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KA201: Strategic Partnerships for school education

RoboPisces

"innovative educational ROBOtics strategies for PrImary School ExperienceS"

IO3: the RoboPisces educational curriculum

Responsible Organization: University of Latvia

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Notes

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Preface

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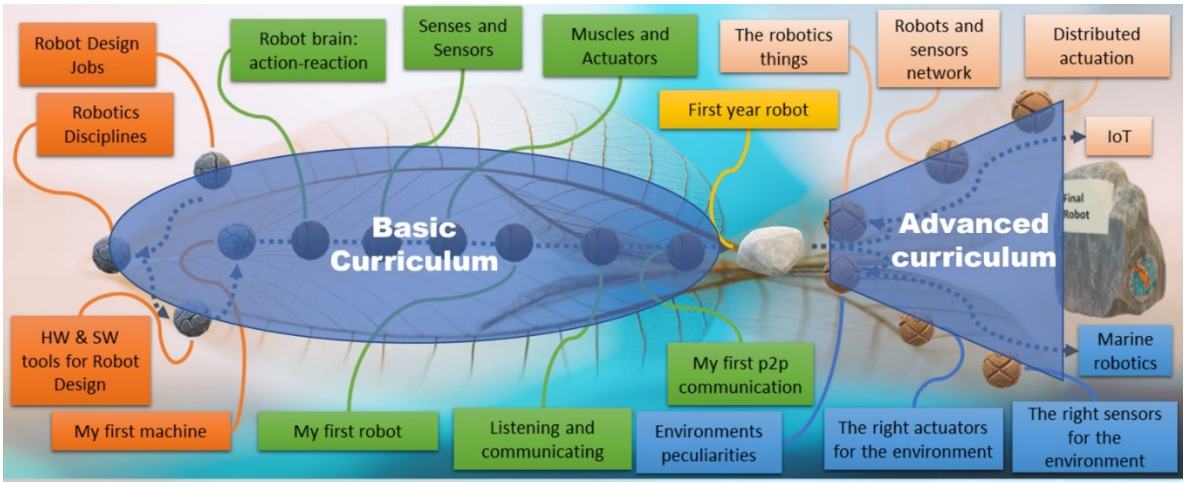
18/10/2022	2.0	Final version of the report: integration of text into the official RoboPisces template, final links to repository

Introduction

Scope and objectives of the document

This document aims at briefly presenting the output 3 of the RoboPisces project, the "RoboPisces educational curriculum".

The intellectual output IO3 is an innovative educational curriculum, which includes a set of learning modules for primary students. It is constituted by an inventory of activities to be implemented in classrooms by teachers. Each module focuses on a specific subject and topic identified by project partners as relevant for the project purposes. The collection of such topics is depicted in the "FISH curriculum" image, which also shows how it is divided into two main parts: Basic and Advanced curriculum.



Each module of the curriculum includes the course material, learning objectives, and assessment methods. Each part includes questions, exercises, and practical activities about STEAM subjects that can be explored thanks to the RoboFISH toolkit, which was developed in the intellectual output 2.

All the educational resources and activities were designed to encourage active, cooperative and experiential learning in all phases of the course. Technology can be very helpful to put this approach into practice: with computers, motors, sensors, electronic boards, children are able to develop their own ideas, experimenting and programming their personal artefacts. The assessment of students' learning outcomes and the validation of the curriculum empower educators with a valuable method for students' evaluation through gamification.

As short-term impact in partner schools, the RoboPisces curriculum aim at increasing attitude towards STEAM careers in both students and teachers, and students' interest in careers of the Blue Economy.

Nowadays, ISCED1 curriculum on robotics are not defined at national levels, but it is very common to find examples of fragmented educational activities in schools that are mostly carried out by external experts who sell their expertise and activities. Thanks to the development of this curriculum as an OER, all schools gain access to a reliable, proved and validated educational robotics curriculum. This is expected to have a positive impact into European schools in the ease of accessing and introducing

innovative education programs in robotics. In fact, it could be adopted by all the countries that are looking for a reference model to introduce Robotics in Primary Education.

Contents of the documents

The document presents the IO3 "RoboPisces educational curriculum" following the main results from its development. The development of the curriculum can be traced in four main steps. First, partners carried out a **mapping of already existing curricula in Educational Robotics, applied to STEAM, in primary schools within the involved countries**. After this extensive review of the state of the art, partners were able to design an innovative education model for primary students. So, the second step in the development of the curriculum involved the partner universities (UNIVPM, NUID UCD, LU and UAegean) in preparing **reference and training material for lesson plan**. The materials are available as Open Educational Resources in English (CC-BY NC SA 4.0 license) in order to be exploitable by most EU countries through the RoboPisces website and also at the RoboPisces MOOC. Notably, to implement the activities at school the teachers of the project partners used the reference material provided by universities in the original English language or adapted it to their national language. The third step in the development of the curriculum involved the creation of **assessment material for students** and the fourth step was to evaluate the quality and consistence of modules and resources thanks to a carefully designed **validation** plan.

Relation to other intellectual outputs

The RoboPisces educational curriculum is an inventory of activities about robotics, IoT and Marine Robotics. Thanks to robotics students can explore many STEAM subjects and also develop some of the so-called soft skills. The activities described in the curriculum were implemented at school using the RoboFISH toolkit (IO2). Teachers were able to decide about how to bring robotics into their school after participating in the teacher training (LTTA C1, C1 advanced and C2). The RoboPisces Training activities were the foundation to develop the RoboPisces Teacher Training Manual (IO4), which represent a collection of guidelines for teachers about Educational Robotics, a comprehensive educational tool with instructions and ideas for creating effective learning experiences for primary school students. The Teacher Training Manual and the experience in the implementation of the curriculum combined to build an effective MOOC for teachers that will ensure the full exploitability of all the project's results for the future.

1 First stage: mapping of educational curricula in educational robotics applied to STEAM subjects in primary schools within the involved countries

It has been quite a long time since Seymour Papert introduced the idea that children should be involved in the use of computers during the learning process to support the development of computational thinking. Nowadays, educational robotics have been introduced in different dimensions of education, but it is 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.

In this context the partners of the RoboPisces project carried out a mapping of the educational curricula in educational robotics applied to STEAM subjects at primary schools within the involved countries (Italy, Greece, Latvia, Croatia, Malta, and Ireland). The result of the analysis of the retrieved experiences about the already existing curricula in Educational Robotics, applied to STEAM, in primary schools within the involved countries, was the state of the art in the Educational Robotics and STEAM field.

The lesson learnt from this activity led the partnership to acknowledge that:

1) There are issues with the learning environment in compulsory educational setting. Since robotics activities take more time than regular lesson time, specific planning of lessons should be done.

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) Teachers are not fully prepared to incorporate robotics activities in compulsory education.

4) Students may not have the basic knowledge for starting activities with robotics kits, and may drop out from organized activities.

5) During the educational robotics lesson can occur a number of practical problems, like the damage of robotic kits, problems with the connection (e. g. internet, Bluetooth), charging problems, theft of robotic parts.

6) Failing to identify the risks connected with the educational robotics activity into the classroom can be quite a big risk because no action can be taken to diminish those risks.

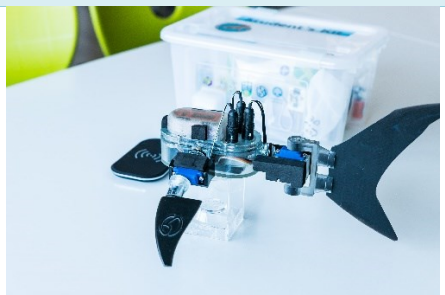
The full version of the results can be found **here**.

2 Second stage – Lesson Plans

The activities and contents of the RoboPisces educational curriculum (IO3) are built upon the RoboFish kit (IO2). Based on the key lessons of the FISH curriculum, teachers can develop a set of lesson plans following the template for Lesson plans and the presentation provided by universities. The educational curriculum is organized to develop a two-years educational path following a linear route made by several educational spots. Also, the RoboFISH toolkit (IO2) was used throughout the curriculum to train the teachers and to teach students concepts of Robotics, IoT and marine robotics in RoboPisces Educational Curriculum (IO3). In a period of first two quarters are dedicated to the basic curriculum which provide students with the basic notions of Robotics. The second two quarters are dedicated to the advanced curriculum that will let the students explore the world of IoT, 3D printing and the marine environment and marine robotics. It is composed of modules that focus on the topics identified in the "FISH curriculum" and each lesson includes the respective:

- lesson plans
- learning objectives
- training materials
- practical activities
- assessment methods and content

The educational curriculum is organised as follows:

1st year is dedicated to the basic curriculum and basic tool KIT	**2nd year is dedicated to the advanced curriculum and advanced tool KIT**
1. Robot Design Jobs	1. **IoT branch**
2. Robotics Disciplines	2. **Marine robotics branch**
3. HW & SW tools for Robot Design	3. **3D printing**
4. My first machine	
5. The Robot brain: Action-Reaction	
6. Senses and Sensors	
7. Muscles and Actuators	
8. My first robot	
9. Listening and Communicating	
10. My first p2p communication	
	

The full access to the educational material is provided:

- at the RoboPisces website, where you will find this document and its useful link
- at the RoboPisces MOOC, where you will find the Teacher Training material
- at the RoboPisces Repository for teachers, where you will find all the resources developed within the project and where you can upload your own OERs based on the RoboPisces Educational Curriculum.

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3 Third stage – Assessment tools

RoboPisces Educational Curriculum (IO3) includes evaluation tools (questionnaires and observations) for students that participated in the project and use this curriculum or tool KIT after the project.

Basic tool KIT	**Advanced tool KIT:**
- Online questionnaires – **Kahoot!** - Available on 4 languages – Italian, English, Croatian, and Greek - List of the correct answers for teachers	- Online Escape game - **Genially** - Available on 4 languages – Italian, English, Croatian, and Greek - List of the correct answers for teachers
	

4 Fourth stage – Evaluation

The evaluation of the modules and resources developed within the project was crucial to understand the effectiveness of what was implemented at school. For this reason, a validation plan was developed. It included both teachers' and students' evaluation.

Teachers were asked to fill two questionnaires: one before they started the activities at school (the questionnaire called "BEFORE") and another one after the implementation phase at school ended (the questionnaire called "AFTER").

Students were tested during the implementation, mainly after the activities of a module were completed, thanks to Kahoot! Quizzes (basic) and Genia.ly escape room (Advanced).

To find out if instructional strategies used in the project support reaching project objectives, a mixed method approach in data collection and data triangulation was performed for the validation of activities and in the assessment of learning outcomes.

The developed research model can be replicated, and the developed tools can be used in different contexts to evaluate outcomes such as learning motivation, improved attitude to learning, and improved behaviour and problem-solving skills.

Results from this evaluation highlighted that the goals set out at the beginning of the project have been achieved as reported in the following table.

Indicator	**Evaluation method**	**Comment**
Improvement of the interest, the participation and the motivation of students in STEAM subjects.	Google Form (question included in teacher QUESTIONNAIRE)	The level can be assessed as increased, this was proven in the teachers' survey after the project activities.
Development of digital competence, rational thinking, creativity and innovativeness through a simple approach to robotics.	1. Classroom activities - Basic and Advanced kits (students) 2. Kahoot tests (students) 3. Genia.ly game (students) 4. Google Form (teachers) 5. Training activities (teachers)	Indicators can be unequivocally evaluated as achieved, it is proven by the amount and results of various activities implemented during the project.
Promotion of technology and robotics in the partners schools as transversal components of the school curricula.	Google Form (question included in teacher questionnaire BEFORE and AFTER project activities).	The level can be assessed as increased, this was proven in the teachers' survey after the project activities.
Enhancement of primary school teachers' skills and comprehension within the field of robotics.	C1 online training: Teacher's questionnaires on Google Forms, Teachers tests on Survey Monkey	The results were evaluated within the framework of the LTTA C1, the online course activated as a place for teachers to learn and discuss the fundamental topics of the FISH curriculum. The teachers participated in the training activities and evaluated their quality, as well as tested their knowledge.

Transnational learning and sharing environment for teachers.	RoboPisces space for collaboration (partners only) RoboPisces Repository for teachers Forum section at the RoboPisces MOOC RoboPisces MOOC LTTA C2, Dublin	Different spaces were set up to enhance communication among teachers of different countries. A first space dedicated to the collaboration among teachers at partner organisations and with partner universities was set up at the beginning of the project as a reserved space for partners. Another space was dedicated to the collection and showcasing of the activities developed during the project; it can be found at the RoboPisces Repository for teachers. Another space was dedicated to the synchronous and asynchronous exchange of messages thanks to the forum in the elearning platform of the project. Transnational learning held onsite was ensured by means of the LTTA C2 that was held in Dublin.
Introduction to the Ocean thematic.	Advanced kit Lesson plans Genially game	The topic is included in the curriculum and learned unified interdisciplinary important topics: Air Activity, Land Activity, Sensing Gravity, Soil Moisture, Water Activities, etc.

The full version of the validation report can be found **here**.

5 The RoboPIsces educational curriculum

As a result of the validation of the curriculum, an inventory of activities was created to collect all the material that teachers can use to implement the educational path at school. Two sections were created: the manual of the basic curriculum and the manual of the advanced curriculum. The former collects all the educational materials which are useful for implementing the activities of the basic curriculum (e. g. lesson plans and assessments); the latter collects all the educational materials which are useful for implementing the activities of the advanced curriculum. The basic curriculum is organised following an ideal sequence of fundamental activities, whereas the advanced curriculum is organised following sequential learning scenarios.

The RoboPisces project aims at engaging as many interested teachers as possible in bringing educational robotics into the school, so feel free to contact us if you want to know more about the project or even just to leave a comment.

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https://www.instagram.com/robopisces/

https://www.researchgate.net/project/Innovative-educational-ROBOtics-strategies-for-PrImary-SChool-ExperienceS-RoboPisces

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