DIGITAL SCHOOLHOUSE
together with
NINTENDO SWITCH

+44 (0) 207 534 0586
contact@digitalschoolhouse.org.uk

Teaching Guide.

The Maths Quiz

Introduction

This workshop combines mental maths skills with computing and algorithmic thinking. The day begins by encouraging pupils to think about algorithms and introduces this concept through magic. Early on pupils are encouraged to decompose existing puzzles and tricks to identify the algorithm behind them as well as extend their learning to develop their own. Pupils then move onto the concept of variables and random numbers using unplugged activities before the quiz is introduced.

Pupils develop their plans for the quiz by initially examining an existing game. Through discussion and play they decompose the game to identify key elements within it. An existing flowchart is used to compare against set criteria and identify the missing elements. They are then encouraged to extend their flowcharts to illustrate how their planned modifications to the quiz would work.

Pupils develop their programming skills in order to develop their quiz. Once they believe they've finished, group work is used to encourage dry run testing and debugging. Peer feedback and support is used to help pupils develop their programs further, correct them and modify them. Communication skills are encouraged throughout the day and especially at the end when the groups have to feedback the results of their activity to the rest of the class.

This workshop and its resources are based in Scratch. However, the workshop could easily be delivered in an alternative programming environment such as Python.

+44 (0) 207 534 0586
contact@digitalschoolhouse.org.uk

Computing Programmes of Study Links

2.1. design, write and debug programs that accomplish specific goals, including controlling or simulating physical systems; solve problems by decomposing them into smaller parts

2.2. use sequence, selection, and repetition in programs; work with variables and various forms of input and output

2.3. use logical reasoning to explain how some simple algorithms work and to detect and correct errors in algorithms and programs

Progression Pathway bands covered

ALG = Algorithms: Pink, Yellow, Orange, Blue

Reference

PA1	Understands what an algorithm is and is able to express simple linear (non-branching) algorithms symbolically.
PA2	Understands that computers need precise instructions.
PA3	Demonstrates care and precision to avoid errors
YA1	Understands that algorithms are implemented on digital devices as programs
YA2	Designs simple algorithms using loops, and selection i.e. if statements.
YA3	Uses logical reasoning to predict outcomes.
YA4	Detects and corrects errors i.e. debugging, in algorithms.
OA1	Designs solutions (algorithms) that use repetition and two-way selection i.e. if, then and else.
OA2	Uses diagrams to express solutions.
OA3	Uses logical reasoning to predict outputs, showing an awareness of inputs.
BA2	Designs solutions by decomposing a problem and creates a sub-solution for each of these parts.
PA1	Understands that iteration is the repetition of a process such as a loop.

+44 (0) 207 534 0586
contact@digitalschoolhouse.org.uk

P&D = Programming & Development: Pink, Yellow, Orange, Blue

Reference

PP1	Knows that users can develop their own programs and can demonstrate this by creating a simple program in an environment that does not rely on text
PP2	Executes, checks and changes programs
PP3	Understands that programs execute by following precise instructions
YP1	Uses arithmetic operators, if statements, and loops, within programs.
YP2	Uses logical reasoning to predict the behaviour of programs
YP3	Detects and corrects simple semantic errors i.e. debugging, in programs.
OP1	Creates programs that implement algorithms to achieve given goals.
OP2	Declares and assigns variables.
OP3	Uses post-tested loop e.g. 'until', and a sequence of selection statements in programs, including an if, then and else statement.
BP2	Uses a variable and relational operators within a loop to govern termination.

IT = Information Technology: Pink, Yellow, Orange, Blue

Reference

PI5	Talks about their work and makes changes to improve it.
YI5	Talks about their work and makes improvements to solutions based on feedback received.
OI3	Makes appropriate improvements to solutions based on feedback received, and can comment on the success of the solution.
BI4	Uses criteria to evaluate the quality of solutions, can identify improvements making some refinements to the solution, and future solutions

+44 (0) 207 534 0586
contact@digitalschoolhouse.org.uk

Computational Thinking Strands

AL – Algorithmic Thinking

Ref.	Activity
A1	Writing instructions that if followed in a given order (sequences) achieve a desired effect
A2	Writing instructions that use arithmetic and logical operations to achieve a desired effect
A3	Writing instructions that store, move and manipulate data to achieve a desired effect; (variables and assignment)
A4	Writing instructions that choose between different constituent instructions (selection) to achieve a desired effect;
A5	Writing instructions that repeat groups of constituent instructions (loops/iteration) to achieve a desired effect;

AB – Abstraction

Ref.	Activity
Ab1	Reducing complexity by removing unnecessary detail;

EV - Evaluation

Ref.	Activity
E3	Designing and running test plans and interpreting the results (testing);
E10	Stepping through algorithms/code step by step to work out what they do (dry run / tracing);
E15	Assessing whether a solution meets the specification (criteria);

DE - Decomposition

Ref.	Activity
D1	Breaking down artefacts (whether objects, problems, processes, solutions, systems or abstractions) into constituent parts to make them easier to work with

+44 (0) 207 534 0586
contact@digitalschoolhouse.org.uk

Learning Outcomes

1. Understand that algorithms are instructions written concisely
2. Be able to solve simple mathematical problems mentally to be able to test the accuracy and functionality of their program
3. To understand the concept of iteration and to be able to implement it within their program
4. To explain and understand the concept of variables
5. To be able to use variables in simple formulae
6. To be able to create a calculator in Scratch
7. To be able to design and edit their own sprites in Scratch
8. To be able to program the sprites within scratch using simple constructs such as sequence, selection and repetition.
9. To be able to use an existing maths quiz program and decompose it to identify its component parts and program
10. To be able to use a model of a completed quiz to be able to write and develop an algorithm for their own extended version
11. To be able to test and debug their own and their peers maths quiz program to resolve errors
12. To be able to work in a group to suggest modifications
13. To be able to provide feedback to their peers
14. To be able to use feedback provided by their peers to make suggested modifications

Digital Schoolhouse, 18a Blackbull Yard, 24-28 Hatton Wall, London EC1N 8JH.

+44 (0) 207 534 0586
contact@digitalschoolhouse.org.uk

Session Overview

SESSION 1

Session Content / Activity	Resources Used	Prog. Pathway	Comp. Thinking	Computing POS Link
Welcome the group Introduce the routines and specifics for the day Introduce the topic	DSH_WelcomeIntroduction.ppt			
Carry out starter activities. Begin by carrying out one of the suggested magic tricks from Mr Magoriums Magic Emporium or alternatively, pick one of the CS4FN magic tricks. Afterwards have a discussion with the pupils; can they work out how the trick was done? Then show pupils the instructions to carry out the trick. Enable them to try it for themselves. Reinforce the message that algorithms are simply instructions. Well written, concise instructions.	http://nationalschoolspartnership.com/pdfs/mr-magoriums/MagicActivity.pdf http://www.cs4fn.org/mathemagic/	ALG PA1, PA2, YA3, OA3	A1	2.3
3 is the magic number While this is trick, it is mathematical in nature and therefore a good way to set the scene. Use the instructions added to slide 3 of the PowerPoint and carry it out with the class. Ask the students to get into pairs and test it with each other. Why is the result always 3? The answer is based on the 9 times table	Maths Quiz.ppt	ALG OA3	A1, A2	2.3
Introduce the river crossing puzzle activity. Read out the puzzle – do pupils know what the answer is? Cut out the individual statements from “the river crossing puzzle”. Give each small group of pupils a pack of	Maths Quiz.ppt The River Crossing Puzzle.ppt	ALG PA1, PA2, YA3, BA2	A1, A2, D1, Ab1	2.1, 2.2, 2.3

+44 (0) 207 534 0586
contact@digitalschoolhouse.org.uk

statements. Ask them to select the correct statements and rearrange them in the correct order to solve the puzzle correctly. Ask groups to share their answer. Show them the solution – emphasise that it's only an algorithm to solve a problem! Programming! Go through slides 8 – 10 and discuss how the algorithm can be changed. Introducing the concept of the variable within it. Allow pupils to manipulate their algorithms, to redevelop it and refine it by placing and using different objects. Pupils are taking a solution to a problem and potentially adapting it to solve a similar but different problem.				
Use slides 12 & 13 to reinforce the idea of variables and algorithms and point these out in the work that they have just done.	Maths Quiz.ppt	ALG PA1, YA1	A3	2.2
What is a variable? The activity on slides 14 – 16 is simple. You simply need a container of some kind, this could be anything. A box is suggested on the slide but you could just as easily use a plastic wallet or envelope. Ask pupil to think of a number between 1 – 100, write it on a piece of paper and add it in the container. Then ask another pupil to do the same. However, only one piece of paper (value) can go in at one time. (you could allow multiple pieces of paper, and the rules for organising them would illustrate other data structures such as stacks and queues) It's a simple activity that you only need to repeat a few times and shouldn't take more than a few minutes to carry out. You can extend it to show how we can increment the value in a variable, or how we can make comparisons of the data within it. Have a very brief discussion to highlight that students were thinking of random numbers, and what these might mean.	Maths Quiz.ppt A container	ALG YA3 P&D OP2	A3	2.2
Explain the quiz to the pupils. Then get them to play the game from the Scratch file.	Maths Quiz.ppt			2.1

+44 (0) 207 534 0586
contact@digitalschoolhouse.org.uk

Distribute the 'can you figure it out' worksheet. The worksheet provides prompts to help students investigate the programming contained within the game. Guide students to help them consider what the key elements of the game are, and how they interact with each other. End this with a discussions drawing in suggestions from the group	Maths Quiz.ppt Can you figure it out.doc	ALG PA1, PA2, PA3, YA1, YA2, YA3, OA1, OA2, OA3, BA2	D1	2.1, 2.2
Show the diagram on slide 21. The flowchart illustrates how the program works. Can students work out that the countdown timer has not been included? Move onto slide 22, and ask students to recreate the flowchart as they see on screen, but by including the elements needed for the countdown timer. Display the answer after sufficient time has been given. Enable students to discuss variations between their flowcharts. Explain if the logic works, then the flowchart is correct. Slide 24 asks pupils to refer back to their 'can you figure it out' worksheet. Ask pupils to add to the current flowchart and extend it to include one of their modifications. Keep this to the side	Maths Quiz.ppt Can you figure it out.doc	ALG PA1, PA2, PA3, YA1, YA2, YA3, YA5, OA1, OA2, OA3, BA2, PPA1	A1, A2, A3, A4, A5, Ab1, E10	2.1, 2.2

SESSION 2

Session Content / Activity	Resources Used	Prog. Pathway	Comp. Thinking	Computing POS Link
Recap key elements from session 1. Enable pupils to share and discuss their flowcharts with their peers	Maths Quiz.ppt			2.1, 2.2, 2.3
Use slides 25 to 29 to work with students to help develop their Scratch skills. Pupils may have used Scratch already and therefore, may have existing skills, if so adapt this session accordingly. Use the help videos to help deliver this section as a resource that pupils can use. There are alternative options to the traditional "demo and do" teaching technique here. For example, set the key elements of what they need to learn as a 'challenge'. Challenge pupils to work out the answer for themselves. Or challenge different groups of pupils to discover investigate	Maths Quiz.ppt	P&D PP1, PP2, PP3, YP1, YP2, YP3, OP2, OP2, OP3, BP2	A1, A2, A3, A4, A5, Ab1, E10	2.2

+44 (0) 207 534 0586
contact@digitalschoolhouse.org.uk

different things. Then allow the pupils to share their learning with each other. Either by swopping members of the groups or by demonstrating what they've learnt to the whole class.				
Show slide 30/31 on the board. Tell pupils to use their flowcharts from session 1 as a guide to help them develop their quiz. If they have a problem they should refer back to their flowcharts to guide them on how it should be working. Help students to complete a working version of the maths quiz. The videos can be used by the pupils for individual support.	Maths Quiz.ppt	P&D PP1, PP2, PP3, YP1, YP2, YP3, OP2, OP2, OP3, BP2	A1, A2, A3, A4, A5, Ab1, E10	2.1, 2.2, 2.3

SESSION 3

Session Content / Activity	Resources Used	Prog. Pathway	Comp. Thinking	Computing POS Link
Begin the session by having a brief discussion enabling pupils to share their progress made in the previous session.	Maths Quiz.ppt			
Divide class into groups of 4. This could be random groups, or students who are sitting next to each other. Or you may wish to divide into ability/mixed ability groupings etc. This is a testing and debugging exercise. Encourage pupils within the group to take it in turns to play each other's quizzes. Perhaps they can compare scores and compete. Their goal is to try and find out the 'bugs' within the program. What doesn't work, and why? Pupils can establish their own method of recording and communicating their feedback to each other. Each pupil should then aim to correct and repair their program based on feedback. Group members should support each other to ensure that they all have a working quiz by the end of the program. Perhaps this could be turned into a class competition? Which group completes this task first? The teachers could	Maths Quiz.ppt	P&D PP1, PP2, PP3, YP1, YP2, YP3, OP2, OP2, OP3, BP2 ALG PA3, YA3, OA3, BA2	E3, E10, E15	2.3

+44 (0) 207 534 0586
contact@digitalschoolhouse.org.uk

then check and test to verify the winner – perhaps a small prize for the winning group or a reward?				
Within their groups once again, the pupils should then examine the modifications they wanted to build at the start of the day. Within their groups encourage them to discuss these modifications and support each other in building them. Group members can advise each other on what could be done. The entire group could select and implement the same modification, or they could all continue this as individuals. It is entirely up to them. Or you may wish to use this as an opportunity for differentiated activities if groups have been set according to ability.	Maths Quiz.ppt	P&D PP1, PP2, PP3, YP1, YP2, YP3, OP2, OP2, OP3, BP2 ALG PA3, YA3, OA3, BA2	A1, A2, A3, A4, A5, E3, E10, E15	2.1, 2.2, 2.3
End the day by enabling pupils to feedback and share. Leave time for groups to sit together and decide the nature of their feedback. Each group should nominate a spokesperson – or share their speaking. They should decide how best to feedback to the class their testing procedure and details of the modifications they made. You may wish to encourage the rest of the class to ask questions to further discussions. Encourage groups to demonstrate the work that they have carried out.	Maths Quiz.ppt	IT PI5, YI5, OI3, BI4	E3, E10, E15, Ab1	2.3
End the session with a summary of the day. perhaps a simple plenary such as asking pupils to share their: - Major success/achievement of the day - Would be even better if…		IT PI5, YI5, OI3, BI4		

+44 (0) 207 534 0586
contact@digitalschoolhouse.org.uk

Files/Resources

Filename	Resource Type	Purpose/Description
Can you figure it out.doc	Worksheet	Worksheet for pupils to complete
Maths Quiz.ppt	PowerPoint	Main teaching PowerPoint
The River Crossing Puzzle.doc	Worksheet	Puzzle algorithm statements to photocopy and cut out for pupils
Maths Quiz intro.avi	Video Clip	Video Tutorial
Maths Quiz intro.sb	Scratch Source file	Source document
Maths quiz Variables.avi	Video Clip	Video Tutorial
Maths quiz Variables.sb	Scratch Source file	Source document
Maths quiz Scoring.avi	Video Clip	Video Tutorial
Maths quiz Scoring.sb	Scratch Source file	Source document
Variable countdown Timer.avi	Video Clip	Video Tutorial
Variable countdown timer.sb	Scratch Source file	Source document

PLEASE NOTE: The activities outlined in this workshop pack are a suggested outline of how the workshop can be delivered. It is envisaged that teachers will adapt the resources and the organisation of them according to the needs of their class.

Digital Schoolhouse, 18a Blackbull Yard, 24-28 Hatton Wall, London EC1N 8JH.