**TITLE: Practical Educational Robotics Workshop**

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1. **Description of the scenario**
   1. **Domain**
      1. *Primary domain:* Robotic Product Development (Technology Design)
         1. Science ()
         2. Technology (x)
         3. Business ()
         4. Engineering ()
         5. Arts ()
         6. Mathematics ()
      2. *Contextual (peripheral) domain:* STBEAM
         1. Science (5)
         2. Technology (10)
         3. Business (3)
         4. Engineering (8)
         5. Arts (2)
         6. Mathematics (8)
   2. **Objectives**
      1. *Subject related:* Learn the key robotics elements (technology); construct a robot (technology & engineering) , develop a visual program to control the robot and to execute tasks (technology and maths); develop the creative thinking skills needed to find different applications of robotics in other fields ( science, arts & business)
      2. *Technology use related:* Arduino controllers; motor drivers; ultrasonic sensors; scratch or snap visual programing.
      3. *Social and action related:* teamwork skills in a groups of 3-4 students; creative thinking of the whole class; ideas generation by individuals and achieving consensus in a team and in a class; and presenting results by the teams.
      4. *Argumentation and fostering of maker culture:* formulate and express ideas; listening skills; decision-making within a team, etc
   3. **Time**
      1. *Duration:* 2-6 weeks
      2. *Schedule:* 2 or 3 workshops 4 hour each; 4 – 6 workshops 2 hours each.
   4. **Materials and Artifacts** 
      1. *Digital artifact:* students will work with Scratch or Snap; Arduino IDE; python s2a\_fm and pymata program are used to connect the robot to a computer and to control it with visual interfaces. Optional hummingbird server could be used if Finch robot is used for the programming classes and Choreograph could be used to demonstrate the NAO humanoid robot
      2. *Robotic artifact:* custom set developed by ESI CEE: gearbox; chassis; chains and wheels; Arduino controller; motors driver; breadboard; jump wires; ultrasonic module; Bluetooth module or USB cable; batteries and batteries holders. NAO and Finch robots for demonstration are optional.
      3. *Student’s workbook and manual:* Visual Guide how to construct the robot; tasks and illustrations
      4. *Teacher’s instruction book and manual:* Manuals How to connect and program the robot
2. **Space and Students Info**
   1. **Students Info (Target Audience)**
      1. *Sex and Age:* boys & girls, 8-12 years
      2. *Required Prior knowledge:* No prior knowledge required
      3. *Nationality and cultural background:* Bulgarian, cultural background diverse, capital city and other cities
      4. *Social status and social environment:* mainstream public schools and private schools
      5. *Special needs and abilities:* no special needs and abilities are required
   2. **Space Info**
      1. *Organizational and cultural context:* Workshops in school, either in classroom or computer room during regular school time
      2. *Physical characteristics:* indoors;
3. **Social Orchestration**
   1. **Population** 
      1. *Students:* 20-40 students in a class
      2. *Tutors:* 1 or 2 researchers + 1 or 2 assistants
   2. **Grouping**
      1. *Setting:* one table and one PC per team of 3-4 students
      2. *Grouping criteria:*  no specific criteria
   3. **Kinds of Interaction during the activity (emphasis)** 
      1. *Actions*: learn the basics of robotics through demonstrations and games; construct an Arduino robot using visual instructions and guidance by the instructor, if needed; 2-hour creative workshop based on Tony Buzan’s mind-mapping concept; programming and controlling Arduino robots or Finch robots through visual programming to complete simple tasks (task could be closely related to maths, algebra or geometry)
      2. *Relationships:* collaborative
      3. *Roles in the group:* the roles are not predefined as we encourage the students to shift their roles between team leader, programmer, robot developer, presenter
      4. *Support by the tutor(s):* facilitator and consultant for robot construction; teacher and instructor for teaching of basics of robotics and creative thinking
4. **Teaching and Learning Procedures**
   1. **Teacher’s role**
      1. *Teacher’ function:* facilitator and consultant for robot construction; teacher and instructor for teaching the basics of robotics and creative thinking
   2. **Teaching methods**
      1. *Teacher’s approaches:*  constructionist with elements of instructionism,
   3. **Student activity processes**
      1. *Students’ function:* learning; analysing, creating, discussing, observing
   4. **Student learning processes**
      1. *Designed Conflicts and misconceptions:* competing is the main goal
      2. *Learning processes emphasised:* all students in the team work together and construct the robot. They are confident and know that building a simple robot is not difficult.
      3. *Expected relevance of alternative knowledge (which):* alternative knowledge will be encouraged to be demonstrated during the creativity session in which the students will have to associate the robot with other domains.
5. **Student productions**

**5.1 Artifacts - robots**

5.1.1 *assignment:* defined engineering and programing tasks; open exercises and creative tasks

5.2.2 *interaction:* Visual through schemes, mind maps, drawings and pictures and verbal through instructions, presentations and discusisons.

5.2.3 *morphology:* Mostly anthropomorphic

5.2.4 *behavior:* Mostlyfriendly and cooperative

5.2.3 *parts:*

**5.2 Programs - code**

5.2.1 Structure of code-commands: visual programing following patterns that are typical for C and C++ programing

5.2.2 Elements (e.g. iteration, selection, variables): variables, constants, simple cycles and logical functions such as if, and, or.-

5.2.3 Conditionals (e.g. event handling): -using the ultrasonic sensor to detect and avoid obstacles or to direct the robot to objects.

**5.3 Discussions – arguments (describe the activity emphasis on one or more of the following types of discussion)**

Discussions and reflections were left to the teachers in the classroom

5.3.1 descriptive - explanatory: description of base robotics elements such as sensors, processors, drivers, actuators; description of the general tasks and purpose.

5.3.2 alternative: provision of alternatives if a dead end is reached;

5.3.3 critical - objection: critical thinking about problems and possible solutions;

5.3.4 contributory - extending: discussions about alternative design or additions to the construction; software and purpose .

1. **Sequence and description of activities**

Total duration of the activities will be in the range of 6-12 hours. The session in which the student will develop code and will animate the robots will be used as a buffer to compensate the time.

Orchestration: team of 3-4 students per table; enough free space in the center of the room for demonstrations; demo robots such as NAO; omnidirectional models or mobile telepresence robot + full set per a team.

Description:

Module 1 Introduction and pre-evaluation (1/2 hour)

The researchers introduce themselves as robot enthusiasts and explain that in this workshop they will play and work together with the student teams in order to build together a real robot. It is important to provide feedback and contribute to the that will be used to design even more interesting educational workshops. The rules and safety instructions are explained:

Rules

* Everybody listen to the others and respect their ideas
* No direct competition, lets cooperate and have fun
* Questions and strange ideas are highly encouraged
* The researchers are facilitators and friends – everybody can argue with them regarding the content but not regarding the discipline

Safety instructions:

* Do not put small parts in the mouth – can have serious injury
* Do not connect batteries before the instructors check the model for short circuits – the robot can cause fire.
* Be careful when using jump wires and pins – you can feel pain.

Kids fill out pre-workshop evaluation form.

Module 2 What is a robot (1/2 – 1 hour)

The researchers discuss with student the key elements of the robots such as processors, drivers actuators and sensors. The researcher is using the available demo robots to show the elements. Children guess different types of robots such as industrial robots; home robots; humanoids; drones; toys and others.

Module 3 Construction (1-2 hours)

Students build a robot using visual guides on printed cards or slideshow on computers. The instructor do not directly contribute during the building but help them to discover the right approach.

Module 4 Robot’s touch (1-2hours)

Ones the models are built the researchers demonstrate in action different type of robots such as Nao, vGo, omnidirectional robots or other and facilitate Q&A session. During that time technical assistant or another researcher verifies the models to be sure that they are operational and no significant mistakes e.g. short circuits are present.

Student play with their models using predefined control program and PC keyboards. They pass through different obstacles and experiment with the physical characteristics of the models.

Module 5 Let’s imagine… ( 2 hours)

Researchers facilitate creativity session trough brain storming and mind mapping on how the robots can support people in their life and what is the importance of robot for our civilization.

Module 6 Programming (2-3 hours)

Students learn how to control the robots with Scratch or Snap and they try to fulfil missions that were included in the brain storming by developing simplified code. The students are using proportions, arithmetic operations, geometry and other math domains in order to achieve their missions. The students could use paper, glue and other materials to decorate the robots

Module 7 Evaluation (1 hour)

Evaluation session is held for students to present their achievements and evaluate their experience.

Group and/or individual interviews are conducted and students fill out post-workshops questionnaires.

1. **Assessment Procedures ( for teacher reflection or student feedback)** 
   1. **Formative assessment**
      1. *Pupil voice activities (Interviews with students, Questionnaire):* Questionnaire before and after the workshop and interviews at end of the workshop
      2. *Observation notes:* Observation notes will be taken during the workshops and video audio recordings will be produced if written consent by parents and students is obtained.
      3. *Peer assessment*: peer reviews will be done by researchers at certain workshops
   2. **Summative assessment**
      1. *Essays: Students could be asked to write essays about the workshop*
      2. *Tests:* no formalised test are envisaged.
      3. *Student productions (code-robots-textual discussions)* standardised robots; standardised and custom commands; creative mindmaps and ideas.
      4. *Mark sheet*