ROBOESL PROJECT

ROBOTICS-BASED LEARNING INTERVENTIONS FOR PREVENTING SCHOOL FAILURE AND EARLY SCHOOL LEAVING

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Output 2: curriculum for blended (online and face to face) training course for teachers

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Declaration

This intellectual output has been prepared in the context of the ROBOESL project. Where other published and unpublished source materials have been used, these have been acknowledged.

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Abstract

This document reports the Intellectual Output 2 (curriculum for blended (online and face to face) training course for teachers) produced in the context of the ERASMUS+ project ROBOESL. The output reports pedagogical approaches to cope with school failure/ESL focusing on robotics-based learning methodologies inspired from constructivism and project-based learning principles. Then training activities are presented for familiarisation with educational robotics using robotics kits and software and 10 exemplary robotics-based learning activities are provided in the form of concrete worksheets. Then, the output provides evaluation guidelines and tools for validating the impact of robotics-based learning activities on the prevention of school failure/ESL and finally validation criteria and tools for validating the impact of the curriculum on the participant teachers. Guidelines for the use of the Open Educational Resources developed in the ROBOESL project are also offered to make easier for teachers the use of the resources.
Introduction

Aim: The curriculum aims at enabling teachers to master the technical and pedagogical skills necessary for using the robotic technology in school in order to enrich their teaching and learning activities in classrooms with robotics and finally to become able to develop their own robotics activities using innovative, student-centered and constructivist pedagogical approaches with a focus on preventing School Failure and Early School Leaving.

Target group

Teachers targeted by the curriculum are those non-experienced in educational robotics, especially teachers who work with children at risk of school failure and early school leaving.

Specific objectives

The aim of the training curriculum is specified in the following main objectives:

To provide a stepwise approach for a step by step acquisition of technical skills in using robotic technologies (hard- and software).

To enable teachers to implement the robotics-based learning activities in their school following the curricula developed in O1.

To practice and adopt the same pedagogy (constructivism/constructionism) that teachers are encouraged to implement in their school.

To develop broader perspective projects and strategies and to provide multiple pathways for teachers to introduce robotics in school to engage young people with diverse interests and learning styles.

To highlight that robotics benefits are relevant for all children, especially those at risk of school failure or early school leaving.

To offer a clear performance guide towards the trainee’s achievement of expected outcomes helping trainees to understand the training context.

To promote learning through interaction of the trainee with the robotics technologies.

To support self-directed action allowing trainees to learn independently.

To support the development of “real” training scenarios encouraging the engagement of the trainee in authentic problem solving.

To adjust training to trainee’s needs and interests by offering training tasks with options to advance to different levels of difficulty.

Finally to provide methodology and tools for the overall evaluation of the training program.
Chapter 1: Pedagogical approaches to cope with school failure/ESL (O2.1)

Problems with school failure, early school leaving, drop-out correlate with each other and if not solved can lead to risks of social exclusion which has become one of the important themes in contemporary social policy debates in OECD countries. While there is considerable debate about the precise meaning of the term (Evans, Paugham, and Prelis, 1995, Atkinson, 1998a, Klasen 1998), some of the most useful definitions have sought to emphasise that social exclusion is concerned with the ‘inability to participate effectively in economic, social, and cultural life and, in some characteristics, alienation and distance from mainstream society (Duffy, 1995).’ It means that problems which can lead to social exclusion should be addressed as early as possible. Robotics based activities which are the tool for reducing risks of schools failure and ESL.

To address these problems, we need to understand what is school failure and early school leaving:

I School failure

There is no unified definition of school failure, but mostly it is connected with low level of achievements, lost interest in learning. All the causes, which can lead to school failure, can be divided into several groups:

1. Problems connected with health:
   - specific learning disabilities,
   - mental retardation,
   - sensory impairment,
   - chronic illness,
   - attention deficits,
   - sleep disturbances,
   - nutrition problems (bulimia, anorexia)
   - emotional illness.

2. Family problems:
   - family dysfunction,
   - low level of socio-emotional competence,
   - ethnic minority,
   - Divorce,
   - social problems.

3. Problems in school
• ineffective schooling,
• no support at school,
• school and class leadership problems

4. Students’ personal problems

• intrinsic characteristics of the child,
• Low level of socio-emotional competence
• Learned helplessness
• Fear of exams
• Low self-esteem
• Behavioral problems

What can cause problems at school and influence learning success?

• Learning difficulties/failure – Learning difficulties, learning failure in one or more subjects is one of the most common «drop out» causes. Students who have learning problems/difficulties and who do not know how to overcome them are among them who «drop out» from education;

• Special needs (all kind of special needs);

• Frequent absence from school – students with learning difficulties often are the ones who are absent a lot, and this is one of the most serious signals «dropping out» from the educational system. Students who are absent at least one day a week are at risk «dropping out» from the educational system.

• Many students who "drop out" of the educational system, are bored at school because training has no connection to real life. They do not feel belonging to the school, to their class, and they also do not feel the interest of adults;

• Changing schools - the change of social environment for some children has a negative impact on their ability to adapt to school and new situation;

• Lack of family support;
• Poverty;

• The migrant family who do not know the educational system of country, culture and language of the country where they arrived, the possible support systems, etc.;

• Social crisis in the family (death of family member).

II. Early school leaving (ESL)

- ESL mostly is a result of school failure
- ESL mostly understood as leaving school (in any level of education);
- Sometimes it is used as synonyme for drop-out

**Pedagogical approaches**

All these problems should be addressed to help students to be successful. Unfortunately very often teachers do not have information about all the factors which can influence students attitude and teachers do not have such resources to solve all these problems, but they can support changes in class culture which has more effect than socioeconomical status (poverty), they can change educational process to make it more interesting and engaging, and to support positive motivation, which impacts brain metabolism, conduction of nerve impulses through the memory areas, and the release of neurotransmitters that increase executive function and attention. Relevant lessons help students feel that they are partners in their education, and they are engaged and motivated. Schools can be the haven where academic practices and classroom strategies provide children with emotional comfort and pleasure as well as knowledge. When teachers use strategies to reduce stress and build a positive emotional environment, students gain emotional resilience and learn more efficiently and at higher levels of cognition.

All these aspects are included in the curriculum for robotics based learning because robotics activities are exciting projects, opportunities for innovation and creativity, learning and creativity at a high level. It supports the development of students’ self-esteem, confidence in their abilities, respect for others, and respect of others. These activities help them to find acceptance, belonging to a group, identification with a successful group.

**Step by step procedure:**

1. To start implementation of the curriculum for robotics based activities, there were developed the tool with criteria (see Annex No 1) to choose students who are at the risk of school failure/ESL to be involved in these activities to fulfill the aim stated in the Project.

2. To start implementation of the curriculum, there were organized training course sessions for teachers.

3. Before starting robotics based activities students and teachers filled in the questionnaires to collect data before these activities and after the robotics projects they will have to fill in questionnaires. It is needed to evaluate intervention process on risks of school failure/ESL.

4. After each Robotics Project teachers had to fill the observation protocol to evaluate improvement in students attitude.

5. After the all process of activities teachers have to write a report about the whole process to evaluate the curriculum and students attitude.

**Important!**

- We must understand that every activity aimed at reducing school failure and risk of early school leaving has time delay;

- Most children have multiple factors which cause school failure and it means that teachers have to be ready to implement creative solutions.
Chapter 2: Robotics - based learning methodologies inspired from constructivism and project - based learning principles (O2.2)

The methodology of the training course will be in line with the curricula developed in O1 with the aim to support interdisciplinary robotics projects in schools. Drawing upon the well known axiom that "teachers teach as they are taught, not as they are told to teach", the training curriculum aims at engaging the teachers in the ideas underpinning the ROBOESL learning interventions in the same way they are expected to implement them in their class. The curriculum is based on the constructivist/constructionist pedagogy (Piaget, Papert) and the project-based learning approach and details on how the deployment in the class can take place.

Project-based methodology

Project-based learning (PBL) is a teaching and learning methodology that engages learners in sustained, cooperative investigation and includes authentic content, authentic assessment, teacher facilitation, explicit educational goals, collaborative learning, and reflection.

Project based learning is a model for classroom activity that shifts away from the classroom practices of short, isolated, teacher-centred lessons. PBL helps make learning meaningful and useful to students by establishing connections to life outside the classroom, addressing real world problems, and developing real world skills. PBL supports learners to develop a variety of skills including the ability to work well with others, make thoughtful decisions, take initiative, solve problems, develop self-directed learning skills and motivation for learning. Thus, established principles of learning, such as motivation, relevance, practice, active learning, and contextual learning operate significantly in a PBL environment, and to a much lesser extent in conventional curricula.

In the classroom, PBL provides significant opportunities for teachers to communicate and establish relationships with their students. Teachers are required to be ready to shift their role based on modern didactic practices and to become facilitators and scaffolders and co-learners.

Implementing the ROBOESL training paradigm and the scaffolding mechanisms

The projects that will be addressed to the students should integrate aspects of real, relevant and meaningful learning. The projects should provide links to different subject/cognitive areas and to the real world. The projects should address problems which have personal relevance to the learners. To this end authentic contexts and interdisciplinary scenarios may create opportunities for engaging learning experiences.

The learners can “engineer” or alter the proposed scenario; they can extend the scenario or design their own scenarios personalizing the robotic learning experiences. This will allow the learners to move towards a more self-directed approach and to work on projects that are in line with their interests and needs.

“What if” experimentations are encouraged for instance through the changing of parameters. In this way, the learners will be challenged to explore alternative solutions and explore in depth the underlying scientific concepts.

Active reflection upon the task: during the execution of the task the learner can stop execution and ask for feedback and take time for some reflection on his/her previous action.
**Guided skill development**: the learners can seek more support while working on complex tasks. Supporting resources will be also available in the form of worksheets and videos (for example video and programming code to be followed) to guide the learners’ engagement in robotic constructions and programming without revealing solutions. The solutions are not given; the path to the solution is described in a constructionist way.

**Going beyond trial and error strategies**

Usually students begin their robotics problem solving efforts using trial-and-error strategies that result in weak solutions and poor learning results. However, these trial and error practices might be a first necessary step to engage students in useful explorations within their robotics projects and offer opportunities for teachers to encourage students over time to progress beyond trial and error strategies and try out more rational approaches to problem solving that will be closer to the scientific spirit.

**Embodiment**

Very often students intuitively use their own bodies to reason about how to program a certain behaviour for their robotic device. While students are trying a modeling strategy to reason about the problem they should be encouraged to use either the robotics materials or their own bodies to simulate the desired movement of the robot. For instance student’s hand might be standing in for the robot and students are moving their hands in the manner that the robot should be programmed to move. This embodied activity might serve the learning purpose better than physically moving the robotic device resulting in embodied cognition.

**The role of the teacher**

Teachers are advised to try out the robotic curricula before bringing them in their class. However their role is not to ensure that students solve problems and run projects in the way anticipated by the teacher nor just follow steps to arrive at a pre-defined result. The teacher in the aforementioned constructivist theoretical framework does not function as an intellectual “authority” that transfers ready knowledge to students but rather acts as an organizer, coordinator and facilitator of the learning process. The teacher organizes the learning environment, raises the tasks / problems to be solved, offers the resources and supports students’ engagement in the ROBOESL interdisciplinary projects; discreetly helps where and when necessary, encourages students to try out different ideas and solutions, to work in teams and finally organizes the evaluation of the activity in collaboration with the students. In conclusion, the teacher ensures a playful, open, non-judgmental, and collaborative classroom environment that fosters creativity and collaboration.

**The role of the students**

When preparing a work with programmable robotic constructions, the students are first encouraged to reflect upon the problem that is addressed through the project. Discussion can take place in a group; then the group supported by their teacher set up an action plan to solve the problem. The students work in groups to realise the plan taking into account teacher’s feedback. Students may redefine the action plan after the experience gained during a preliminary work. They are invited to creatively synthesize the parts of the solution and reach conclusions regarding the problem under investigation. The final products and solutions of the groups are presented in the class, discussed and evaluated. Finally the students are invited to reflect upon their work, to express their views and to record their experiences in a diary. Students should be allowed to spend some time playing with the robotics devices, to walk around and collaborate with classmates.

**Training activity 1: 3 different teaching practices**

This module comes in the first day of the course just after the first Lab (A first example: follow the line) and the Lab activities for familiarization with Lego Mindstorms (hardware & software).
**Aim:** to trigger discussions in the class that will connect the lab activities with theories behind Educational Robotics with a focus on constructivism & constructionism.

**Method:** Teachers work in groups of 3-4 to elaborate the following topic/question:

After your first experiences with educational robotics please comment on the following cases (10 min):

Three teachers introduce for first time robotics in their class.

**Teacher A** starts with a presentation of the Lego Mindstorms kit together with projection of slides that show in detail the content of the kit and demonstrates in front of the class how to make a first robotic construction.

**Teacher B** divides the class in groups of 3-4 students, provides a Lego Mindstorms kit for each group and a handbook with step by step instructions to make a robotic car.

**Teacher C** divides the class in groups of 3-4 students, provides a Lego Mindstorms kit for each group, then encourages and help students to explore the content of the kit, and invite them to try out a first robotic construction of their own choice.

1. Comment each of these three cases and identify strong and weak points in each case, why do you think these are strong or weak?

2. Which of the three practices you think better for your students to follow in your class?

A plenary discussion follows when one representative from each group reports shortly the answers of the group. The discussion closes with short references to behaviourism, constructivism (Piaget), constructionism (Papert) and project-based learning. The following resources are uploaded in an eclass and are suggested for further study:

Chapter 1, Constructionism and Robotics in Education, available in Alimisis D. (2009) - D. Alimisis (Ed.), *Teacher Education in Robotics - enhanced Constructivist Pedagogical Methods*, ASPETE, Athens


**Training activity 2: a 5-stages methodology**

This module comes in the 2nd day of the course just after the lab: Robotics Project 1.

**Aim:** to familiarize the trainees with constructivist/constructionist methodologies that can be deployed in robotics projects and classes.

**Method:** Teachers work in groups of 3-4 to elaborate the following topic/question (10 min):

Selecting the proper learning and teaching methodology is crucial for successful robotics activities in school classes. It is not enough to introduce robotics in class, technology alone cannot affect minds; robotics has to be integrated in a well designed learning methodology.

Study the TERECoP methodology in the summary you will find in your eclass.

Discuss within your group the following questions:

1. Do you find all the five proposed phases necessary?
2. Which phases are more important?

3. Which phases might be omitted?

4. Any additional phase you would wish to include?

5. Would you suggest a different sequence of phases?

6. Do you think this methodology is applicable in your school reality?

A plenary discussion follows when one representative from each group reports shortly the answers of the group.

The following resources are uploaded in an eclass/ and are suggested for further study:

D. Alimisis (Ed.), *Teacher Education in Robotics - enhanced Constructivist Pedagogical Methods*, ASPETE, Athens (2009)

Chapter 3: Training activities for familiarisation with educational robotics using robotics kits and software (O2.3)

O2.3 (part a – A first example – 30 min)

The familiarisation phase actually starts with the realization of a very simple but complete example, the so called 'follow the line'. Further insight into building procedures and software features are dealt with the successive module.

**Aim**: to give the trainees an immediate feeling of the possibilities provided by Mindstorms EV3 and its programming environment. The example is particularly suitable as a starting experience because, in spite of its simplicity, it can show how the robot can interact with the environment, how the program can be tuned to improve the robot behavior and it can also convey an immediate gratification which is important to get when working with a new, and in some sense mysterious, technology.

**Method**: Teachers work in groups of 3-4 to elaborate the software solution. The robots are already built in the RileyRover structure with one light sensor mounted to pick reflected light from the plane of motion. This latter is prepared with a closed circuit made with a black tape on the floor (or on a table, or printed on a suitably wide sheet of paper). The background color must be lighter than the tape color (fig. 1).

![Fig. 1 – The circuit (source: nxtprograms.com)](image)

Use the port view firmware feature to perceive the role of a sensor, namely the light sensor used to capture the reflected light (fig. 2). Observe the difference between the value given back by the sensor when it is put over the light area and when it is put over the tape. Try to imagine what is the better numeric threshold to discriminate the two situations (that is, less than that threshold means surely dark, greater means light).

![Fig. 2 – The Port View function](image)
Now we have to explore the EV3-G environment: teachers are conducted to create a project, to start a new program, to discover command blocks. In this very first experience we have to use just three different blocks: move steering, switch, loop (fig. 3). The purpose in this initial activity is to reach a reasonable solution in a very short time without entering too much into details.

Fig. 3 – First command blocks to use
O2.3 (part b - familiarization with Lego Mindstorms (hardware & software))

This module follows the very first experience and requires to dealt with Mindstorms EV3 structure (pieces, building procedures, supporting tools like Lego Digital Design) and EV3-G, its programming environment.

**Aim:** to familiarize the trainees with how to build robots, to understand the meaning of the most important command blocks and how to organize a EV3-G project.

**Method:** Some general explanations and demonstrations are provided. Some concepts must be introduced from the beginning for their specific function: control conditions, data wires, display. Then teachers work in groups of 3-4 to explore the structure of an EV3 robot. Using one of the already built robot (or building sheets) each group in turn has to build a robot from the scratch.

The work with EV3-G consists first in exploring command categories (Action, Flow Control, Sensors, Data Operation, Advanced; My Blocks is ignored for the moment), trying to understand the different features included in each category. In this exploration teachers learn to use the on-line help.

Then teachers are asked to design very simple actions, each one exploiting one or two specific commands. In programming these actions, teachers are requested to deepen the meaning of the parameters which are associated with every used command block.

At the end of this module each group briefly summarize the experience, focusing on encountered difficulties. We expect that from the plenary discussion is possible to answer the following questions:

1. Can you briefly describe the common functions of each category of command blocks?
2. In which two different ways sensor readings can be integrated in a program?
3. What is the most evident difference between Move Steering and Move Tank?
4. What happens of the program execution while the robot is executing a move command that lasts 5 seconds?
Chapter 4: Guidelines for the use of the Open Educational Resources developed in ROBOESL project (O2.4)

This section provides guidelines for teachers on how to access and use the open educational resources (OER) developed in the frame of the ROBOESL PROJECT.

The ROBOESL OER include:

A. **10 curricula** for robotics projects freely available at [www.roboesl.eu](http://www.roboesl.eu) (click tab resources).

Each curriculum includes:

a. **Scenario** from real life: teachers may use this (or own similar scenarios) to put the robotics projects in a meaningful, authentic context for their students.

b. **Connections with subjects** are identified in each project. Teacher may emphasise those relevant for his/her students taking into account their needs and interests.

c. **Pedagogical objectives** are divided in general and specific ones. The general ones refer to objectives present usually in robotics projects while the specific ones refer to objectives that should be achieved by students upon successful implementation of the activities described in this curriculum.

d. Suggestions for **learning methodologies** exemplify the constructionist methodology introduced in the part O2.2 and are tailored to the scenario introduced in each curriculum. Suggestions should not be considered by teachers as “cook recipes” to follow step by step in their classroom but rather as ideas and recommendations on how to implement the robotics projects with their students making their own choices according to their students’ learning style, needs and interests.

e. **Technical guidelines** provide step by step description of the projects from technical point of view. Teachers will find here instructions for building robots, illustrative solutions for programming robots, suggestions for the implementation of the projects, several extensions and variants marked as easy/medium/difficult. Teachers will decide which of the extensions and variants are relevant to their class and what level of difficulty their students should be exposed.

f. **Evaluation tools** provide a rubric that teachers can use to evaluate students’ achievement in each specific objective of this curriculum. More evaluation tools are provided in Output 3.

g. **ev3 file** with the all the programming solutions for each curriculum as they are described in the technical guidelines. Once again, teachers can use the proposed solutions as a reference but they might try their own solutions and for sure they should be open to other solutions that might come from their students.

h. **Youtube video** links demonstrating the robotics activities described in the technical guidelines.

B. **curriculum for teacher training** freely available at [www.roboesl.eu](http://www.roboesl.eu) (click tab resources).

The curriculum includes

a. **pedagogical approaches to cope with school failure/early school leaving:**
   - the problems of school failure and early school leaving,
- factors behind them,
- pedagogical approach to cope with them,
- the ROBOESL project method

b. **robotics-based learning methodologies inspired from constructivism and project-based learning principles:**

- The project-based methodology,
- The ROBOESL training paradigm,
- Going beyond trial and error strategies
- Introducing embodiment in robotics activities
- The role of the teacher
- The role of the students
- Training activity 1: three different teaching practices for introducing robotics in class first time. Teachers can try out this activity and give their own answers. Trainers of teachers may use this activity in their courses to trigger discussions with teachers. References for further reading are provided.

- Training activity 2: a five-stage methodology in robotics projects, intended for triggering discussions between trainer and teachers/trainees.

c. **Training activities for familiarization with educational robotics (hardware and software):** teachers and teacher trainers can find here a popular robotics project (follow the line) intended to give an immediate feeling of the potential inherent in robotic technologies. Then they can start familiarizing themselves with the robotics kit and the programming environment that will be used in the training course (in the case of ROBOESL project this was Lego Mindstorms EV3 but same approach is recommended for different kits).

d. **Exemplary robotics-based learning activities:** here teachers and teacher trainers will find one worksheet for each of the 10 curricula mentioned above. Teachers can follow the worksheets for their own self-training before they introduce the curricula in their class. They can also use the worksheets for supporting their students in executing the projects in class making changes and adjustments if needed. Teacher trainers can use the worksheets to design their training courses providing hands-on experiences for their trainees.

e. **evaluation guidelines and tools for validating the impact of robotics-based learning activities on the prevention of school failure/ESL:** templates for questionnaires to be filled in by teachers and students

f. **Validation criteria and tools for validating the impact of the curriculum on the teachers:** template for questionnaire to be filled by teachers/trainees in the end of their training course.
Chapter 5: exemplary robotics-based learning activities (10 worksheets) (O2.5)

Worksheet 1: The Roborail project

Scenario
Imagine a train travelling in a straight rail. The distance between two successive stations is the same. A train runs over this rail travelling at constant speed on the track between two stations, and stops for some time at each station before leaving again. When it reaches the end of line, it waits a bit longer and then it comes back in reverse way towards the starting station.

Your project
1. Draw the rail with a straight line and some stations in the same distance on a long sheet of paper and put it on the table or on the floor or put directly on the table or on the floor some short pieces of tape in same distance to stand for the stations.
2. Make a robot to emulate the train on the monorail. You will need a robot with 2 motors but no sensors. Each motor will drove one wheel. Add a ball caster on the rear to allow steering (fig. 1).

Fig. 1 – A simple RileyRover (source: daminekee.com)

3. Examine how the block Move Steering works

4. Exploration: Set the duration in seconds. How many seconds the train needs to travel from one station to the next one?

Write your answer here ………………………

How did you find this answer? …………………
5. The next step is to make the train to wait for some seconds when it reaches a station. The Wait block helps here.

6. Now make your train to travel all the line stopping in each station for some seconds.

7. Can you think of a command that would help to make the previous programming task?
Write your idea here ……………………

8. Here is the Loop block to repeat the motion as many times as you wish.
You can insert your blocks inside one Loop block.
Make your train to travel all the line using the Loop block.

9. Now, make your robot to reverse direction in the final station experimenting with the steering block

10. Finally, put all these tasks together: make your train to travel all the rail stopping in each station for a certain time, reverse direction in the final station and come back to the starting position stopping again in each station for the same time.

11. What happens if the distance between the stations changes? Working again with the “trial and error” method takes time!
Let’s use some maths to make the train to travel the distance between the stations.
Tips!
✓ In the Move Steering block, the ‘duration’ can be also typed in terms of rotations or degrees of the motor
✓ Remember! When the wheel rotates 360 degrees (1 full rotation) the robot travels $2\pi R$ distance (R=radius of the wheel).
Write here your solution …………….. 

Check your solution, does it work?
Worksheet 2: The “Go to park” project

Task 1. Fully autonomous vehicles, also known as driverless cars, already exist in prototype (such as the Google driverless car), and are expected to be commercially available around 2020. Intelligent Parking Assist System for vehicles is a new technology that assists drivers in parking their vehicle. The car can steer itself into a parking space with little input from the user. In addition to automatic parking, the autonomous vehicles offer exciting innovations such as: Obstacle avoidance, Driver assistance systems, and more.

Discuss within your group how you imagine the future vehicles will look like? What are the consequences for the drivers and the automobile safety? Prepare a short presentation for your class.

Task 2. How can you make a robotic vehicle capable to find an empty slot in a parking station and park without driver?

Form and write down a methodology to solve this problem.

Task 3. Create a mock-up representing the parking area where the robotic car will operate based on the scenario.

Task 4. Make a RileyRover. What sensor you need to mount on the RileyRover for detecting obstacles?

Task 5. Explore how to make the RileyRover to turn around the point of one stopped wheel.
**Task 6.** Experiment how to make the robot turn 90 degrees.

**Task 7.** Can you find the relation between the rotation of the motor and the turning angle of the RileyRover? Keeping notes with the rotation values and the turning angles you are trying out will help you to find the relation.

**Task 8.** Study in the following sketch how the RileyRover turns around the stopped wheel. Can you think of a mathematical reasoning underpinning the relation between the rotations of the motor and the turning angle of the RileyRover?

**Task 9.** Explore how the “switch” programming block works. Can the switch block help the RileyRover to make decisions while trying to find an empty parking slot? Write down your ideas.

**Task 10.** Use the sound block to introduce some sound during the process of parking.
Task 11. Try again and again your parking project until you succeed!
Worksheet 3: The “desert scout“ Project

Task 1: For several years autonomous robots have been used as scouts instead of humans in all those occasions when the use of a machine is advisable, due to hard or even dangerous conditions.

Write down with your group 3 examples where robots are used in missions dangerous for humans.

Task 2. Here is our example: Due to prohibitive conditions for humans, an autonomous robot is requested to visit the vertices of a regular n-sided polygon where to make a coring followed by a measure of quality of the extracted sample, emulated by a reading with the light sensor, in order to find the position (i.e. vertex index) corresponding to the maximum measured value.

Create with your group a mock-up representing the environment in which the robot will operate based on this scenario.

Task 3. Discuss within your group the aforementioned scenario. How can you make the robot to follow the sides of a regular polygon of 6 sides and to collect some data, namely the color code of a piece of paper or tape put on each vertex reporting the maximum value.? form and write down a general methodology for solving this problem.
**Task 4.** Build a RileyRover and mount a light/color sensor on your RileyRover in such a way that it can measure the colour code in each vertex. Explore the use of the colour sensor and measure the colour code in each vertex of the hexagon.

**Task 5.** Explore with your group how to make the robot to turn left or right. Explore different ways using the Move Steering command.
Write down your different solutions

**Task 6.** Experiment with the use of the “Move Steering” command to turn the robot for the angle that is needed in order to move on the lines of the hexagon.

**Task 7.** based on the results of your experimentations try to discover with your group a mathematical solution to link the rotation of the motor with the turning angle of the robot.
Write it here…

**Task 8.** Years ago S.Papert (http://papert.org) formulated the Turtle total trip theorem: the turtle will draw a closed figure with \( n \) sides when the sum of the angles turned is 360.
In the triangle example \( 3 \times 120 = 360 \) and in the square example \( 4 \times 90 = 360 \).
Write the hexagon example

What is the angle to turn each time to draw a triangle? …………………………
If you get it right the turtle will draw a closed triangle. Try it with your RileyRover.
What is the angle to turn each time to draw a square? …………………………
Confirm this with your RileyRover.
Now what is the angle to turn each time to draw a hexagon? …………………………
Confirm again with your RileyRover.

**Task 9.** Explore the role of a variable for keeping the values provided by the color/light sensor in each vertex of the hexagon.

**Task 10.** Think of ways to compare the values of a variable in order to identify the maximum value. Write down your solution in your own words.

Make a program in your EV3 programming environment to realise your solution and try it out with your RileyRover. Does it work? If not, check your solution and try again. Continue until you succeed!
Worksheet 4: the “Let’s play and dance“ Project

**Task 1.** Free your imagination and decorate the robot so that to look like a dancer. For example, the robot may take a human-like or an animal like appearance. There are no limitations- free your imagination and creative thinking. You can also create a mock up on which your robot will operate/dance.

**Task 2.** Draw a black straight line on the floor or on your mock up. Our aim is to make the robot move across the black line. Which sensor should you mount on the RileyRover so that to achieve this behavior?

Sensor to be mounted: ……………………………………………

**Task 3.** Use the appropriate sensor and measure the reflected light in the following situations:

<table>
<thead>
<tr>
<th>Situations</th>
<th>Value of reflected light intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td>on something black</td>
<td></td>
</tr>
<tr>
<td>on something white</td>
<td></td>
</tr>
<tr>
<td>on something grey</td>
<td></td>
</tr>
<tr>
<td>on something red</td>
<td></td>
</tr>
<tr>
<td>on something blue</td>
<td></td>
</tr>
</tbody>
</table>

**Task 4.** Can you describe the way the colour/light sensor functions in relation to reflected light?

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**Task 5.** The block at your right hand side controls the motors and is used to propel the robot. The steering value ranges from -100 to 100 and the same applies to the power. Play with the different steering and power values so that to achieve the following movements:

<table>
<thead>
<tr>
<th>Movements</th>
<th>Select a steering value</th>
<th>Experiment with negative or positive power value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>
Task 6. This task assumes that a colour/light sensor is attached to the appropriate port and is suspended just above the ground, pointing at the ground, as in Figure 1. Can you compose an algorithmic solution to make the robot following a random black line exploiting the observations made in Task 3?

You may consider using the following blocks to compose your solution (see below). Please note that the values should be adjusted and the blocks should be composed properly.

Figure 1. The robot follows the black line

This block represents a loop. A loop is actually a control flow statement that executes a set of blocks at least once, and then repeatedly executes the block, or not, depending on a condition at the end of the block. In this case there is not any specific condition set and thus the loop will be executed forever.

This block represents a switch. The switch executes different cases based on the evaluation of a condition to true or false. A case may include a single programming block or a set of blocks.

In the demonstrated switch the condition evaluates to true if the value of the reflected light intensity is less than 50.
Below you can see parts of the solution. However, the values need your adjustments and the block should be reasonably snapped together.

![Image of a robot solution](image)

*Figure 2. The half-baked solution for making the robot following the black line*

**Tips:** Check if the reflected light is higher or lower to a certain threshold.

**Task 7. Here comes the sound!** Experiment with the sound block to make the robot play sounds.

Can you make the robot to move forwards for 5 seconds and then to play a note of your preference for 2 seconds? Consider of using the move steering command and do not forget to activate the option “On for seconds” (see below).
Can you make the robot to move forwards for 10 seconds while playing different notes within this period of time? You should connect the appropriate blocks in parallel in order to achieve parallel execution of the two blocks. Below you can see a part of the solution. However, values should be adjusted and more blocks may be added. You may also consider of exploring the different options of the sound block that can become active.

![Figure 3. A half-baked solution.](image)

**Task 8. Work on the following subtasks:**

Can you make the robot play a specific note 2 times?

Can you make the robot play a specific note 5 times?

Can you make the robot play a specific note 30 times? Which programming block can you use to produce a more optimal and elegant solution? Use this block to make the robot play the selected note forever.

**Task 9. Let us now introduce to you two new blocks:**

This is the “**random block**” with the option ‘Numeric’ active. This means that the block returns a random number within the defined range of values. In this case: -5 to 7. The result can be the input of other blocks.

This is the “**random block**” with the option ‘Logic’ active. This means that the block returns the logic value true or false. You can also set the probability of true. This means that the value of true has 40% probability to come. The logic output can be used as input in other blocks.

Can you use the random block to make the robot play random tones between 400 and 1000 Hz in a repeatedly way?

Tips: Activate the option Play tones from the sound block.
Can you use the random block to make the robot perform random movements in a repeatedly way?

Tips: Use the output of the random block as input in the move steering block.

**Task 10.** Based on the knowledge gained from the previous tasks can you now make the robot perform a random dance so that each random movement to be combined with a random tone? Work on the algorithmic solution use as repetition condition the 30 random dance steps (in EV3 programming words: Count = 30 times).

**Tips:** To achieve synchronization define the same duration for sound and movement and nest the relevant commands in the same loop. In other words in each loop cycle the random sound and the random motion should have the same duration.
Worksheet 5: The “Sunflower” Project

Task 1. This activity revolves around the heliotropism phenomenon, according to which parts of plants (flower or leaves) move in response to the direction of the sun. This behavior (with some variations) is also performed by the sunflower. Find information online about the heliotropism, the floral heliotropism, the leaf heliotropism and the behavior of the sunflower in relation to the sun movement. Make a short presentation for your class with the more interesting info you found.

Task 2. Use your imagination to decorate the robot so that to represent a sunflower.

Task 3. Inspired by the phenomenon of heliotropism, the pivotal task here is to make the robot track and follow the light. Which sensor will you need? Mount the appropriate sensor on the RileyRover/robot.

Sensor to be mounted: ............................................

Tips: Place the appropriate sensor in a higher position in order to better capture the ambient light. Put a possible source of light in front of the robot (i.e. the torch of your mobile phone)

Task 4. With the support of your teacher use the colour/ light sensor to measure the ambient light in different places in the room

Select a dark place and document the value of the ambient light:…….

Select a bright place and document the value of the ambient light:…….

Select a place that is neither very bright nor very dark and document the value given by the light sensor:…….

Task 5. Repeat the experiment. But this time use a light source (i.e. a torch) and observe the light variations as the robot approaches and moves away from the light source.

Which is the value of the ambient light (measured by the robot) when the robot is close to the light source?………….

Which is the value of the ambient light when the robot is almost “3 pencils” far away from the light source? ………….

Which is the value of the ambient light when the robot is almost “6 pencils” far away from the light source? ………….

Can the light sensor provide indication regarding the distance of the robot from the light source? Can you describe in your own words how the light sensor functions?

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………………………………………………………………………………………………

………………………………………………………………………………………………

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Task 6. We have one light source. The robot is stopped. How would you make the robot keep a certain distance from the light source while the light source is moving?

Tip: Measure the ambient light when the light source and the robot are stopped.
Complete the state table below based on the scenario described above. Indicative states that you may consider of using to describe the behavior for the robot: “Moves forwards”, “Stops”, “Moves backwards”

<table>
<thead>
<tr>
<th>The light source…</th>
<th>Values for the ambient light (measured by the robot)</th>
<th>Reaction of the robot</th>
</tr>
</thead>
<tbody>
<tr>
<td>approaches the robot</td>
<td></td>
<td>The robot should…</td>
</tr>
<tr>
<td>moves away from the robot</td>
<td></td>
<td></td>
</tr>
<tr>
<td>is stopped</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Task 7.**

Use the value of the ambient light (measured by the sensor) to control the power of the motors repeatedly.

Tips: You may consider of using two blocks in the body of a loop: the color/light sensor block and the move steering block

Which is the behavior of the robot?

……………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………………………………………………………………………………………
**Task 8.** Check what will happen if you integrate the “advanced math block” among the two blocks that you have already built.

![Integration of the advanced math block](image)

*Figure 4. Integration of the advanced math block that executes the math formula: (a-b)*c*

Note that “a” is the current value of the ambient light and “b” represents the value of the ambient light when both the source of light and the robot are stopped keeping a certain distance. In our example, the value of “b” has been set to 40 (found after some experimentations). Please note that this is an indicative value that differs from one place to another. You are encouraged to make your own experimentations and to reset the “b” value.

What happens when a equals to b? .................................................................

What happens when a is bigger than b? ..........................................................

What happens when b is bigger than a? ..........................................................

What happens when c takes positive or negative values? Can you describe the role that c plays?

.................................................................

.................................................................

.................................................................

.................................................................

.................................................................

Experiment with the different values of a, b and c in order to make the robot operate as closely to the given scenario as possible.

**Task 9.** The light source is moving. Can you come up with another algorithmic solution of the same problem so that the robot moves according to the moving light source while maintaining a certain distance from it?

The robot is stopped and waits for some conditions to be met: 1) The light source approaches and 2) the light source is moving away.

1st range of values: Measure a range of values for the ambient light when the light source (i.e. your torch) is stopped: ..............................................

2nd range of values: Find a range of values for the ambient light when the light source (i.e. your torch) is approaching the robot: ..............................................
**3rd range of values:** Find a range of values for the ambient light when the light source (i.e. your torch) is moving away from the robot: ………………………………

**Scenario:** “Imagine that the robot is stopped and waits for a change in the surrounding state to happen. If the measured ambient light falls into the 1st range the robot remains stopped, if it falls into the 2nd range it moves backward, if it falls into the 3rd range it moves forward. However, each time there should be a check whether or not the measured ambient light falls into a new range of values”

**Below you are given different parts of the solution but not the whole solution.** In other words the solution is “half-baked”. Change and adjust the values of the ambient light and introduce the appropriate programming blocks to solve the problem and to complete the algorithmic solution.

**Note:** The “half-baked solution” is based on the following measured values for the different states (but yours may be different).

- The robot is stopped and does not perform any activity: 20<values<40
- The robot moves backwards: values>40
- The robot moves forwards: values<20

Please bear in mind that these are indicative values and you are expected to experiment to find the ranges of values that work better in your case/conditions.

**“Half-baked” solution:**

![Figure 5. Half-baked solution](image)

**Task 10.** Imagine that the light source is now moving around the robot.

Is the solution provided in the previous task still working? Discuss in your team and describe a methodology for making the robot turning towards the light.
**Task 11.** Can you come up with an algorithmic solution for solving the aforementioned problem? You may consider of using the following set of blocks for addressing a solution. There is a brief explanation on the functionality of the given set of blocks. The sub-questions below may also help you compose a solution

11.1 Which block will you use to make the robot spin towards one direction?

11.2 Can you now instruct the robot to measure the current ambient light and spin towards the opposite direction in case the current ambient light is weaker compared to the recorded value (the value of the variable light)?
11.3 The following figure presents parts of the solution. Core parts are missing. Based on the following sub-steps can you instruct the robot to spin towards one direction in order to follow the light source and to undo this action in case the light source is not in that direction?

![Figure 6. The half-baked solution](image)

Execute the algorithmic solution. Are you satisfied with the behavior of the robot?

Can you think of another solution that would give a more precise behavior? Discuss with your partners and briefly document your ideas.

Task 12. Mount two light sensors on the robot (see figure below).
Move the light source in different positions and check the values of the ambient light recorded by each sensor.

<table>
<thead>
<tr>
<th>Position of the light source</th>
<th>Value of the ambient light by Sensor A</th>
<th>Value of the ambient light by Sensor B</th>
<th>Difference among the two values measured by the two sensors</th>
</tr>
</thead>
<tbody>
<tr>
<td>The light source is among the two colour/light sensors as shown in figure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The light source slightly moves to the right and rotates for almost 10 degrees</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The light source slightly moves to the left and rotates for almost 10 degrees</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The light source moves to the right and rotates for almost 30 degrees</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The light source moves to the right and rotates for almost 45 degrees</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The light source moves to the right and rotates for almost 90 degrees</td>
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</tr>
<tr>
<td>The light source moves to the left and rotates for almost 45 degrees</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The light source moves to the left and rotates for almost 90 degrees</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**You are encouraged to make additional experimentations and to report the values**

What is the range of values that the robot does not need to perform any action?

………………………………………………………………………………………………………

………………………………………………………………………………………………………

………………………………………………………………………………………………………

Figure 7. 2 colour/light sensor and 1 light source
When the robot should start spinning to the left?

When the robot should start spinning to the right?

Can you translate your observations to an algorithmic solution? Once again you are provided with some parts of the solution while others are missing. Useful blocks are introduced below with short explanation.

The **range block** gets a number and returns the logical value “true” if the number is within the two indicated bounds.

The **compare block** gets two numbers and returns the logical value “true” if the numbers respond to the chosen comparison. In this case if a is less than b.

Below you can find a “half-baked” solution. This means that some parts are missing and some values needs to be adjusted. Can you complete the algorithmic solution?
Challenge: Can you find another solution to this task using the “advanced math block” in a similar way to that used in task 8/Figure 1 but involving now both sensors?

Tips

✓ control the spinning of the robot on the basis of the difference between the two light measures
✓ make the robot turn on one side if on that side the sensor captures more light than the other sensor so that to maintain the source of light in an intermediate position with respect to the couple of sensors
Worksheet 6: The “Slalom“ Project

**Task 1.** In this project the robot simulates a skier performing slalom skiing. **Slalom** is an alpine skiing and alpine snowboarding discipline, involving skiing between poles or gates. The skier follows a specific path down to alternate the side through which s/he passes around red and blue poles. Find information in the web about the slalom skiing and the way skiers perform their slaloms. Make a short presentation for your class with the more interesting info you found; show some video with your favorite skiers performing slaloms on the snow!

**Task 2.** Use your imagination to decorate your robot to look like an alpine skier! Make a simulation of the slalom track on your desk or on the floor putting some obstacles, for example small bottles, on a long table or on the floor on a straight line at sufficient distance one another.

**Task 3.** Build the usual **RileyRover** structure: the RileyRover should be able to turn and to spin.

**Task 4.** The robot has to move towards the obstacles and, when it is close to one of them, it goes around on the side which is alternatively left and right. After a predefined number of obstacles it stops.

Which sensor will you need?

Sensor to be mounted: ..............................................................

Mount the appropriate sensor on the robot.

**Tip:** Place the sensor in a position in order to better detect the obstacles.

**Task 5.** Start programming your robot to skip just one obstacle. Repeat your trials until you succeed. Describe here your programming solution in your own words for further discussion.
**Tip:** start with the robot moving around the obstacle on orthogonal segments

![Diagram of robot moving around an obstacle on orthogonal segments]

**Tip:** try the same task with the robot moving on semicircular path around the obstacle

![Diagram of robot moving around an obstacle on a semicircular path]

**Task 6.** Now the robot is ready to attempt the slalom between the obstacles! Use your previous solutions to make the robot to move towards the obstacles and, when it is close to one of them, it goes around on the side which is alternatively left and right. After a predefined number of obstacles it stops.

**Tip:** You may need a state Boolean variable in the program which says if the robot has to skip the pole on the right side, when true, or on the left side, when false; the variable is negated after each repetition. Ask your teacher for help if you need any.

**Task 7.** Connect the obstacles with a straight black tape. Find a solution for an autonomous realignment of the robot after skipping the obstacles using the known line follower program.

**Tip.** You need to equip the robot with the color sensor mounted so that it can collect the light reflected by the surface.

Describe here your solution in your own words.
**Task 8.** Prepare with your group a short presentation of your final solutions in the class, reflect with critical mind on your work, on comments and evaluation from your peers and teacher. After that write down your personal experiences from this project in your diary.
**Worksheet 7: What’s the number?**

**Task 1.** When you checkout from the supermarket, you have seen the cashier to use a scanner to read automatically the code of each item in your basket. You have also seen a barcode on the surface of the items you buy like this one in the picture. Discuss in your group

- How the barcode scanner reads the barcode?
- What are the benefits of using barcodes?
- Can you mention other similar applications that read images?

**Task 2.** Work on your desk or on the floor to make a barcode on a paper sheet similar to the figure

**Tip.** Draw a table with rows of the same height and fill some of them in black. The first row is always black and it is used for synchronization purposes, while the following rows read 0 for white and 1 for black. Thus the final reading is a binary number i.e. 1001011….

**Task 3.** Use your robot as a barcode reader. Build the usual tribot.

Which sensor will you need?

Sensor to be mounted:

```
.................................
```

Mount the appropriate sensor on the robot.

**Tip:** Place the sensor in a position that will better detect the barcode.

**Task 4.** Define a certain low power for the motors and keep it constant. What time the robot takes to travel the distance equal to the height of the rows you have defined?

Write your solution here

```
Time = .........................
```
**Task 5. How can you** program your robot to read 4 consecutive bits from the barcode? Discuss the problem within your group; write your proposed solution below in your own words.

**Tip.** When the color sensor detects the first transition from white to black, we know that the first synchronizing row begins at that moment. Because all the rows have the same height on the paper sheet, how many seconds it takes so that the sensor is in the middle of the first coding row where it can detect whether it is white (bit 0) or black (bit 1)?

**Task 6.** Now make your robot to announce the bit it reads.

Tip. Use the sound block and the Lego Sound files for zero and one.

**Task 7.** Make your robot to display the bit it reads.

Tip. Use the Display block

Prepare with your group a short presentation of your final solutions in the class, reflect with critical mind on your work, on comments and evaluation from your peers and teacher. After that write down your personal experiences from this project in your diary.
Worksheet 8: To be or not to be?

Task 1. Write with your group a short theatrical scenario where the robot plays an active role as a character of the theatrical play, either as a protagonist, singer or interlocutor.

Come on the stage with your group and play the theatrical scenario including the role you envision for your robot to play!

Task 2. Work on your desk or on the floor to create a mock up, that is the environment within which the robot-actor will operate based on your scenario.

Task 3. Use the tool built-in in the EV3 software to prepare specific audio clips to be uploaded unto the robot so that it can reproduce them playing its role according to your scenario.

Tip. Go to Tools/Sound Editor, this will allow you to record and edit your own sound files. Edited sound files can be saved on your computer and then used in the Sound block.

Task 4. Use your robot as an actor. Build the usual tribot. Creatively decorate the robot as an actor on the stage according to your scenario.

Task 5. Now design a methodology for realizing the scenario with your robot in the main role!

How can you synchronize the actions of the robot so that the theatrical action evolves in a convincing way?

Reflect with your group upon possible ways of making the robot to play its role.

Task 6. How can you use colors as command codes for controlling the behavior of your robot?

Which sensor will you need?

Sensor to be mounted: ....................................................

Mount the appropriate sensor on the robot.

Tip: Place the sensor in a position that will better detect the colours.

Write your solution here in your own words.

Task 7. How can you use brick buttons as command codes for controlling the behavior of your robot? Discuss the problem within your group; write your proposed solution below in your own words.

Tip. Use the Brick Buttons block.
Task 8. Now use two robots. Connect them through the Bluetooth wireless connection. Use this connection to send/receive messages between the two robots to synchronize their behavior.

Tip. Use the Messaging block.

Prepare with your group a short demonstration of your theatrical play with your robot(s) in the class. Reflect with critical mind on your work, on comments and evaluation from your peers and teacher. After that, write down your personal experiences from this project in your diary.
Worksheet 9: Wall-e project

Task 1. The modern world, and especially densely populated areas, are dealing hard with waste management today and even more so in the future. Americans produce nearly 400 million tons of solid waste per year but recycle less than a third of it. Landfills are filling up so quickly that the UK may run out of landfill space by the year 2017!

What is the role of consumerism in human environmental impact?

Statistics show waste collection to be one of the most dangerous jobs. How can robots help with the waste management?

Discuss these questions first in your group and be prepared to present your opinions in the plenary of the class.

Task 2. Can you devise a robot to collect garbage? The robot has to follow a black line, to detect an object (garbage) along its path, concurrently during its motion, to grab the object and to move it aside. Objects (garbage) may be, for example, small bottles or cans.

Work on your desk or on the floor to create a mock up where the robot will operate based on this scenario.

What sensor is needed to detect the objects?

What hardware solution is needed to enable the robot to grab and transfer objects aside?

Demonstrate your solutions in the class.

Task 3. Program the robot to follow the line and, at the same time, to detect an obstacle possibly present on its way, to grab the objects and transfer them aside.

Write here your solution in your own words

Experiment with your programming solution until you succeed.

Tip. Ask your teacher how to make your robot to grip more stably the object and transfer it aside. You need to add a gripping system in the higher part in front of the robot. This system is actuated by a medium motor you will find in your EV3 kit.

Keep the grip fully open, then find experimentally the angle to be rotated by the motor to close the grip properly i.e. enough to capture the object but not too much to stress the motor. Program the action of the medium motor accordingly.
Tip: A smooth and precise following the line helps the robot to fulfill its task. Ask your teacher how to design a better, smoother motion of the robot when following the white-black border.

Task 4. Try out different arrangements of the objects on your mockup. How can your robot detects the objects, grabs and transfers them aside in each case?

Prepare with your group a short demonstration of your work with your robot in front of the class. Reflect with critical mind on your work, on comments and evaluation from your peers and teacher. After that, write down your personal experiences from this project in your diary.
Worksheet 10: Give precedence

Task 1. Situation when vehicles often come into conflict with other vehicles because their intended courses of travel intersect. The general principle that establishes who has the right to go first is called "right of way", or "priority". It establishes who has the right to use the conflicting part of the road and who has to wait until the other does so.

Who has the right to go first? Who has the right to use the conflicting part of the road and who has to wait until the other does so?

Why is so important for all of us to comply with precedence rules?

Discuss these questions in your group and be prepared to present your answers in the plenary of the class.

Task 2. Work on your desk or on the floor to create a mock up representing an intersection. Build two tribots representing the vehicles moving on this intersection.

Task 3. The two robots reach the intersection more or less at the same moment. At this point each robot stops and checks the situation. How can a robot detect the other one before entering the intersection? Which sensor is needed?

Write here your ideas

Task 4. How can you program your robots to give “precedence to the right”?

Tip. The robot turns a bit to the right and waits until nothing is detected within a certain distance.

Write down your solution in your own words.

Task 5. Very often the drivers make signals each other and priority arrangements. How can the two robots do the same?

Tip. Explore the messaging block and experiment with the messaging action between the two robots.

Task 6. Let’s assume that one of the robots is an ambulance and thus gets always precedence to the others. How can you assure that while the ambulance is crossing the intersection, the entrance of the other robot is blocked until the ambulance clears the intersection?

Tip. The ambulance sends a message “go” when it exits the intersection. The other robot has to wait for the message “go” before entering the intersection.
**Task 7.** Invent other situations that might happen in the intersection. What priority rules apply in these situations? Make your robots to move with safety in the intersection respecting the priority rules.

Prepare with your group a short demonstration of your project with your robots in front of the class. Reflect with critical mind on your work, on comments and evaluation from your peers and teacher. After that, write down your personal experiences from this project in your diary.
Chapter 6: evaluation guidelines and tools (to be used in O3) for validating the impact of robotics-based learning activities on the prevention of school failure/ESL (O2.6)

CRITERIA TO SELECT STUDENTS TO PARTICIPATE IN THE PROJECT

WE SELECT IF:

- 2 answers YES from 1st table;
- 1 answer YES from 1st table and one answer ALWAYS from 2nd table;
- 1 answer YES from 1st table and three answers ALWAYS from 2nd table;
- 5 answers SOMETIMES;
- 10 answers SELDOM.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Other special needs (functional needs)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Low socioeconomical status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Migrant family</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Social crisis in family (death, illness, loose of job etc.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Lives or has lived in orphanage (or other institution)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Always observed</th>
<th>Sometimes observed</th>
<th>Seldom observed</th>
<th>Not observed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Has learning difficulties in at least two subjects</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Does not prepare homework</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Poor learning motivation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Difficulties to understand graphs and schemes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Concentration problems</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Lack of cooperation with classmates</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. School attendance problems</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Difficulties to formulate sentence</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
9. Uses rude language
10. Low level of achievements
11. Poor reading skills
12. Low level of knowledge
13. Problematic behaviour
14. Poor socio emotional competence
15. Lack of family support

EVALUATION INSTRUMENT

General information about student
Student _______________________________ (name, surname)
_____ (age)
School __________________________________________
grade ______________________________
Average mark for all subjects (grade) _______

Family support
☐ Has family support  ☐ Doesn’t have family support

<table>
<thead>
<tr>
<th>Three learning subjects with LOWEST mark (starting from the lowest):</th>
<th>average mark</th>
<th>Three learning subjects with HIGHEST mark (starting from the highest):</th>
<th>average mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
<td>1.</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td>2.</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td>3.</td>
<td></td>
</tr>
</tbody>
</table>

Missed lessons in semester before starting participate in RoboESL Project
1. Excused by doctor
2. Excused for other reasons (parents etc.)
3. Without an excuse

Number of missed lessons

Difficulties which influence learning
Mark with “X” if the statement characterizes the student

Has learning difficulties with reading
Has learning difficulties with calculation
Has difficulties to understand graphs and schemes
Has different learning difficulties
Has other special needs
Has attention concentration problems
### Attitude to learning

*You need to evaluate these statements about the student from 1-5, where 1 – never, 2 – rarely, 3 – sometimes, 4 – often, 5 – always*

<table>
<thead>
<tr>
<th>Statement</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do all the homeworks</td>
<td></td>
</tr>
<tr>
<td>Cooperates with teachers in a positive way</td>
<td></td>
</tr>
<tr>
<td>Cooperates with classmates during lessons</td>
<td></td>
</tr>
<tr>
<td>Is ready for work in lessons</td>
<td></td>
</tr>
<tr>
<td>Understands the connection between learning and achievements</td>
<td></td>
</tr>
<tr>
<td>Is ready to do extra assignments to improve achievements</td>
<td></td>
</tr>
<tr>
<td>Obey behavioral rules</td>
<td></td>
</tr>
<tr>
<td>Is ready to join in out of class/school activities together with other classmates</td>
<td></td>
</tr>
<tr>
<td>Is ready to join activities led by other classmates</td>
<td></td>
</tr>
<tr>
<td>Involved in sport/art activities not connected with learning at school</td>
<td></td>
</tr>
<tr>
<td>Knows the aim why learning is important</td>
<td></td>
</tr>
</tbody>
</table>

### Problem solving skills

*You need to evaluate these statements about the student from 1-5, where 1 – never, 2 – rarely, 3 – sometimes, 4 – often, 5 – always*

<table>
<thead>
<tr>
<th>Statement</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is ready to solve learning problems by himself/herself</td>
<td></td>
</tr>
<tr>
<td>Is ready to ask for help from teachers</td>
<td></td>
</tr>
<tr>
<td>Is ready to solve conflicts with classmates in a calm way</td>
<td></td>
</tr>
</tbody>
</table>

### Motivation

*You need to evaluate these statements about the student from 1-5, where 1 – never, 2 – rarely, 3 – sometimes, 4 – often, 5 – always*

<table>
<thead>
<tr>
<th>Statement</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is motivated to learn all subjects</td>
<td></td>
</tr>
<tr>
<td>Is motivated to learn subjects where can get positive evaluation</td>
<td></td>
</tr>
<tr>
<td>Is motivated to understand his/her mistakes to correct them</td>
<td></td>
</tr>
<tr>
<td>Is motivated to improve achievements</td>
<td></td>
</tr>
<tr>
<td>Is motivated to overcome difficulties in learning</td>
<td></td>
</tr>
<tr>
<td>Has an aim and works for it</td>
<td></td>
</tr>
</tbody>
</table>

### Observed problems

*You need to evaluate these statements about the student from 1-5, where 1 – never, 2 – rarely, 3 – sometimes, 4 – often, 5 – always*

<table>
<thead>
<tr>
<th>Statement</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Late for lessons</td>
<td></td>
</tr>
<tr>
<td>Problematic behaviour during recess (break)</td>
<td></td>
</tr>
<tr>
<td>Aggressive to other students</td>
<td></td>
</tr>
<tr>
<td>Aggressive to teachers</td>
<td></td>
</tr>
<tr>
<td>Uses rude language with classmates</td>
<td></td>
</tr>
<tr>
<td>Uses rude language with teachers</td>
<td></td>
</tr>
<tr>
<td>Rejects to do assignments during lessons</td>
<td></td>
</tr>
<tr>
<td>In situation of conflict reacts aggressively</td>
<td></td>
</tr>
</tbody>
</table>
Hello! You are going to learn how to work with Robots! Congratulations! It is fun!
Before start learning, can you answer some questions? Your responses are anonymous!

1. I am:
   □ boy  □ girl

2. I am a student in _________________________________ (school)
   At ____________________ (grade)

3. Learning and achievements. You need to evaluate these statements in points from 1-5, where 1 – completely disagree, 2 - rarely agree, 3 - sometimes agree, 4 – mostly agree, 5 – completely agree

   EXAMPLE

   3.1. Learning is fun
   3.2. My achievements depend on my learning
   3.3. I do all the homeworks
   3.4. I like to cooperate with my classmates in lessons
   3.5. I like to work individually to do assignments
   3.6. I like to do extra assignments
   3.7. I like to listen to teachers
   3.8. I like when there are different activities in lessons
   3.9. I like when I can do something active in lessons
   3.10. I like to solve learning problems by myself
   3.11. I like to look for extra information needed for learning

4. If you miss lessons it happens because: Please evaluate these statements in scale 1-5, where 1 – always, 2 – often, 3 – sometimes, 4 – rarely, 5 – never

   4.1. I was sick or had an appointment to doctor
   4.2. I had to participate in another activity – sports, art, etc.
   4.3. I had to help my parents
   4.4. It was unpredictable situation
   4.5. I had to work
   4.6. I had to babysit my sister/brother
   4.7. I did not want to go to school
   4.8. I overslept
   4.9. I did not want to meet my classmates
   4.10. I do not like learning

5. Please write here three learning subjects which you like most

   5.1. _________________________________
   5.2. _________________________________
   5.3. _________________________________
6. Please write here the three learning subjects which you don’t like most
   6.1. _________________________________
   6.2. _________________________________
   6.3. _________________________________
Chapter 7: validation criteria and tools for validating the impact of the curriculum on the participant teachers (O2.7)

Evaluation of training course

We invite you to evaluate training course you have participated. Please respond openly to the following questions. We appreciate your time and feedback!

*Please evaluate following statements in points from 1-5, where 1 – Strongly disagree, 5 – Strongly agree by circling the correct answer*

1. I know how to use pedagogical approaches in robotics-based learning activities to cope with school failure
   
   1 2 3 4 5

2. I understand robotics-based learning methodologies inspired by constructivism and project-based learning principles
   
   1 2 3 4 5

3. I know how to use robotics-based learning methodologies inspired by constructivism and project-based learning principles
   
   1 2 3 4 5

4. I know how to apply training activities for familiarisation with educational robotics using robotics kits and software
   
   1 2 3 4 5

5. I know how to use guidelines for the use of the Open Educational Resources developed
   
   1 2 3 4 5

6. I understand how to organise robotics-based learning activities in my school
   
   1 2 3 4 5

7. I know how to use evaluation guidelines and tools (for validating the impact of robotics-based learning activities on the prevention of school failure/ESL)
   
   1 2 3 4 5

8. I know how to use e-learning platform
   
   1 2 3 4 5

9. Do you have any suggestions how could we develop and improve the curriculum of training course?