ROBOTICS CURRICULUM

FOR KINDERGARTEN & EARLY ELEMENTARY SCHOOL EDUCATION

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INBOTS
Inclusive Robotics for a better Society

EDUMOTIVA
EUROPEAN LAB for EDUCATIONAL TECHNOLOGY

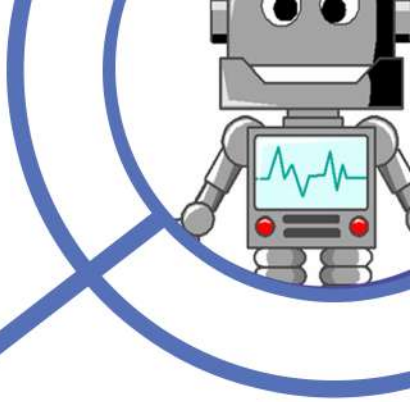
INTRODUCTION

The suggested curriculum smoothly introduces learners 5-6 years old into robotics First, the learners are familiarized with the concept of robotics through warm up activities. Then they are invited to recreate the gained experiences by using floor robots that are programmed through tactile commands. Gradually, and through several sessions, they are getting familiar with several programming methods and other concepts related to robotics such as circuitry, tangibility and interactivity. Embodied activities are also proposed to strengthen their learning experiences.

A wide range of technologies and tools (see appendix) can be used for carrying out the sessions presented below. This is a high priority in the design process of the INBOTS curriculum as we would like to push against tool-oriented curricula. A variety of everyday materials and crafting tools can be also used for carrying out the proposed activities. Having a plan on how to manage materials and organizing a functional and creative working place for exploring robots is important. Towards this end, a file with tips and guidelines for teachers has been created.

The table below presents how the curriculum is structured in sessions. The time per session may vary. A session can be extended or shortened given your children's needs and group dynamics. Sessions can be skipped or merged. If time is tight, teachers can consider leaving out a particular project or activity, giving children enough time to really understand and work with the ideas they are introduced to rather than skimming over all the activities presented in this curriculum.

Sessions	Estimated time
Session 1: Introductory session	1 hour
Session 2: Simple scenarios with floor robots	1 - 2 hours
Session 3: Applying storytelling	2 hours
Session 4: Drawing with floor robots	2 hours
Session 5: Exploring programming concepts with floor robots	2 - 3 hours
Session 6: Creating circuits with simple materials	2 hours
Session 7: Exploring interactivity using programmable toys	2 - 3 hours



Session description:

Introductory session: In this session children are introduced to robotics through simple questions regarding robots and through playful embodied tasks in the physical space.

Prerequisites:

- None

Indicative technologies:

- Not applicable at this session

Session 1

Session outline:

1. Brainstorming session followed by drawings, images, stories etc.
2. Embodied learning experiences in groups of 2-3
3. Wrap up

Objectives:

Children will be able to:

- explain what a robot is and what can do
- follow directional guidelines and orient in space
- provide directional guidelines to orient other in space
- perform specific embodied movements
- practice their collaboration skills through tasks that are based on synchronised efforts
- recognize daily activities that are performed by robots

Children's activities:

- Discussing what a robot is and which are the basic tasks that can perform
- Performing in groups a number of playful embodied tasks (e.g adopting the roles of programmer and performer- see resources in the link below) in order to engage young learners to control robots with precise instructions

Resources:

- Warm up activities and general tips: http://edumotiva.eu/edumotiva/wp-content/uploads/2021/03/WarmUp_activities.pdf

Session description:

Simple scenarios with floor robots: In this session the children build on the experience gained in session 1 and make floor robots (e.g. KUBO, bee-bot, blue-bot) to follow routes.

Prerequisites:

- None

Indicative technologies:

- Kubo, Botley
- Bee-bot, Blue bot, Roamer, Colby mouse

Session 2

Session outline:

1. Recalling the embodied tasks that were performed during session 1
2. Setting routes on the floor or play mat
3. Work in groups and instruct the robot using (where applicable) the available symbol cards (see resources list below) to make the robot follow a route
4. Wrap up

Objectives:

Children will be able to:

- set a route as part of a programming scenario
- use directional language to control a robot
- program a robot using age-appropriate tools
- parallelize the embodied experience to the operation of a robot
- explain what a robot does

Children's activities:

- Recalling the embodied tasks performed during session 1 and discussing in groups on how they can replicate these tasks with the tangible floor robots
- Programming the tangible floor robots to replicate the embodied activities
- Making adjustments and modifications if necessary/ use of cards with symbols indicating orientation (i.e. move forward, turn left etc.) to facilitate the process
- Sharing the results in the plenary

Resources:

- Guidelines for Blue bot: http://edumotiva.eu/edumotiva/wp-content/uploads/2021/03/Blue_bot.pdf
- Guidelines for Kubo: http://edumotiva.eu/edumotiva/wp-content/uploads/2021/03/Kubo.pdf
- Symbol list: http://edumotiva.eu/edumotiva/wp-content/uploads/2021/03/Symbol-cards.pdf

Session description:

Applying storytelling: In this session children are introduced to the concept of storytelling and develop a number of scenarios. These scenarios function as background stories for designing specific routes that will be followed/executed by the tangible floor robots.

Prerequisites:

- None

Indicative technologies:

- Any tangible floor robot (i.e., Kubo, Bee-bot, Blue bot, Roamer etc.)

Session 3

Session outline:

1. Demonstration of 1-2 exemplar stories/plots (which can include cartoon, fairytale, imaginative characters) as an inspiring point for developing additional stories
2. Developing short stories/scenarios/plots in groups
3. Drawing/sketching routes as part of the story scenario
4. Hands-on experience: programming the robot to follow the sketched route
5. Sharing stories/plots in the class

Objectives:

Children will be able to:

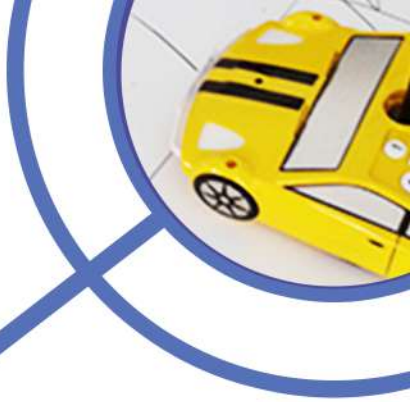
- intermingle storytelling with programming processes and develop goal-driven and meaningful tasks
- work with others towards creating stories/plots
- use directional language to control the robot
- explain their ideas and present their stories in the plenary
- solve problems using trial and error

Children's activities:

- Discussing in groups in order to develop a story/scenario characterized by a starting and and an ending point, as well as some intermediate stages
- Drawing/sketching all the parts of the route
- Programming the tangible floor robots to follow the sketched route/ decorate the robot (optional)
- Sharing the results in the plenary/ challenging other groups

Resources:

- Guidelines for Blue bot: http://edumotiva.eu/edumotiva/wp-content/uploads/2021/03/Blue_bot.pdf
- Guidelines for Kubo: http://edumotiva.eu/edumotiva/wp-content/uploads/2021/03/Kubo.pdf



Session description:

Drawing with floor robots: In this session children will combine robotics with the field of Art by using drawing tangible floor robots (e.g. Bee-bot with an attached marker, Pro-bot etc.) in order to create simple lines and shapes.

Prerequisites:

- None

Indicative technologies:

- Tangible floor robots (i.e., Blue-bot/ Bee-bot, Pro-Bot, Roamer)

Session 4

Session outline:

1. Discussing how the tangible floor robots can be used to draw
2. Hands-on experience/ use of the robot to create lines
3. Creating sketches over the created lines (a number of abstract paintings (e.g., Paintings of cubism, de Stijl, constructivism etc) or sketches (i.e. cartoon) can be presented to inspire children)
4. Wrap up

Objectives:

Children will be able to:

- make the necessary measurements in order to instruct the robot reach a goal
- program (through tactile commands) a robot to draw straight lines on a paper
- move the robot to different points so that to create specific shapes or figures
- explore additional tasks (i.e. drawing) that robots can perform
- describe what the robot does

Children's activities:

- Discussing on possible ways that a robot can draw
- Programming the tangible floor robot to create lines
- Turning the trails into drawings by hand or by using the robot
- Sharing the results in the plenary

Resources:

- Guidelines for Blue bot: http://edumotiva.eu/edumotiva/wp-content/uploads/2021/03/Blue_bot.pdf
- Guidelines for Pro Bot: http://edumotiva.eu/edumotiva/wp-content/uploads/2021/03/Pro_bot.pdf

Session description:

Exploring programming concepts with floor robots: In this session children will be introduced to more advanced programming concepts/processes (i.e loops, recording sequences of commands) using tangible floor robots.

Prerequisites:

- None

Indicative technologies:

- Tangible floor robots (i.e. Bee-bot, Pro-Bot, Kubo, Botley)

Session 5

Session outline:

1. Ideation and planning what the robot will do (i.e., choose a route)
2. Creating a sequence of instructions/commands according to the plan
3. Testing the code and applying modifications
4. Experimenting freely under teachers' facilitation
5. Wrap-up

Objectives:

Children will be able to:

- analyse the given problem/challenge and plan a solution
- discuss ideas towards problem solving
- identify instructions that are repeatively performed
- apply the loop programming concept
- make and record a sequence of commands/instruction
- experiment upon alternative ways of controlling the robot
- present their programming solution and explain what the robot does

Children's activities:

- Ideation on the challenge: discussion in groups about what the robot will do (follow a route, create a shape etc.)
- Planning the solution: discuss and express ideas on how the selected task/challenge will be approached
- Programming a sequence of instructions according to the plan using programming constructs that offer more optimal and flexible solutions
- Testing the results
- Sharing the results in the plenary

Resources:

- Guidelines for Kubo: http://edumotiva.eu/edumotiva/wp-content/uploads/2021/03/Kubo.pdf

Session description:

Creating circuits with simple materials: In this session, children will become familiar with electric circuits using simple, user-friendly and age-appropriate materials like plasticine and clay. The aim is to smoothly recognise electrical circuits as an integral part of robots' functionalities.

Prerequisites:

- None

Indicative materials:

- Plasticine, clay, batteries, leds, battery holders

Session 6

Session outline:

1. Brainstorming session related to the basic concepts around electrical circuits
2. Embodied learning experiences and role playing games
3. Hands-on experience: modelling with plasticine and clay based on specific scenario/plot
4. Presenting to the plenary
5. Wrap-up

Objectives:

Children will be able to:

- name the basic components of the electrical circuits
- name conductive items/materials
- use simple materials to create an electrical circuit
- explain the role of switch in electrical circuits
- light-up simple scenarios (preferably inspired by stories and fairytales)
- work collaboratively and share their results in the plenary

Children's activities:

- Involving in discussion about electricity and circuits
- Role-playing games to realize the concept of electricity, conductivity and the way that circuits work
- Creating their own circuits through the implementation of plasticine (conductive) and clay (non-conductive) and basic electronic components (battery, LED lights)
- Sharing in the plenary and/or discussing with classmates the results

Resources:

- Guidelines and tips for creating circuits with simple materials: https://edumotiva.eu/edumotiva/wp-content/uploads/2021/03/Paper_circuit_resources.pdf

Session description:

Exploring interactivity using programmable toys: In this session children will be introduced to concepts related to interactivity through the assemblance of a robot composed of magnetic robotic blocks, and the implementation of sensor blocks that breath life into the model (e.g. Cubelets).

Prerequisites:

- None

Indicative technology:

- Cubelets

Session 7

Session outline:

1. Brainstorming related to the basic concepts/ Storytelling can be applied to turn the process into a more playful and inspiring experience
2. Use of simple toys (e.g. toy blocks) to get familiar with the concept of the session (optional)
3. Experimenting with the robot by creating different models
4. Implementation of sensor blocks that breath life into the model
5. Discussing the outcomes of the activity

Objectives:

Children will be able to:

- explain what a sensor is and how it works
- describe the relation between the use of sensors and the type of interactivity that is achieved
- use sensors in order to create an interactive robot
- practice flexible thinking and problem-solving by redesigning the robot
- build and program a specific robot based on a scenario

Children's activities:

- Discussing about interactivity: What are sensors? How do they work?
- Playing with physical toys (i.e. toy blocks) to get familiar with the process of using blocks to create a model (optional)
- Creating different models by using the Cubelets robot blocks
- Implementing sensor blocks to add interactivity on the robot
- Testing the results
- Sharing the results in the plenary

Resources:

- Lessons for Cubelets: https://www.modrobotics.com/education/lesson-plans/meet-your-cubelets-units/scope-sequence-pre-k-k/

APPENDIX

Technologies and tools (mentioned in this curriculum):

Robots:

Kubo: https://kubo.education/

Blue-bot: https://www.terrapinlogo.com/products/robots/blue/blue-bot-family.html

Bee-bot: https://www.terrapinlogo.com/products/robots/bee/bee-bot-family.html

Pro-Bot: https://www.terrapinlogo.com/products/robots/pro/probot.html

Botley: https://www.learningresources.com/shop/collections/botley

Roamer: https://www.roamer-educational-robot.com/

Colby mouse: https://blog.generationrobots.com/en/tutorial-robot-mouse-colby/

Cubelets: https://www.modrobotics.com/