BOWLAND
MATHS
Professional development

Into the classroom

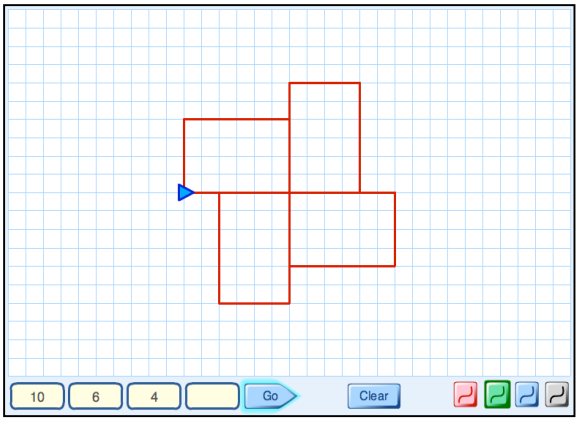
ICT: Using resources effectively

'How do I get them to stop playing and start thinking?'

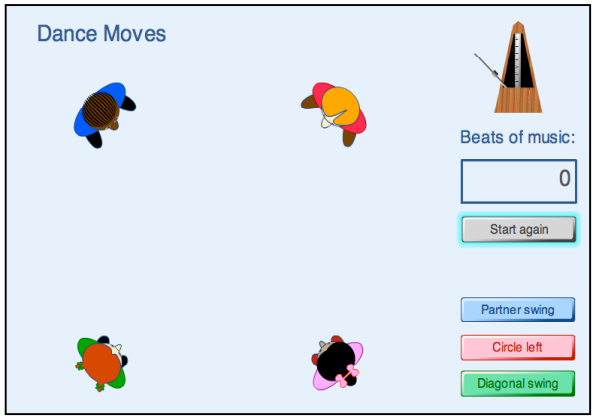
The following suggestions describe one possible approach to using the microworlds *Spirolaterals* or *Dance Moves* with your pupils. Each microworld will need between one and two lessons. Although the plans are presented together, we do advise, that you only use one program at a time!

Introduce the microworld to the class — 5 minutes

Spirolaterals



Dance Moves



Each lesson needs very little in the way of introduction. Give each pupil a copy of the appropriate handout and explain the purpose of the lesson:

> *The aim of today's lesson is for you to explore a simple computer program.*
> *Your task is to try to answer these questions:*
>
> - *What does the program do?*
> - *What interesting problems does it suggest to you?*
> - *Can you solve any of these problems?*
> - *Can you make any conjectures and prove them?*

Explain how pupils are expected to work:

> *I want you to work in pairs to see how the software works.*
>
> *Try to record precisely what happens when you enter different numbers/ press different buttons.*
>
> *As you do this, begin to think of some possible problems to investigate.*
> *You might, for example make up problems that start with the words:*
>
> **Spirolaterals**
> *"How can we make the computer draw ....?"*
> *"What will happen if we .....?"*

Dance Moves
"How many different ways...?"
"How can I make the dancers move so that...?"
"How many beats would....?"
"Can I get the dancers to do .... in .... beats?"

I'll ask you to share your ideas for problems with the rest of the class in five minutes!

Issue pupils with clipboards, 1 cm squared paper, pencils, and rulers. Some pupils have also found it helpful to use coloured counters when working on Dance Moves.

Pupils explore the microworld and generate problems 10 minutes

Allow pupils 5 minutes to explore what happens as they type numbers into the software. Go round, encouraging pupils to describe what is happening precisely.

Spirolaterals
So tell me how the computer knows what to draw when you enter those numbers.

Dance Moves
Tell me exactly how the dancers will move if you press diagonal swing?
Can you show me with counters?

Encourage pupils to write down some ideas for problems to explore.

Pupils describe what is happening and suggest problems to explore 15 minutes

Describing what is happening:

Spirolaterals
If I enter these three numbers (1, 2, 3) what will it draw when I press go?
What is the computer doing with these three numbers?

Dance Moves
If I press "Circle right" what do the dancers do?
What angle do they turn through?
Can you give us a demonstration?

Encourage pupils to describe what is happening as clearly and fully as they can. For example, they might say:

Spirolaterals
You start by facing to the right.
You move 1 unit forward then turn left 90°
You move 2 units forward then turn left 90°
You move 3 units forward then turn left 90°.
You move 1 unit forward then turn left 90°.
... and so on repeating 1,2,3 until you get back to the start.

Repeat this process with other numbers until you think pupils know how the program draws the shapes.

> **Dance Moves**
> The dancers each move forward and join hands to form a 'square'.
> They then rotate through 270° anticlockwise.
> They then step backwards.

Pupils may like to come out to the front and give a demonstration! This isn't as easy as it sounds for some as the orientation of the moves can confuse them.

Suggesting problems to explore

Now brainstorm possible problems to explore and list some on the board or flipchart. Pupils might suggest ideas such as the following:

> **Spirolaterals**
> - *What will happen if we enter a single number* and press "Go"*.*
> *2 numbers? 3 numbers? 4 numbers?*
> *Can we predict the types of shapes we will get?*
>
> - *What happens when we change the order of the numbers?*
> *So how is (1,2,3) different from (1,3,2)?*
>
> - *Do the shapes always go back to the start?*
> *When do they? When don't they?*
> *How can we predict this from the numbers?*
>
> - *When do the shapes have rotational symmetry?*
> *Can we predict this from the numbers?*
>
> - *When do the shapes have line symmetry?*
> *Can we predict this from the numbers?*
>
> - *What happens if we enter the same number more than once?*
> *What happens with 3 numbers, like (1,1,2); (3,2,3)?*
> *What about 4 numbers, like (1,3,4,4)...?*
>
> **Dance Moves**
> - *How can we get the dancers to do a dance and then back to their original positions?*
> *What different ways are there of doing this?*
> *How many different numbers of beats are needed?*
>
> - *What other different positions can the dancers end up in?*
> *How can we represent these positions?*
> *How can the dancers reach these different positions?*
>
> - *Are there impossible configurations?*
> *How can we be sure that they are impossible?*
>
> - *Can we find a dance that lasts, say, 64 beats so that the dancers end up where they started?*

Ask pupils to choose a particular problem to work on. Encourage them to be systematic as they try to answer their problem.

Discuss how they should record their work.

> *When you think you have some hypotheses or conjectures, I want you to be able to show me the evidence for this. So as you work, try to keep careful notes of what you try. You may like to copy some of the diagrams by taking screen shots and pasting them into a word processor.*

Pupils work on the problems 20 minutes

As pupils work on the problem, prompt them to think strategically and analytically:

> *Can you state your problem to me clearly?*
> *What examples have you tried so far?*
> *What are you keeping fixed? What are you changing?*
> *Can you do this in a systematic way?*
>
> *What have you found out so far?*
> *Can you see any patterns or relationships here?*
> *Can you explain **why** your idea seems to work?*
>
> *How are you keeping a record of your work?*
> *Can you use a helpful notation?*
> *Why do you need to do this?*
> *Can you use the computer to do this?*

Pupils report back and share findings 10 minutes

When most pupils have made significant progress with their problem, invite a few pairs to come to the front and communicate their ideas to the rest of the class. They can show some patterns on the software itself, projected for others to see. It does not matter if some have not yet reached any conclusions. They can still share their approaches and ideas.

> *Let's stop and share some of the different approaches we have used and consider what you have discovered.*
>
> *Tell us about:*
> - *the problem you are solving;*
> - *how you have organised your work;*
> - *any conclusions you have reached so far.*
> - *any explanations you have for your answers?*

As pupils share their ideas, ask others to contribute suggestions, further examples or counterexamples and ideas of what to do next.

For homework, pupils could be asked to write an account of their discoveries.