Intellectual Output 3, Task 5:

Erasmus+ Project

RoboScientists: 2018-1-PL01-KA201-051129

"Documentation of case studies that can be used in the class to link robotic construction with the world of entrepreneurship and innovation".

Best Practices in Educational Robotics applied to STEAM (Latvia)

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Introduction

It has been quite a long time since S. Papert introduced the idea that children should be involved in the use of computers in the learning process to support the development of computational thinking. Nowadays, educational robotics have been introduced in different dimensions of education, but mostly utilised as part of a compulsory educational process in nonformal educational activities. Although incorporating robotics activities into the learning process is no longer a novelty, there is still the question of how to use them to promote the development of specific competencies, and which pedagogical principles should be taken into account in order to improve students' motivation to look for new innovative solutions and to ensure inclusive education.

Implementing Robotics in Education

Robotics are considered to be better approached through constructivist theory. This approach provides the learners with the opportunity to work with tools and kits and construct knowledge that can be applied in real life-situations and contexts. In doing so, they will experiment, engage in discourse and work actively. This will help learners develop appropriate skills and adopt certain attitudes towards experimenting, learning, constructing, which are important qualities for other subjects as well (EU, 2011; Johnson, 2013).

Eguchi (2010), has identified three approaches of promoting and establishing the implementation of robotics in education. The first is through a theme-based curriculum approach. In this case, the curricula recommend or prescribe integrated activities or topics that emphasize on robotics. The second is project-based approach. In this case, learners will deal with a real-life problem that has to do with robotics. The third is the goal-oriented approach. In this case, learners will become familiar with robotics within opportunities, as local, national or international competitions or events on Robotics, which tend to become more and more common and popular.

According to Alimisis (2013), the introduction of Robotics in education, in many countries all over the world, has started thanks to initiatives of individual teachers, without any centrally organized effort. However, these initiatives are significant in number and have led to the implementation of innovative projects, of short or long term, that were effectively carried out. Thanks to these, the popularity of robotics is raising. An increasing number of teachers and learners become familiar with this field as well, as its benefits.

In the light of all the above, there are certain criteria and guidelines that should serve as principles when the subject or theme of robotics enters the classroom and the educational reality generally.

1. There should be a coordinated design or promotion of both technological products, means but also practices and curricula that can be easily used in the classroom to assist the teachers.
2. There should be established pathways of communication among teachers, researchers, policy-makers and equipment designers so that the previously mentioned coordination can be realized.
3. Teacher training and further education towards both robotics and new pedagogical approaches is necessary.

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4. It is necessary for teachers to have appropriate lesson plans that will guide them.
5. , There should be institutions or opportunities that will help monitoring, observing and evaluating the progress of education activities as well as curricula where the strong and weak points will be spotted and treated as needed.
6. Establishing teachers' communities or groups were teachers can share experience or ideas can be useful.
7. It can be necessary to provide teachers with formal opportunities to inform other members of the educational community, such as head-teachers, parents, partners of the school about the on-going process of Robotics.

These guidelines can establish a flexible context within schools, which will help the innovative educational approach to be implemented smoothly. In fact, they are able to assist the transition of schools from the traditional type to a modern learning organization, which is open to the wider community and interacts with it. This is important in terms of social progress, for instance, as robotics and technologies develop, the schools will understand the need to catch up with it. They will engage technology and robotics in the classroom and qualify learners as required (Fullan, 2007; EU, 2011).

LATVIA

Latvia is currently undergoing educational content reform within the framework of the "Competencies approach in teaching content" project implemented by the National Educational Content Centre (VISC). The aim of the project is to develop, approbate and implement in Latvia the content and access to teaching of general education, which would result in students acquiring the necessary knowledge, skills and attitudes for life today. The project target audience is pupils aged from preschool to high school. (Skola2030, 2018)

The 2019 Eurodice report "Digital Education in European Schools" reports that the development of digital competence in most countries is targeted at all three levels of education, but unlike traditional subjects, it is also considered in Latvia not only as a separate subject but as the main competence of transversal skills. (EACEA, 2019)

5.2.6. digital literacy: student uses digital technologies responsibly and effectively for knowledge, new content creation, content sharing and communication, critical and constructive assessment of the role of technology and media in society. (Rules on basic education curriculum, LV)

The Education Act, following the reform, provides seven key areas of training, one of which is the field of technology training:

7.6. the field of technology training: the student practically creates products, services, information and environmental solutions useful to himself and the public, by planning, designing and constructing the design process to target it to safe and responsible use of a variety of techniques, tools and devices, including digital ones, selecting suitable materials and acquiring relevant skills, and creating a safe and health-friendly working environment, taking appropriate action in dangerous household situations, *understanding the design process and gaining experience in the pursuit of a simple technological process and addressing engineering problems, able to use digital technologies safely, effectively and responsibly in the design process.* (Rules on basic education curriculum, LV)

The inclusion of digital competence also changes the content of education from the education program.

Results to be achieved in the field of technology:

1. Design solutions (product and information design, environmental solutions) are created in the design process *1.1. Identification of user needs and opportunities;* *1.2. Search for and choose a solution* *1.3. Planning and implementation of the solution;* *1.4. Testing, evaluation and development of the solution;* *1.5. Implementation of the solution.*
2. The choice of appropriate and safe materials and technologies, their efficient use, enables better design solutions (product and information design, environmental solutions); *2.1. Working with materials and their handling techniques;* *2.2. Food technology and table manners;* *2.3. Use of programmable devices and computer networks and management of storage devices;* *2.4. Manage and use office, image, video and audio processing applications and their specific and shared functionality;* *2.5. Use of Internet services and online information processing and cooperation tools;* *2.6. Algorithms, data structure, programming language and software development;* *2.7. Development of engineering solutions;* *2.8. Development of robotic solutions and programmable devices;* *2.9. Development of environmental solutions.*
3. Design solutions (product and information design, environmental solutions) shall be created in accordance with the needs, expectations and capabilities of a specific user and society: *3.1. Cultural heritage is an important source of inspiration for the creation of new and innovative design solutions;*

3.2. Smart design solutions are useful and sustainable;

3.3 It is important to take into account the work environment, safety and ethical considerations in the development of high-quality design solutions;

3.4. The development of science and technology creates new, innovative design solutions.

The projected results to be achieved by the pupil are complex, they reveal the final result in action, include knowledge, understanding and basic skills in the fields of learning - rolling skills. (Rules on basic education curriculum, LV)

The digital competence required in the teaching profession is included in the general standard of professional competence for teachers. In Latvia, the standard of professional competence of teachers is included in the *Procedures for the Organization of the Quality Assessment of the Professional Activity of Teachers*. (Procedures for the Organisation of the Quality Assessment of the Professional Activity of Teachers, LV) In the professional standard, the digital competencies required in the teaching profession are defined as the ability to:

- target and critical choices and integrate different learning techniques, methods and technologies into the learning process;
- assessing the risks associated with the use of digital technologies;
- Targeted, rational and efficient use of information and communication technologies in the training process and vocational development.

In Latvia, since 2014, the Education Development Guidelines 2014-2020 strategy supports the development of digital skills in schools and non-formal education. The use of digital learning tools and innovative digital education content is supported in schools, both phases of secondary education, and the need to ensure the digitization of educational institutions is emphasized. (Education Development Guidelines 2014-2020)

Higher authorities can support the continued professional development of teachers in a variety of ways. This is most often the case by organizing training courses conducted by national or regional training institutes, where training agencies, educational centres or other educational establishments offer a variety of courses related to digital competence. (Eurydice, 2019) For example, the role of eTwinning is particularly important in the context of support measures available to teachers as an opportunity for continuous development with technology and digital competences. (eTwinning activities for digital education in European schools, 2019)

This document looks at several, current, interest education programs in Latvia and attempts to include robotics in school curricula. In the field of technology, design, modelling, programming, 3D, robotics, electronics, technology acquisition, design, etc.

LATVIA- Robotics Educational Practices

A. Latvia Curricula for 10 exemplary interdisciplinary robotics projects

GENERAL INFORMATIONS	
TOPIC	Curricula for 10 exemplary interdisciplinary robotics projects: • enabling teachers to master the technical and pedagogical skills • to become able to develop their own robotics activities • Learn to use innovative, student-centred and constructivist pedagogical approaches • focus on preventing School Failure and Early School Leaving.
TITLE	ERASMUS+ Project RoboESL – Robotics-based learning interventions for preventing school failure and Early School Leaving
DURATION	01/10/2015 – 30/09/2017
LEAD PARTNER/ COORDINATOR	Liceo Fermi (secondary school in Italy)
PARTNERS/ NETWORK	• University of Latvia/Education Dept. was the main pedagogical partner and offered its pedagogic expertise, especially in Early School Leaving. • University of Padova/Dept. of Information Engineering was contributing its technological expertise in educational robotics. • Non-profit educational organizations like Edumotiva (Greece) was contributing on curriculum development • Scuola di Robotica (Italy) was contributing their expertise in educational robotics and in training/learning design. • Students at risk of school failure and ESL that are enrolled in the participant secondary school in Italy, Greece and Latvia was engaged in RoboESL intervention.
WEB LINK	http://roboesl.eu/
RELEVANT DOCUMENTS or OUTPUTS	Output 1: Curricula for 10 exemplary interdisciplinary robotics projects Output 2: Curriculum for blended (online and face to face) teacher training Output 3: Validation of the impact http://roboesl.eu/?page_id=591
INSIGHTS	
DESCRIPTION	The RoboESL project aims at exploring the potential of robotics for developing extra-curricular constructivist learning activities in schools that will help children at risk of failure or Early School Leaving (ESL) to practice and develop their creativity skills, raise self-esteem, motivate and enhance their interest towards staying at school.
AGE OF THE TARGET GROUP	students 13-15 years old

<table>
<tr><td>METHODOLOGY</td><td>Open Lab with focus on roboethics, ev3, scratch, arduino in the framework of the Roboesl project. 10 lessons already developed with Lego EV3 kit. These plans are designed for high schools, for example the two-year period. But if followed, the students of a third secondary school class also are able to carry out the indicated missions. constructivist/constructionist pedagogy (Piaget, Papert)
project-based learning approach
active reflection upon the task
experiential learning and learning by making
instead of giving step-by-step instructions, teachers/learners are advised to try and figure out how to do it themselves</td></tr>
<tr><td>LEARNING OUTCOME</td><td>To provide students with a stepwise approach for a step by step acquisition of technical skills in using robotic technologies (hardware and software).
• To offer the robotics benefits for all children, especially those at risk of school failure or early school leaving.
• To promote STEM learning through interaction with the robotics technologies.
• To support self-directed action allowing learners to learn independently.
• To support the development of a “real” learning scenario encouraging the engagement of the learner in authentic problem solving.
• To adjust the robotics project to learners’ needs and interests by offering tasks with some options to advance to different levels of complexity and difficulty.</td></tr>
<tr><td>RISKS</td><td>Given the special attention to students who are in risk of ESL there is the risk, that other students who are interested in robotics, do not have access to these activities.
Students who have low level of motivation and low level of cognitive ability need more step-by-step instructions but in this project the teaching approach is based on inquiry methodology to let students experiment by themselves</td></tr>
<tr><td>WORKABLE – TRANSFERABLE PRACTICES</td><td>ER methodology requires that learners themselves are active with a high need to explore, to design, to create and to share experiences and ideas
Hence, teachers in ROBOESL training paradigm are encouraged to change their role to facilitators and enablers
They learn to design and implement relative simple robotic projects in the context of scenarios from everyday life using robotics kits
acts as an organizer, coordinator and facilitator of the learning process.
organizes the learning environment,
raises the tasks / problems to be solved
offers resources
supports students’ engagement in the ROBOESL interdisciplinary projects
discreetly helps where and when necessary
encourages students to try out different ideas and solutions and to work in teams
organizes the evaluation of the activity in collaboration with the students.
ensures a playful, open, non-judgmental, and collaborative classroom environment that fosters creativity and collaboration
Specific objectives
More specifically, upon successful implementation of the activities described in this curriculum students will achieve the following objectives:
• Learn to mount the distance/ultrasonic sensor on the tribot for detecting obstacles
• Create the mock-up, the environment into which the robot will operate based on the scenario
• Make the robot turn around the point of support of the stopped wheel
• Make the robot turn by trial and error experimentations 90 degrees</td></tr>
</table>

	• Understand through playful experimentation and trial and error the relationship between the rotation of robot and turning angle of the tribot • To reach the mathematical reasoning underpinning the aforementioned relationship • Understand the use of the distance/ultrasonic sensor • Understand the way the command of “switch” operates and implement solutions using this command • Use of the sound block to introduce sound in the process of parking • Using a variable for generalizing the solution so that to work for a random number of parking slots Sense the presence of an obstacle by means of the ultrasonic sensor • Calibrate motion parameters to obtain the requested behavior • Distinguish the different types of motion (on a straight line, through orthogonal segments, on a semi-circular path) and program the robot to move accordingly • Use a state variable to condition the robot decisions • Understand the NOT Boolean operation • Understand how to make the robot entirely skip the black tape and follow a line [and more]
RESOURCES	The training material is fully ready to use and well structured. LEGO Education EV3 robotics kits are required.
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B. Latvia AlfaRobot – Robotics learning program for 1st-3rd class

Alfa Robot EDUCATION	
GENERAL INFORMATIONS	
TOPIC	Robotics
TITLE	Robotics for 1st-3rd class
DURATION	36 lessons (each 90 min)
LEAD PARTNER/ COORDINATOR	n/a
PARTNERS/ NETWORK	n/a
WEB LINK	https://www.alfarobot.lv/web/mobile/main/web/robot_1.php
RELEVANT DOCUMENTS or OUTPUTS	Lesson 1: History of robotics development History of mechanics development. Lesson 2: Mechanical connections. Lesson 3: Application of gears in mechanics (dimensions of gears and their interaction). Lesson 4: What is an algorithm. Algorithm record form. Lesson 5: Basics of algorithmic. Lesson 6: Reading the algorithm. Algorithm step. Lesson 7: Execution mechanisms. Engine types. Lesson 8: Engine types. Engine management. Lesson 9: Motor connection types and connections. Lesson 10: Light elements. Lesson 11: Light elements.

	Lesson 12: Algorithm notation type with time units. Lesson 13: Programmer. Program code. Lesson 14: Program recording. (Syntax). Lesson 15: Object management using program code. Lesson 16: Using sensors. Reading information from sensors. Lesson 17: Logical operators. Branching. Lesson 18: Cycle design programming. Lesson 19: Power supply. Battery cells. Lesson 20: Types of equipment / actuators connection. Lesson 21: Design views. Basics of drawing.
INSIGHTS	
DESCRIPTION	Robotics classes are an effective way of teaching technical subjects in primary school. The implementation of the curriculum helps in the development of advanced learner skills, team work, communication group, work with multimedia and information sources, basics of programming and algorithms. The course helps to discover an exciting world for children with elements of robotics, which will be a strong motivating factor for the student to learn mathematics, information technology and other sciences related to the technical field.
METHODOLOGY	Thematic plan of the lessons During the lesson, the themes of the curriculum will be adapted to the age group of the target group and individual needs using the study material prepared for each age group. Teaching work will be provided using three teaching methods: hermeneutic (20%), empirical (60%) and research (20%) methods. Divided into 3 parts: theory, practical lesson with the help of a lecturer, independent work, which also includes work in groups. The theory learned during the lesson will be tested in practical lessons, using the Lego WeDo Education, Lego Mindstorm ev3 and AlfaRobot ™ extension pack kits for each group, solving individual tasks.
RESULTING BENEFITS	Program topicality: The training course developed by the Training Center is related to the priorities of the curriculum based on the new competency approach, which: will help the learner to set clear and meaningful results to be achieved, will offer diverse, complex, personalized tasks in the learning process; will give an opportunity to form a true understanding, to interconnect what has been learned in the study process, will encourage to choose the most suitable method of solving problems; provide appropriate support and regular feedback during training; will encourage learners to reflect on their learning and thinking. Planned results of the study program: Pupils have developed communication skills through teamwork. The student is able to determine the constructive features, structure and mechanisms of different models. The student knows and can apply the software development stages and the basics of basic programming in robot control. The student can independently and in a team plan his / her and team work, control and monitor the work execution processes, set goals and choose methods to achieve the goals by working with robotics-related tools. We are right at school
RISKS	Training materials and classes are not available free of charge (40 EUR per months).
WORKABLE – TRANSFERABLE PRACTICES	Currently, AlfaRobot classes take place in more than 140 Latvian schools and pre-school institutions. The classes are attended by about 3,200 students.
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C. Latvia RobotNest – SumoBoy study material – basics of robotics

	“SumoBoy” v 1.0
GENERAL INFORMATIONS	
TOPIC	The study material and worksheets should be used together with a set for learning the basics of robotics – SumoBoy. (Kit is made in Latvia)
TITLE	Learn the basics of robotics
DURATION	From the age of 12
LEAD PARTNER/ COORDINATOR	n/a
PARTNERS/ NETWORK	n/a
WEB LINK	http://robot-nest.com/uploads/filedir/sumo_boy_print.pdf
RELEVANT DOCUMENTS or OUTPUTS	http://robot-nest.com/uploads/filedir/sumoboy_datasheet-eng.pdf
INSIGHTS	
DESCRIPTION	The SumoBoy is designed to learn fundamentals of electronics and programming for pupils and enthusiasts. Its design is fully compliant with international robot SUMO competition rules and is ready to be compete. SumoBoy reflects experience and know-how of the Latvian robotics team, which has been among winners of European, USA and Japan robot competition for several years. The robots is controlled by well-known Arduino Micro microcontroller. Allowing to use huge knowledge of the Arduino community. The robot will be attractive for both beginners and experienced enthusiasts. • Reflects the best of Latvian robotics team experience and know-how; • Hardened steal armour; • Machined aluminium wheel disks; • Special silicone composition rubber wheels; • Five forward looking sensors; • Specially designed motors and reducers; • 4 dip switches for strategy selection; • Arduino Micro controller; • Supports IR remote compliant with international rules; • Safe LiFePO4 battery; • Integrated charging schema; • More than 30 exercises for learning electronics and programing;
METHODOLOGY	The study material is divided into topics that are addressed to specific aspect of the robot design, such as electronic components, motor control, etc. c. For each a general description and terms of reference have been prepared for the topic. Topics are numbered sequentially throughout in the study material, and worksheets for each topic are provided, i. i., independent work on each topic begins with worksheet 1.
RESULTING BENEFITS	Expected results of mastering the program:

	• Learned the basics of safety and soldering, have skills in using a multimeter. • Gained an idea of the basics of electronics elements and their use. • Gained an idea of electric motor control and sensor data processing. • Acquired basic programming skills. To acquire the ability to combine the elements of electrical engineering, electronics and computer science in order to create a robot using the components included in the training kit, which performs the activities built into the software. Soldering is not included in physics curriculum, therefore the basic robotics program included here includes one additional lesson. Worksheets include tasks on security issues and learning to use a multimeter. At the end of the school year, a sumo robot competition is organized to motivate students to learn. Encourage students' interest in robotics as one from the fastest growing fields of engineering; to motivate students to link their further education with engineering
RISKS	All training materials are available free of charge, but the robotics kit must be purchased separately (its price is 219 EUR). The teachers should be prepared to use with these robotics kits to help student to understand the basic principles and to support the learning. Students need to have previous knowledge to work with these kits and if there is no knowledgeable teacher behind then it can lead to avoidance to use these materials
WORKABLE – TRANSFERABLE PRACTICES	All materials can be used for both training projects and children's robotics camps. • Top quality equipment for schools, robotics clubs, centres of technical creativity; • For enthusiast of international scale robotics competitions; • Attractive equipment for teaching informatics; • Excellent hands-on helper for teaching electronics fundamentals; • Provide a lot of fun with friends; • An excellent present for teenager or student starting the next education level;
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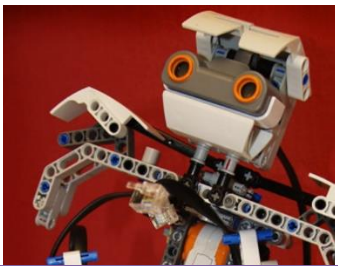
D. Latvia Classes for improvement of social and digital skills, to provide qualitative free time using LEGO robotics elements

	
GENERAL INFORMATIONS	
TOPIC	The aim of the project is to promote social inclusion of at least 70 children and young people at risk of social exclusion in Ogre region (Latvia), as well as their families, by organizing trainings for the development of social and digital skills, implementing high-quality leisure opportunities, using motivating LEGO robotics elements. • to develop methodology, curriculum and learning materials for innovative service: qualitative free time together with LEGO. • approbation of service during seminars, classes and camps. • to improve service taking in account results from approbation.
TITLE	"Social integration measures for children and youth at risk of social exclusion in Ogre region"

DURATION	from: 01.08.2014. to: 01.08.2015
LEAD PARTNER/ COORDINATOR	Association “Development and Innovation Training Center” (Latvia)
PARTNERS/ NETWORK	Ogre Region Social Service Family Support Day Center (Latvia)
WEB LINK	https://roboti.aimc.lv/ezz-projekts/project-summary/ https://odo.lv/Training/Lego
RELEVANT DOCUMENTS or OUTPUTS	https://odo.lv/Training/LegoMethodology https://odo.lv/Training/LegoCurriculum#HM101c12BbuprogrammaLEGOrobotikasnometnei https://odo.lv/Training/LegoMethodology#Hteorijaunmetodes
INSIGHTS	
DESCRIPTION	The project team has prepared teaching materials for the acquisition of basic skills in LEGO robotics. By learning these training materials, you will learn what EV3 robot hardware consists of, what is EV3 robot software, where to get it, and how to prepare for LEGO robot programming. With the help of the training material you can learn how to program the movement of the EV3 robot, the use of touch sensors to start the movement, stop the movement of the touch sensors, the use of the color sensor and the ultrasonic sensor. In the tutorial you will learn how to program cycles and branching.
METHODOLOGY	In order to ensure that children and young people at risk of social exclusion are prevented from the risk of exclusion, a methodology for social inclusion has been developed. Social learning – There are four main assumptions about social learning: 1. Behavior is taught (an individual learns and strengthens his / her behavior in the process of socialization). This means that the child develops and reinforces his or her behavior as he or she grows and observes the patterns of behavior of others, trying them out and receiving responses from others. Of course, hereditary factors should not be ignored either, for example, if a person has a mental disorder, it will greatly affect how he or she perceives what is going on around him or her. 2. The pattern of behavior is formed in response to rewards and punishments. This assumption means that others can influence a person’s behavior by acting in a certain way. And in particular, positive behavior can be encouraged by rewarding, but negative behavior can be curbed by punishment or non-reward. This principle is easy to understand when analyzing the techniques parents use to raise their children. 3. Learning takes place in a social context. This assumption means that the environment plays an important role in the learning process. For example, learning in a classroom, where learning is seen as a “bump” (learning takes place compulsively, without understanding the information provided), creates a different environment than learning in a classroom where learning is perceived as an opportunity to assert oneself. The learning process is like self-discovery, when a person reveals his / her strengths and weaknesses. Every learning environment is different and it affects the way we learn. 4. Learning is influenced by our personal issues / interests. This assumption means that the young person adapts his / her learning ability to each specific situation and that the young person learns topics that are interesting and important to him / her differently than minor and insignificant ones. For example, in one classroom with 20 young people, each of whom is different and has brought their own personal problems to the lesson, it will be natural for each participant to take something different from the lesson. Each young person’s experience is different and it means that these ‘different’ young people will perceive, select and arrange the information differently, leading to different conclusions. https://odo.lv/Training/LegoMethodology#Hteorijaunmetodes (LV)

RESULTING BENEFITS	• it is created innovative educational after school activities using LEGO robotics elements for children and young people which have risk of social exclusion. • 70 Ogres county children and young people which have risk of social exclusion have improved quality of live and have strengthen their democratic values. Activity: Inventory and equipment acquisition for activities Activity 1: Expert / teacher knowledge development sessions how to organize workshops, classes and camps using LEGO robotics for social inclusion. Activity 2: Development of free time educational activities for social inclusion using LEGO robotics: curriculum, methodologies, learning materials. Activity 3: Educational workshops of providing qualitative free time service for social inclusion by taking advantage of LEGO robotics elements Activity 4: Educational classes of providing qualitative free time service for social inclusion by taking advantage of LEGO robotics elements All planned results were achieved. The innovative educational after school activities using LEGO robotics elements for children and young people were created. These activities include development of the methodology, curriculum and learning materials. Free access to all materials is provided in the project website roboti.aimc.lv. 95 children and young people (instead of planned 70) participated in these after school activities during 3 seminars, 30 classes and 5 camps. Project partner coordinator invited the group of students to participate in the project activities. The invitation was distributed in the project and county websites also. 95 Ogres county children and young people which have the risk of social exclusion have improved quality of life and have strengthen their democratic values.
RISKS	All training materials are available free of charge (LV), but the robotics kit LEGO EV3 MINDSTORM must be purchased separately. The developed activities were aimed to the group of students who have a risk of social exclusion which can raise the risks for other students, who wish to participate in such activities, to feel marginalized and it can lead to other risks of exclusion
WORKABLE – TRANSFERABLE PRACTICES	All materials can be used for both training projects and children’s robotics camps.
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Summary

In Latvia from the September 2020 educational robotics is included in national curriculum and it should be delivered as transversal competence to all children. It is very ambitious and innovative plan to prepare young generations for the world they will have to live in and to ensure that students became creators of innovations not only as passive users of products developed by someone else. It should be noted that there is not enough teacher training carried out to prepare them to work with educational robotics. It means that there has to be much work done to reach these ambitions because robotics combines design and programming in one subject, which provides versatile development for children. STEM is an exact science that is taught to a child by involving robotics' designers, tablets and an appropriate curriculum of the learning process. By learning through playing, children comprehend the world of interconnection of different technologies and, from the age of 5, understand the sequence of things and learn algorithmic thinking through programming.

Cognitive, fine motor and social development improves. Classes include theoretical part, design and programming. The children apply the knowledge acquired in the learning process in practice at the same time. Playing while learning is especially important because children compete with each other using hand-built robots. Educational robotics ensure new opportunities for creative and critical thinking. By experimenting and inventing, children become engineers and storytellers. Using motors and sensors at work, as well as creating personally significant projects, children use their imagination and contribute to the development of problem-solving potential. By programming simple algorithms with flowcharts, young students can make their story a reality.

Educational robotics helps to ensure secure demonstration of technology. Sometimes this environment seems intimidating to adults who are worried that their children are spending too much time on smart devices. An integral part of robotics - programming ensures the safety of the student in the learning process. During the educational process, children learn what the computer is actually intended for. Under the supervision of a teacher, the computer teaches the child the principles and interconnections of a logical circuit.

As a result, children are able to structure and explain the basic principles of the mechanisms used in everyday life and create new, innovative solutions based on the acquired knowledge.

Children want to learn and explore things. If the learning process is properly organized using child-friendly teaching aids, the educator's only task is to lead the process and answer questions. If the children ask questions in class and not the teacher – the result is achieved.

Early introduction to robotics significantly contributes to a child's ability to grow and expresses her/himself, as her/his cognitive, critical and creative potential is involved. In this way, learning robotics helps our future designers and engineers to better understand and explore the world around them.

In Latvia there are quite a lot of robotics activities held in previous years, which can be assumed as stable background to reach objectives set in national curriculum. There are also companies who develop their own educational robotics kits, which comes together with lesson plans and guidelines for teachers. There are eTwinning activities to prepare teachers for working with educational robotics activities. Also new educational master study program "Technological innovations and design for education" will start from September 2020 where educators will be prepared for organizing technology enhanced learning, develop digital learning materials, work with educational robotics, virtual reality, 3D printing devices and also how to ensure learning in this changed educational landscape.

Conclusions

The risks can be divided in several groups:

1) Problems with learning environment in compulsory educational setting where specific planning of lessons should be done because robotics activities take more time than regular lesson time which in project countries are 40-45 minutes but robotics activities should be planned for 90 minutes at least.
2) Educational robotics activities are not in line with compulsory curriculum and in cases where it is, these activities are not included in curriculum but are organized as voluntary activities.
3) Problems with teachers who are not fully prepared to incorporate robotics activities in compulsory education, or who are prepared to work with motivated students interested in robotics. Teachers who are prepared to work in constructivism paradigm where students construct their knowledge during hands-on activities but sometimes there should be used another learning approach with students who have lover level of cognitive ability, lover level of motivation etc.
4) Problems with students who do not have basic knowledge for starting activities with robotics kits, those who drop out from organized activities (maybe because of teaching approach is not suitable for them).
5) Practical problems, like – damage of robotic kits, problems with the connection (internet, Bluetooth), charging problems, theft of robotic parts.
6) Indicating that there are no risks can be quite a big risk because it shows that some hidden risks are not acknowledged and therefore there are not activities taken to diminish those risks.

Recommendations

1) The educational environment should be prepared for incorporating educational robotics in compulsory education but to reach this aim there should be several steps taken:
- Lesson plans should be adapted to allow organize robotics activities for 90 minutes in row
- Teachers should be prepared not only for organizing hands-on educational activities, but also use different approaches in cases when some students are not motivated, they do not have previous knowledge, they have lover level of cognitive ability, they have a risk of drop out.
- Teachers should be prepared to explain robotics' ethics related aspects and legal aspects in use of sensors and free information flow.
- Learning spaces should be adapted for robotics activities – enough robotics kits, possibility to charge robotics kits and tablets or notebooks, access to the network, spare robotics parts, maker space to let students develop their own robotics parts

2) There should be taken activities to support inclusion of educational robotics in compulsory education to ensure that every student have access to this knowledge. Otherwise, it can be that only particular groups of students participate in educational robotics activities and it can lead to exclusion factors
3) There should be taken activities to ensure inclusive education taking in mind also hidden factors.

Educational robotics also shouldn't be taken as providing a panacea for all the problems that exist in education. However, challenges can be raised if ER activities are provided as nonformal educational activities that are available for a special group of students—those whose families can pay for these activities or those who are labelled as the focus group of activities (for example, 'children at risk', 'Muslim girls', etc.). Children don't want to be labelled. If ER activities are provided at a time when the school bus can't take students home, this again provides the possibility to participate for those who live close to the educational setting or whose families can take them home by car. Also, students who are labelled can feel satisfied and encouraged inside such groups, but they can feel excluded from the compulsory education environment because of feeling 'labelled'. This risk can be observed not only in countries of low gross private domestic investment (GPDI), where formally the possibility is provided, but hidden factors are not met.

> Skills have become the global currency of the 21st century. Without proper investment in skills, people languish on the margins of society, technological progress does not translate into economic growth, and countries can no longer compete in an increasingly knowledge-based global society
>
> - OECD Secretary-General Angel Gurría

Schools and early years settings must continually evolve, improve and learn from best practice in relation to STEM education. Teachers are now required to change their approaches to STEM teaching, learning and assessment. The teachers need a significant amount of assistance and support in this area. In Latvia, the introduction of robotics in the learning process is only at the very beginning. With the new educational standard and the “learning outcomes” in robotics included in it, teachers will now have to introduce robotics into the teaching process. The former subject “household / housekeeping" and "handicrafts" is replaced by the subject "design and technology". This subject will provide students with a basic knowledge of both robotics and electronics, of course, together with subjects such as programming, computer science.

Although so far robotics has only been in the form of extracurricular activities, camps, projects, or individual learning, it is expected that this will change in the coming years and robotics will be taught to students in schools as well. The teaching materials developed so far have been developed either in collaboration with EU projects, in which case they are free and should be used by all teachers and private companies and educational institutions, in which case they are paid lessons / camps. There are observable good tendency for more and more private companies to share their experience and knowledge, they provide both teaching robotics in schools and participate in projects, and develop training materials in robotics for schools. In future, it would be interesting if more such activities are implemented within the education systems. Moreover, it would be very interesting if these activities are combined with a greater effort to establish a curriculum on Robotics or STEAM that could provide appropriate instructions, notes and guidelines, goals on Robotics to assist teachers further.

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ROBOSCIENTISTS PROJECT

Motivating secondary school students towards STEM careers through robotic artefact making

Erasmus+ KA2 2018-1PL01-KA201-051129

Creators

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Declaration

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