

EDUROBOTICS

25 November 2016 | Athens, Greece

2016

EDUROBOTICS 2016 International Conference “Educational Robotics in the makers era”


Program and abstracts

Athens, November 25, 2016

Co-chairs

Dimitris Alimisis, EDUMOTIVA, Greece

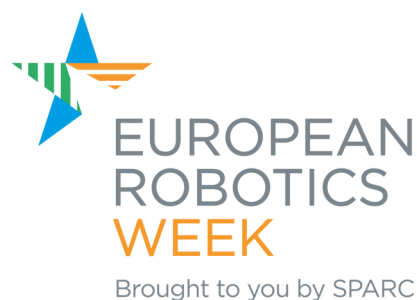
Michele Moro, Dept. of Information Engineering, Univ. of Padova, Italy



EDUROBOTICS 2016 International Conference “Educational Robotics in the makers era”

Athens, November 25, 2016

The EDUROBOTICS 2016 Conference is organized in the context of the European Robotics Week 2016 (ERW 2016)



Organizers

EDUMOTIVA (European Lab for Educational Technology), Greece

Dept. of Information Engineering, University of Padua, Italy


INNOVATHENS – Hub of Innovation & Entrepreneurship, Technopolis City of Athens, Greece





CONFERENCE PROGRAM OVERVIEW

08:45-09:30	Registration
09:30-09:45	Welcome
09:45- 11:00	Invited talks
11:00- 11:30	Coffee Break
11:30- 13:30	Session 1 - Paper presentations
13:30- 14:30	Lunch Break
14:30- 15:00	Poster Session
15:00- 16:20	Session 2- Paper presentations
16:20-16:30	Coffee Break
16:30-17:50	Session 3- Paper presentations
17:50	Conclusions



PROGRAM & ABSTRACTS

09.30-09.45 Welcome Speech (D. Alimisis-EDUMOTIVA, S. Manika-INNOVATHENS)

09.45-11.00 Invited talks | chair person: D. Alimisis

Mindstorms revisited: making new construals of Seymour Papert's legacy

Meurig Beynon, Computer Science, University of Warwick, UK

Abstract: Seymour Papert's Mindstorms is a seminal text in educational technology. Its subtitle: Children, Computers and Powerful Ideas reflects Papert's broad visionary ambition, yet the cover of its second edition is headlined thus: ALL ABOUT LOGO – HOW IT WAS INVENTED AND HOW IT WORKS. Notwithstanding the enormous practical impact of LOGO on educational applications of computers, we should not forget Papert's declaration regarding the computer-inspired revolution in learning he envisioned: "I do not present LOGO environments as my proposal for this ... [they are] too primitive ... too limited by the technology of the 1970s ...". This paper revisits the challenge implicit in this declaration, appraising the extent to which today's technological advances can realise Papert's vision, and proposing an alternative model for his central conception of "an object-to-think-with, that will contribute to the essentially social process of constructing the education of the future".

Arts Meet Robot – Toward Inclusive STEAM Education

Ilkka Jormanainen, School of Computing, University of Eastern Finland, Finland

Abstract: Science, technology, engineering and math education has also been expanded by the inclusion of the arts as an integral area. STEAM education *is posed to be gender inclusive and accessible for all levels of technical abilities. In this paper we present first our work on the inclusion of the arts into robotics education through the theatre robotics concept. A description of the processes involved to develop a multidisciplinary theatre robotics project are presented alongside highlighted benefits that can be expected in terms of fostering the students' 21st century skills. We have leveraged the core lessons learnt from conceptualizing theatre robotics concept in the forthcoming eCraft2Learn project funded from EU Horizon 2020 research and innovation framework. Through the deployment of eCraft2Learn framework, we expect to achieve a smooth integration of technical and humanities subjects and skills paving the way towards a motivating and inclusive STEAM education for all students*

Primary level Young Makers programming & making electronics with Snap4Arduino

Alfredo Pina, Public University of Navarra, Spain

Abstract: The main goal of this study is to show that young makers (8-12 years old) are able to start programming & making electronics with Snap4Arduino, and that this is a way to have (already trained) Makers for secondary level education.

11.00-11.30 coffee break



SESSION 1

11.30-13.30 : “Edurobotics projects in school and higher education “ | chair M. Moro

Educational Robotics and STEM Education in Primary Education: A pilot study using the H&S Electronic Systems platform

Maria Stergiopoulou, Anthi Karatrantou and [Chris Panagiotakopoulos](#), University of Patras, GR

Abstract: In this paper an attempt is made to utilize educational robotics applications in Primary Education in order to teach basic principles of Automatic Control Systems and Programming. For this purpose, the robotic package H&S Electronic Systems was used in the frame of the STEM education approach. According to the latter, emphasis is given to the connection of the four subjects, Science, Technology, Engineering and Mathematics (STEM). Educational robotics can be proven to be an important tool to achieve these goals, but also to develop students' motivation to participate in an active way in learning. Within this work the students are asked to work in groups to design, develop and implement their programs to control the behavior of their robotic constructions, following specially designed worksheets. This work, finally, aims to investigate and highlight educational benefits emerging from the data analysis of students' work.

Learning support teacher training in Educational robotics: a revised implementation

Francesca Agatolio, Monica Pivetti, Silvia Di Battista, Emanuele Menegatti and [Michele Moro](#), Univ. of Padua & Univ. of Chieti-Pescara, IT

Abstract: This paper discusses the new implementation of a strengthened introductory training course in Educational Robotics for pre-service and in-service learning support teachers. We compare this year course, with the one provided in the previous year. In particular, the number of hours of the course have been doubled. Some distinctions regarding the school level have been maintained. The questionnaire for the final evaluation is comparable with the one issued in the first implementation, making it possible some interesting observations on the obtained improvements.

Teacher education to analyze, design, and prototype systems through reverse engineering and making

[Igor Verner](#) and Moshe Greenholts, Technion - Israel Institute of Technology

Abstract: This paper proposes to enhance engineering design education in high schools by introducing reverse engineering (RE) and making activities. The rationale is to foster meaningful learning by engaging students in the analysis of design solutions of existing technological systems and in practical implementation of new designs in the spirit of makers. We present a pilot technology teacher education course which includes studies of engineering and pedagogical fundamentals, RE practices, development of instructional units, and participation in a maker fair. Positive reflections on the course encourage further development of the proposed approach and exploration of its possible use in high schools.



A didactical model for Educational Robotics activities: a study on improving skills through strong or minimal guidance.

Soumela Atmatzidou and Stavros Demetriadis, Aristotle University of Thessaloniki, GR

Abstract: This paper introduces a proposed didactical model for organizing educational robotics activities, addressed to primary and secondary school, and called “CPG+” after Collaboration, Problem, Game - competition, while “+” stands for supplementary teachers’ supportive interventions such as promoting students’ problem solving and computational thinking skills. Then, a study conducted in an elementary school is presented, which was based on the CPG+ model and investigates the development of computational thinking and problem solving skills, focusing on the role of guidance (strong vs. minimal). For developing computational thinking skills we focused on the basic concepts of CT: abstraction, generalization, algorithm, decomposition, modularity, and debugging. The results show that: (a) educational robotics activities fringed by the educational model CPG+ can be a vehicle for the development of high order skills, (b) although providing written answers is tiring and boring for students, it is an important learning tool.

The Effectiveness of Integrating Educational Robotic Activities into Higher Education Curricula in Developing Countries

Ernest B. B. Gyebi, Marc Hanheide and Grzegorz Cielniak, University of Lincoln, UK

Abstract: In this paper, we present a study to investigate the effects of educational robotics on a formal undergraduate Computer Science education in developing countries. The key contributions of this paper include a longitudinal design of the study, spanning the whole duration of one taught course, and its focus on continually assessing the effectiveness and the impact of robotics-based exercises. The study assessed the students' motivation, engagement and level of understanding in learning general computer programming. The survey results from these activities indicate that educational robotics is a promising direction for both improving students' understanding of programming concepts but also their motivation and engagement in practical sessions. There are benefits which can be gained from such activities and educational robotics is a promising tool in developing engaging study curricula. We hope that our experience from this study together with the provided materials resulting from this study will be beneficial to other educators working with educational robotics in different parts of the world.



Duckietown: an Innovative Way to Teach Autonomy

Jacopo Tani, Liam Paull, Maria Zuber, Daniela Rus, Jonathan How, John Leonard and Andrea Censi, Massachusetts Institute of Technology, Cambridge, MA, USA

Abstract: Teaching robotics is challenging because it is a multidisciplinary, rapidly evolving and experimental discipline that integrates cutting-edge hardware and software. This paper describes the course design and first implementation of Duckietown, a vehicle autonomy class that experiments with teaching innovations in addition to leveraging modern educational theory for improving student learning. We provide a robot to every student, thanks to a minimalist platform design, to maximize active learning and introduce a role-play aspect to increase team spirit, in which the entire class is modeled as a fictional start-up (Duckietown Engineering Co.). The course formulation leverages backward design by formalizing intended learning outcomes (ILOs) enabling students to appreciate the challenges of: (a) heterogeneous disciplines converging in the design of a minimal self-driving car, (b) integrating subsystems to create complex system behaviors, and (c) allocating constrained computational resources. Students learn how to assemble, program, test and operate a self-driving car (Duckiebot) in a model urban environment (Duckietown), as well as how to implement and document new features in the system. Traditional course assessment tools are complemented by a full scale demonstrations to the general public. The “duckie” theme was chosen to give a gender-neutral, friendly identity to the robots so as to improve student involvement and outreach possibilities. All of the teaching materials and code is released online in the hope that other institutions will adopt the platform and continue to evolve and improve it, so to keep pace with the fast evolution of the field.

13.30-14.30 | Lunch break

POSTER SESSION

14.30-15.00 : Poster Session | Chair person: M. Moro

Robotics poetry

Angeliki Theodosi and Ermioni Deli, Ralleia Experimental Primary Schools, GR

Abstract: The connection between art and technology may for some people be already known, but for the general public is not obvious nor widely spread. So, the question “But what kind of relationship can Kavafis have with robotics?” wasn’t heard as absurd, but justified in a first level, as it is difficult for someone to relate two phenomenally unconnected fields, Robotics, with Literature. Even more, Robotics with Kavafis’ poetry, whose thematology may be deeply well-timed and eternal, but reaches the reader through people and language from a different era. And all this, taking place in the primary level of education. However, the effort which was made by the Robotics Club, which consists of students of 5th and 6th grade of Ralleia Model Experimental Primary Schools, was exactly towards the connection of art with technology and, in particular, Kavafis’ poetry with robotics.



Educational Robotics Pedagogy Framework for Inclusion

Fiorella Operto and Emanuele Micheli, School of Robotics, IT

Abstract: Educational robotics has the potential for supporting special needs education and for eliminating learning barriers for SEN children. However for teachers, employing robots will be a challenge, as they will have had no training in educational robotics opportunity during their curriculum studies. EDUROB project developed a robotics based Pedagogical Framework relevant for European Nations curriculum, and teachers easy-to-use Interface for robots.

Programming constructs in curriculum for educational robotics at lower secondary school

Michaela Veselovska and Karolina Mayerova, Katedra základov a využíovania informatiky, SK

Abstract: In this article we present programming constructs taught to lower secondary school pupils in the context of educational robotics curriculum. It consists of eleven activities with robotic kit LEGO WeDo. Students develop many important skills, such as problem solving skills, programming skills, design and ICT competencies. The development of this curriculum was a part of our doctoral research. The students were in 5th and 6th grade (10 - 12 years old), studying the school subject Informatics. We used qualitative methods of data collection and data analysis. In this article we present programming constructs such as count loop, conditions, variables and parameters that most of the pupils in our classes acquired. These constructs were based on analysis of programming environment for robotic kit LEGO WeDo.

Using LEGO Mindstorms as an Instructional Tool to teach Science in Primary Education

Marievie Panayiotou and Nikleia Eteokleous-Grigoriou, Frederick University Cyprus

Abstract: This paper reports a case study concerning the use of LEGO Mindstorms Robotics as an instructional tool in science education. In particular, the paper briefly delineates a teaching class module in the field of Science Education for the primary level. It is the authors' expectation to evaluate the proposed methodology under a large-scale study designed to measure the effectiveness of this approach in terms of learning outcomes, students' satisfaction, enjoyment and perceived usefulness.

Intensive Robotics Education Approach in the Form of a Summer Camp

Anton Yudin, Maria Salmina, Dmitriy Sukhotskiy, Anatolii Vozhdaev, Vladimir Sukhotskiy and Tatiana Sukhotskaya, Bauman Moscow State Technical University, Lomonosov Moscow State University, Stankin Moscow State Technological University, State budget vocational and educational institution "Vorobyovi Gori"

Abstract: The paper summarizes approaches and results of an intensive robotics education programme carried out by the authors in the form of a summer camp. The paper proves that using digital fabrication machines for building a robot in a team for competitions is an outstanding tool of technical, engineering education.



Hedgehog Light – A Versatile, White Box Educational Robotics Controller

Clemens Koza, Wilfried Lepuschitz, Martin Wolff, Daniel Frank and Gottfried Koppensteiner, Practical Robotics Institute Austria

Abstract: Robotics curricula that include programming generally require a robotics controller as core platform. The controller and its capabilities shape the offered curriculum in terms of programming means, and therefore age appropriateness. A closed, black-box controller also limits the uses outside the context of such a curriculum. The Hedgehog Light controller aims to imply as few limitations as possible by using open source methodology, the open and well-documented Raspberry Pi, a multi-platform protocol and programming interface, and that can mostly be built in fabrication laboratories (fab labs).

Anthropomorphic Robots and Human Meaning Makers in Education

Karolina Zawieska and Agnieszka Sprońska, Industrial Research Institute for Automation and Measurements PIAP, PL

Abstract: This paper discusses the use of anthropomorphic social robots in education in the role of meaning disruptors. While social robots are often used to imitate human roles to a varying degree, be it teachers, assistants or peers, the underlying assumption here is that anthropomorphic robots are creations that may be assigned entirely new roles. Also, this paper argues that rather than aim at the close resemblance of human characteristics in the robot's form and behaviour, anthropomorphic robots may deliberately exploit the divergence between the robot's characteristics and performance and the human frame of reference. This is how both teachers and school students will become active meaning makers and an increased interest in robotics will be maintained over time. The main subject of reflection is the difference between the human and human-like.

Design requirements for Educational Robotics (ER) activities for sustaining collaborative problem solving (CPS)

Raoul Kamga, Margarida Romero, Vassilis Komis and Anastasia Mirsili, Université Laval Canada, CA, Univ. of Patras, GR

Abstract: The objective of this study is to identify the design requirement of Educational Robotics (ER) activities for sustaining the collaborative problem solving (CPS) skills. In CPS activities learners are engaged in teams towards the analysis, the identification and the solution of a problem. The importance of CPS for the 21st century education has been promoted by PISA and most of the 21st century skills frameworks. In this study we aim to analyse ER opportunities for the 21st century education, in general, and CPS skills, according to the PISA CPS framework. For this goal, we review the design requirements of learning activities which has been identified in the literature to sustain CPS Afterwards, we identify the design requirement of ER activities which can sustain the development of CPS. Activities engaging learners in authentic ill-defined problems, with a certain level of complexity are identified as design requirements having the possibility to promote CPS in ER activities.



SESSION 2

15.00-16.20 | Session 2: Educational methodologies in Edurobotics | chair I. Verner

29 Effective Ways You Can Use Robots in the Classroom: An Explanation of ERA Pedagogical Principle

Dave Catlin, Valiant Technology, UK

Abstract: Catlin and Blamires proposed the “Educational Robotic Application (ERA) Principles”. These 10 principles give researchers, designers, educators and teachers a way of evaluating and comparing educational robots and their activities. The ‘Pedagogical Principle’ was one of these ideas. It stated you could use many different developmental theories to view and describe the learning involved. It also identified 28 (now 29) different ways you could use a robot in a classroom. Catlin and Blamires did not give a satisfactory explanation of these methods. This paper corrects this.

A scenario-based approach for designing educational robotics activities for co-creative problem solving

Vassilis Komis, Margarida Romero and [Anastasia Misirli](#), Univ. of Patras, GR, Université Laval Canada, CA

Abstract: Educational robotics are increasingly integrated from early childhood education to postsecondary maker activities. In some cases, robots are used as an extracurricular activity which is not oriented towards the learning objectives of the curriculum. In other cases, the educational robotics activities are aligned to the curriculum objectives or the development of the so-called 21st century skills such as collaboration, problem-solving, creativity, critical thinking and computational thinking. In this paper we introduce a scenario-based approach for designing educational robotics activities aiming to support co-creative problem solving in K12 formal education contexts.

Assessment of Lower Secondary School Pupils’ Work at Educational Robotics Classes

Michaela Veselovska and Karolína Mayerova, Katedra základov a vyučovania informatiky, SK

Abstract: This paper presents our proposal for assessment of lower secondary pupils working with educational robotics LEGO WeDo, using the curriculum we have designed. The curriculum consisted of eleven activities with complex methodical materials that the teachers can incorporate into their ordinary classes. Teachers can use this curriculum within compulsory subject Informatics and therefore it was necessary to create a way to assess pupils’ work. We have created evaluation through rubrics, because working with robotic kits encompasses several aspects. The assessment focuses on three main aspects: a) the construction of the robotic model, b) program to control it and 3) the presentation of mentioned program. In this paper we also describe the concrete example of assessment of pupils’ work using our rubrics.



Orbital Education Platform: Introducing Orbital Robotics to Secondary Education

Nikolena Christofi, Evangelos G. Papadopoulos and Iosif S. Paraskevas, National Technical University of Athens, GR

Abstract: In this paper, the development of an Orbital Robotics educational prototype platform is presented, consisting of a hardware-developed physical system and an accompanying set of curriculum-based lessons (IB Physics curriculum) that target upper secondary students (16-18 years old target group). The students interactively use the hardware, consisting of a bespoke space-emulating table and small satellite mockups. During the lessons, this platform allows students to acquire knowledge of the dynamics of space systems, as well as the environmental conditions and physical constraints that characterise on-orbit operations. Students will be able to manipulate the space robot (satellite) mockups performing basic tasks such as docking, and landing or grasping space debris. Additionally, a smartphone application has been implemented to allow the interaction with the platform, via a dedicated User Interface (UI). The lessons are inquiry-based and are structured so that the students are actively engaged in the learning process, according to a learner-centric approach

16.20-16.30 Coffee break



SESSION 3

16.30-17.50: Edurobotics and programming | chair A. Pina

The combined use of Lego Mindstorms NXT and App Inventor for teaching novice programmers

Stamatis Papadakis and Vasilleios Orfanakis, University of Crete, GR

Abstract: Both in Greece and abroad, students perceive programming as a difficult and tedious task. Introductory programming courses are often disappointing both for students and for teachers. One of the major factors to which these difficulties in learning programming has been attributed is the traditional approach to teaching the fundamentals of programming, which is unable to provide students with an interesting and richly stimulating environment through which problems and concepts are the subject of investigation in a creative and enjoyable way. In contrast, several studies claim that teachings robotics is suitable to students regardless of age and background and is a way of encouraging learning. This paper presents an alternative use of robotic Lego Mindstorms constructions and the visual programming App Inventor environment for teaching programming with the goal of understanding basic programming structures.

Educational robotics driven by tangible programming languages: A review on the field

Theodosios Sapounidis and Stavros Demetriadis, Aristotle University of Thessaloniki, GR

Abstract: This paper presents a comprehensive literature review on tangible programming languages which are designed to program real robots and robotic mechanisms. Tangible programming interfaces appear to be more accessible to novice programmers and possible reduce the age threshold for participation, making this way robot programming an educational toy even for preschool and elementary students. Moreover, this paper makes a short examination on the recent research findings on the field of tangible robot programming and argues that the combination of tangible programming and robot construction may offer unique opportunities for educational robotics.

Introduction to programming through robotics for elementary school students

Lito Athanasiou, Paraskevi Topali and Tassos A. Mikropoulos, University of Ioannina, GR

Abstract: Studies have shown that teaching programming to students is often a difficult task. The specific programming language itself is not as much a challenge as the concepts and structures which define it. This paper explores the use of educational robotics to introduce basic concepts through meaningful teaching and learning activities with the hands-on use of bee-bots. The results from this empirical study show that students can successfully develop algorithmic thinking and programming skills. Thanks to the tactile interaction with robots, students developed their creativity and imagination as they built robots with Lego WeDo, all the while enjoying the lesson through teamwork activities.



Learning Programming with Educational Robotics: Towards an Integrated Approach

Marios Xenos, Nikoleta Yiannoutsou, Marianthi Grizioti, Chronis Kynigos and [Sofia Nikitopoulou](#),
Educational Technology Lab, National and Kapodistrian University of Athens, GR

Abstract: Despite the fact that it has been a few years since robotics entered the school and offered new learning opportunities, educational robotics usually is offered in the context of extra-curricular activity (e.g. a “club”) which addresses a limited number of students and participation is based on student personal interest. In this paper we explore the potential of ER when it is integrated in the typical school curriculum. In the study we report here, we integrated ER in the computer science curriculum and all students of a 9th grade class engaged with robotics activities. The rationale underlying the study, is that robotics can be used as a medium to motivate students in engaging with programming and support them to negotiate real life problems. Analysis of the data collected, indicate that ER when integrated with the computer science curriculum, can create a rich learning environment where programming is contextualized and students are highly motivated to engage and negotiate important STEM concepts.

17.50 Conclusions & Conference Closure | co-chairs D. Alimisis, M. Moro

