm to create a program
6 Break it down	Learners will take on a larger programming task. They will break the task into chunks and create algorithms for each chunk. This process is known as 'decomposition' and is covered further in key stage 2. Learners will also find and fix errors in their algorithms and programs. They will understand this process to be 'debugging'.	To create and debug a program that I have written • I can test and debug each part of the program • I can plan algorithms for different parts of a task • I can put together the different parts of my program

Subject knowledge and CPD opportunities

This unit focuses on developing learners' understanding of computer programming. It highlights that algorithms are a set of clear, precise, and ordered instructions, and that a computer program is the implementation of an algorithm on a digital device. The unit also introduces reading 'code' to predict what a program will do. Learners will engage in aspects of program design, including outlining the project task and creating algorithms.

When programming, there are four levels that can help describe a project, known as 'levels of abstraction'. Research suggests that this structure can support learners in understanding how to create a program and how it works:

- Task — what is needed
- Design — what it should do
- Code — how it is done

- Running the code — what it does

Spending time at the 'task' and 'design' levels before engaging in writing code aids learners in assessing the achievability of their programs and reduces the cognitive load for learners during programming.

Learners will move between the different levels throughout the unit.

Continuing professional development opportunities
Enhance your subject knowledge to teach this unit through the following free CPD:

- Getting started in Year 2 – short course
- Introduction to primary computing remote or face to face
- Physical computing – KS1 BeeBots

Teach Primary Computing Certificate
To further enhance your subject knowledge, enrol on the primary certificate. This will support you to develop your knowledge and skills in primary computing and gain the confidence to teach great lessons, all whilst earning a nationally recognised certificate!

Progression

In advance of the lessons in this Year 2 unit, learners should have had some experience of creating short programs using floor robots and predicting the outcome of a simple program. This unit progresses learners' knowledge and understanding of algorithms and how they are implemented as programs on digital devices. Learners will spend time looking at how the order of commands affects outcomes. Learners will use this knowledge and logical reasoning to trace programs and predict outcomes.

Common misconceptions

A common misconception when pupils first use floor robots, or with any early programming, is the idea that if the Bee-bot does not reach it's intended destination that the Bee-Bot 'didn't do what they asked it to'. This is important to tackle early, to ensure that pupils understand that floor robots can only do what we tell them to do. If the floor robot doesn't behave as we expect, the problem is with the program we put onto it, not the robot not behaving. Whilst you may not want to introduce the vocabulary of debugging at this stage, the understanding that computers only follow the instructions given to them, so if an outcome isn't as expected it is down to the program not the computer, is an essential first step to understanding the need to debug.

Curriculum links

Computing

- Understand what algorithms are, how they are implemented as programs on digital devices, and that programs execute by following precise and unambiguous instructions
- Create and debug simple programs
- Use logical reasoning to predict the behaviour of simple programs

Maths

Measure

- ∉ sequence events in chronological order using language [for example, before and after, next, first, today, yesterday, tomorrow, morning, afternoon and evening]

Geometry - position and direction

- ∉ describe position, direction and movement, including whole, half, quarter and three-quarter turns

Assessment

Formative assessment

Assessment opportunities are detailed in each lesson plan. The learning objective and success criteria are introduced in the slide deck at the beginning of each lesson and then reviewed at the end. Learners are invited to assess how well they feel they have met the learning objective using thumbs up, thumbs sideways, or thumbs down.

Summative assessment

Please see the assessment rubric document for this unit. The rubric can be used to assess learning and highlights whether the pupil is approaching (emerging), achieving (expected), or exceeding the expectations in this unit.

Resources are updated regularly — the latest version is available at: ncce.io/tcc.

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