



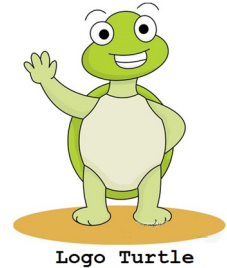
# Learning with Computer Programming

How programming helps children develop valuable 21<sup>st</sup> century skills

1

## 21<sup>st</sup> Century Learning Skills

It is universally accepted that in the 21<sup>st</sup> century, facts and information will matter less. Our children will need *intellectual curiosity* and a *life-long interest in learning*. They will need the *ability to learn on their own*. They will use *creativity* and *multi-disciplinary skills* to solve real-life problems. They will need to be *entrepreneurial* in their thinking. And they will benefit from skills in *Math, Science, and Technology*.



2

## How Children Do Programming

When children (usually grades 5<sup>th</sup> and above) do programming, they undertake design-based projects to create *artwork, puzzles, animation, games, simulations*, and so on. They use languages like *Scratch* and *Logo*, which have a *simple syntax* and an intuitive environment. Children get immediate feedback when they program. These languages are extremely popular worldwide and have been designed specifically to make “learning” happen when you program in them.

When children do programming, the teacher’s role is that of a *facilitator, coach, or debugger* (helper in problem-solving). Children spend most of their time in *hands-on activity* and *group collaboration*, and they enjoy the overall experience immensely.

3

## Children’s Experience

When children do programming, they talk with the brain of the computer and thus develop a life-long friendship with the “real” computer. Their perspective changes from being just a “software user” to becoming a “software builder”. They get introduced to ideas in **computational thinking**. They apply their math skills and problem-solving skills in their projects. They gain valuable insights through exploration and through the mistakes they make. And every child gets to taste the joy of achievement.

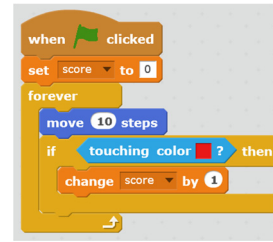
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## What Most Children Do Today with the Computer

In many schools and at home children’s interaction with computers involves using ready-made applications (such as Paint or Word) or entertainment (playing games and videos, and social media). Naturally, they view the computer as a box with ready-to-use applications or as a window to information (the Internet).

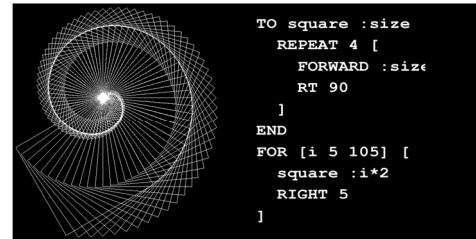
It is not uncommon for some children to even develop fear of the computer’s mysterious powers.

# Learning with Computer Programming



← Scratch

Logo



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## What is Computational Thinking?

It's an approach to solving problems in a way that can be implemented with a *computer*.

Students become “users” as well as “designers”; they develop *perspectives* of themselves and the world around them.

**Computational concepts** (such as abstraction, recursion, and iteration) help process and analyze data, and to create real and virtual artifacts.

It's a problem-solving methodology that can be transferred and applied across subjects.

3

## Power of the “Project Approach”

When children do programming they work on a series of design projects. Projects foster creativity and active learning. They allow conceptual learning to happen gradually and indirectly.

When children do projects, their learning has a sense of purpose, e.g. Geometry/Mechanics through animation. Project work promotes **computational practices** such as iterative construction, reusing and remixing, modularity, testing/debugging, etc.

4

## “Soft” Skills

Programming projects give children confidence in dealing with complexity. They develop persistence – the habit of working till you succeed.

Due to the open-ended nature of programming problems, children develop tolerance for ambiguity.

In a group environment they share ideas and insights, and thus develop the ability to communicate and work with others to achieve a common goal or solution.

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## How Computational Thinking Helps

It's also known as *algorithmic thinking* – which is a new way of solving problems.

In this way of thinking there is no *right* or *wrong* – there are multiple approaches to a solution, which is achieved through incremental improvement.

Computational concepts (like repeat, random, decisions) create interesting new possibilities.

Complexity is tackled by dividing big problems into sub-problems. Children learn “debugging” – a technique of spotting errors in thinking.

5

## Benefits to the Community

By letting children work on creative design work we sustain the next generation of *Creators* and *Innovators*.

Programming skill gives the power to solve real-life problems (and thus help the community).

It prepares students for future careers & endeavors related to science and technology. Students develop key 21st century skills: Collaboration, Communication, and Teamwork.