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ROBOTICS

INTEGRATION OF ROBOTICS IN EDUCATION; INFLUENCE ON TEACHING- LEARNING PROCESS: NEW TECHNOLOGY IN EDUCATION

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ABSTRACT:

This paper deals with the current situation in the field of educational robotics and marking the changing scenario and trends focusing on the use of robotic technologies as a tool that will support creativity and a new mode of teaching- learning skills. In recent years, robots have been considered as a complementary tool to improve the motivation and academic performance of students, which has generated a technological development that is increasingly incorporated into our daily lives for the many purposes. Studies indicate that robotics is venturing into education in an accelerated manner which is providing benefits as a teaching tool, performing repetitive tasks with great precision, flexibility, human-robot hyperactivity, since these devices are presented with various characteristics providing to student's fun, motivating activities and real experiences, creating interactive and attractive learning environments. Teaching-learning activities in the classrooms of the 21st century is being complemented and supported with the help of robotics that is, in science, technology, engineering and mathematics, in addition, with project-based courses which challenge the creativity of students, improving their cognitive skills and motivating them to be active learners. The incorporation of new technologies in the classroom and educational robotics seek to improve interdisciplinary learning environments where students and teachers can structure their research and solve problem situations in a concrete way; developing new skills and abilities in people, giving positive responses to the changing environments of a world impregnated with a lot of technology, contributing to the development of student's creativity and cognitive capacity. Finally, conclusions and proposals are presented for promoting cooperation and networking of researchers and teachers that might support the further development of the robotics movement in education.

Keywords: Educational Robotics, Changing Scenario, New Mode and Teaching-Learning

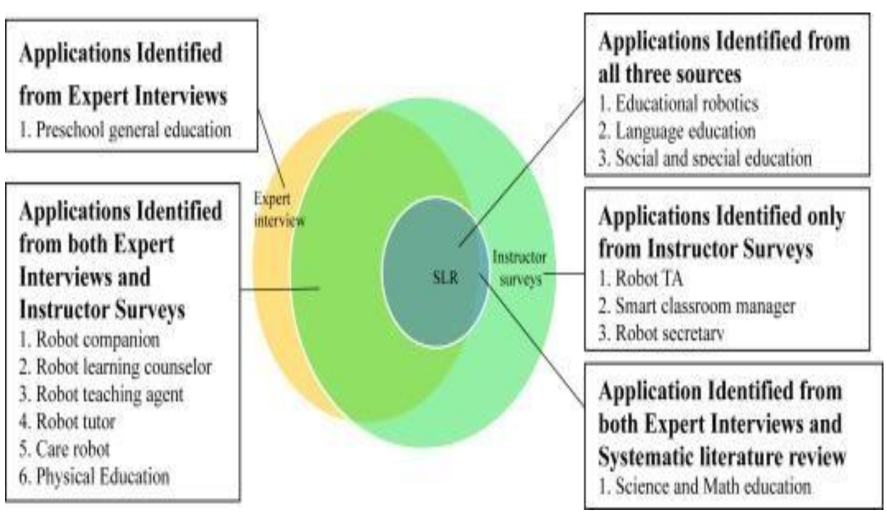
INTRODUCTION:

The word robot was invented by Czech writer Karel Capek to designate the automata in his science fiction play *R.U.R. (Rossum's Universal Robots),* which premiered in Prague in 1921. A word coined by Capek from the Czech term robota, which refers to hard work. Almost a hundred years later, automata have become part of our children's development and learning process. Educational robots enable students of all ages to become familiar with and deepen their knowledge of robotics and programming, while at the same time learning other cognitive skills.

Educational robotics teaches the design, analysis, application and operation of robots. Robots include articulated robots, mobile robots or autonomous vehicles. Educational robotics or pedagogical robotics is a discipline designed to introduce students to Robotics and Programming interactively from a very early age.In the case of infant and primary education, educational robotics provides students with everything they need to easily build and program a robot capable of performing various tasks. There are also more advanced and more expensive robots for education purpose. In any case, the complexity of the discipline is always adapted to the students' age. Educational robotics is included within the so-called STEM (Science, Technology, Engineering and Mathematics) education, a teaching model designed to teach science, mathematics and technology together and one in which practice takes precedence over theory

Three different approaches to Educational Robotics are reported (Eguchi, 2010):

- **Theme-Based Curriculum Approach:** Curriculum areas are integrated around a special topic for learning and studied mostly through inquiry and communication (e.g., Detsikas & Alimisis, 2011; Litinas &Alimisis, 2013)
- **Project-Based Approach:** Students work in groups to explore real-world problems; this is for example the case proposed in the methodology developed by the European project *TERECoP*, *Teacher Education in Robotics-enhanced Constructivist Pedagogical Methods*, www.terecop.eu) (Alimisis, 2009).
- **Goal-Oriented Approach:** Children compete in challenges in Robotics Tournaments taking place mostly out of school, such as FIRST Lego League (http://www.firstlegoleague.org),RoboCupJunior (http://www.robocupjunior.org), Trophée de robotique in France (http://www.planete-sciences.org/robot), World Robotics Olympiad in Greece (http://wrohellas.gr) and more.



Educational robotics, considered as a branch of the educational technology, suffers from the same old problems well known in the latter. In the next sections, some critical current problems and the consequent emerging scenario for educational robotics community are identified and discussed.

TECHNOLOGY IS EVERYWHERE, EXCEPT IN SCHOOLS:

Research by legislative bodies (such as the United Nations Economic Commission for Europe, the International Federation of Robotics, and the Japan Robotics Association) indicates that the market growth for personal robots, including those used for entertainment and educational purposes, has been tremendous and this trend may continue over the coming decades. However, as a recent OECD report remarked "technology is everywhere, except in schools" (OECD, 2008). While experts are optimistic concerning the development of technology-enhanced learning opportunities, skepticism prevails concerning the ability of formal education systems and institutions to keep pace with change and become more flexible and dynamic. These difficulties are not irrelevant to findings of current surveys of school students‟ attitudes to Science and Technology (see for example: TISME, The Targeted Initiative on Science and Mathematics Education 2012, http://tisme-scienceandmaths.org), which witness declining interest and engagement in technological fields of study (Nourbakhsh et al., 2006).

Proposals have appeared in the recent years for a roadmap by which robotics applications can enliven technology education and capture the interest of students (Nourbakhsh et al., 2006). Movements like the so-called "digital fabrication and making in education" movement (Gershenfeld, 2007; Blikstein, 2013) have appeared aspiring (and working) to overcome bias inherit within the educational systems and to link the intellectual work in the classroom with students‟ experiences in „making‟ and building things either with their parents or friends or in jobs in garages, in construction companies etc.

TECHNOLOGIES IN SCHOOLS TODAY DO NOT SUPPORT THE 21ST-CENTURY LEARNING SKILLS:

Promoting excellence in education and skills development is one of the key elements within the "Innovation Union" Flagship Initiative (2012). The "Innovation Union" communication recognizes that weaknesses remain with science teaching; the skills for future responsible innovators/researchers as well as for "science- active" citizens have to be built starting from early age including scientific reasoning, as well as transversal competences such as critical thinking, problem solving, creativity, teamwork and communication skills.

However, most uses of technologies (including robotics) in schools today do not support the pre-mentioned 21st century learning skills. In many cases, new technologies are simply reinforcing old ways of teaching and learning. Current typical school science labs seem not appropriate for fostering critical thinking, problem solving, creativity, and teamwork and communication skills since they are architected for rigorous, disciplined, and scripted experiences (Blikstein, 2013) in which students are guided usually through recipe-style guides towards the “discovery” of predefined concepts.

IS ROBOTICS JUST THE SERVANT OF OTHER SUBJECTS? NEED FOR NEW AND BROADER PERSPECTIVES

If the reasoning of the previous section is adopted then a need for broadening robotics audiences and target groups emerges. The way robotics is currently introduced in educational settings is unnecessarily narrow (Rusk et al., 2008). Till now most of the applications of robotic technologies in education have focused on supporting the teaching of subjects that are closely related to the robotics field, such as robot programming, robot construction or mechatronics (Benitti, 2011).

Embodiment is another new and innovative way that might be introduced in robotics activities to make them more meaningful for children. Embodied experiences with robotics can be realised when students physically move their own bodies and then program robots to perform a certain task. In such a case learning develops from personal embodiment to embodiment through surrogate robots (Lu et al., 2011). Another way to facilitate embodied learning with robotics is to make the learners embody the robotic system, for example by asking learners to reenact or follow movements of robots through gesturing (De Koning & Tabbers, 2011). Embodiment within robotics seems a promising path for further research based on current theories of embodied cognition.

IS ROBOTICS JUST A FASHION? CALLS FOR VALIDATION OF THE IMPACT OF ROBOTICS

It is clear that while robots have positive educational potential, they are no panacea. In the literature there have been studies reporting non-significant impact on learners observed in some cases (Benitti, 2011). In any case, the impact of the robotics in promoting student learning and in developing skills needs to be validated through research evidence. Without validation of the direct impact of robotics on students‟ learning and personal development, robotics activities might be just a fashion. However, there is a lack of systematic evaluations and reliable experimental designs in educational robotics. Benitti (2011) highlights that most of the literature on the use of robotics in education is descriptive in nature and is based on reports of teachers achieving positive outcomes with individual, small-scale initiatives.

A criticism emerges within the robotics community in recent years claiming that there is a clear lack of quantitative research on how robotics can increase learning achievements in students. point out lack of a systematic examination of the robotic projects and of a significant evaluation of the impact of the approaches or if they meet their goals. In other cases, the expected benefits have not been clearly measured and defined because there is not a system of indicators and a standardized evaluation methodology for them. Despite the usually positive educational and motivational benefits, studies suggest that rigorous quantitative research is missing from the literature. Research involving robotics in the classroom very often provide results dependent on teacher or student perceptions rather than rigorous research designs based on student achievement data.

However, during a robotics class students' work in developing their projects or in problem solving takes usually diverse and unpredictable paths making difficult for evaluators to follow students' progress. Monitoring environments have been proposed to allow the teacher to monitor and model the learning process based on the data coming from the under-evaluation learning situation.

WHAT IS COMPUTATIONAL THINKING AND WHY IS IT IMPORTANT?

The term was coined by Jeanette Wing in 2006, at the Carnegie Mellon University, to describe an approach to problem solving. "Computational Thinking is an approach to problem solving". Computational thinking is not a skill, but a range of concepts, applications, tools and thinking strategies that are used to solve problems. You can practice Computational Thinking without using a computer. Jeannette Wing defines four major facets to computational thinking:

1) Decomposition: breaking a problem down into smaller parts;

2) Pattern recognition: finding similarities and differences between the different parts, to be able to make predictions;

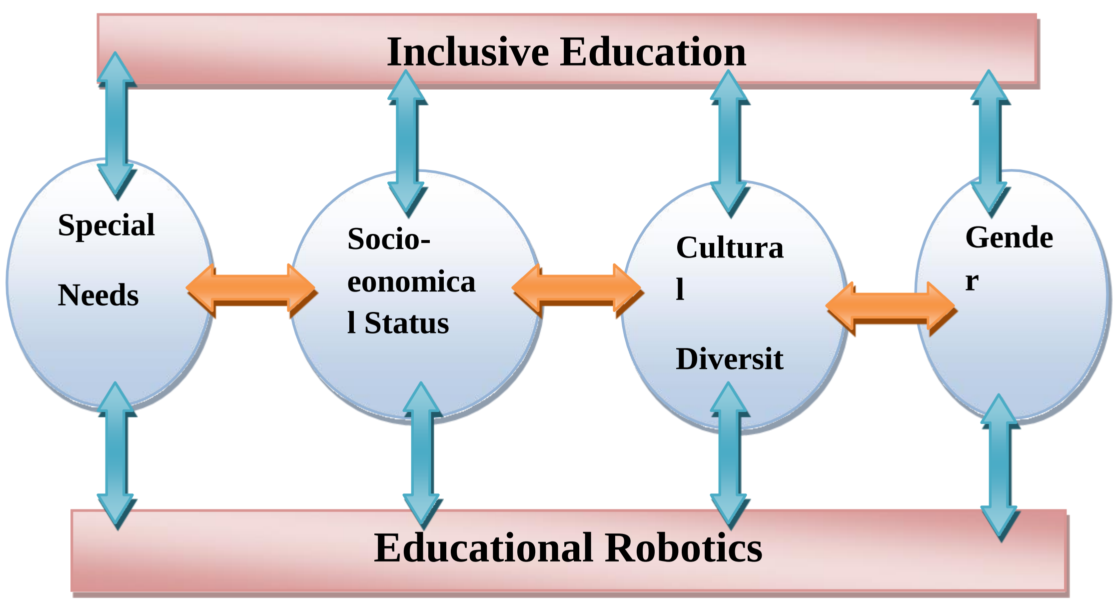
3) Abstraction: the ability to find the general principles behind the parts and patterns in problems;

4) Algorithm Design: developing the step-by-step instructions to solve different problems.

As technology continues to change our society, it is imperative for pupils and students to learn to think critically as well as to be able to control and create their own digital experience. Rather than be consumers of digital technologies, we want pupils to become the producers of it. Teaching young people computational thinking and enabling them to understand how digital technologies work, is important to ensure they can become empowered by digital technologies, and not merely be users of digital technologies.

INCLUSIVE EDUCATION AND EDUCATIONAL ROBOTICS:

Robotics incorporates a range of skills, and thus promotes a learning environment for people with different talents. If properly harnessed, it also promotes a culture of teamwork. It can even be used to help students who might struggle to learn in traditional classroom settings. For example, the ASK NAO robot was developed to help autistic students. Its main goal is to bring everyone on board through modern educational-technology approaches in academia.



In an inclusive education system, educational robotics can help provide a better education for all children by interacting on four different levels. These four dimensions are: It should also be taken in consideration that by ensuring specific support the problems can arise that can lead to social exclusion. This can occur on different levels: exclusion from education systems or from particular fields of education, such as technology. Some examples on how educational robotic activities can lead to the risks of social exclusion are given below (Daniela, Lytras, 2018):

- Special needs can both reduce access to education in general and limit access to learning in particular areas. For example, children who have colour blindness or discoloration problems can be confronted with the programming of LEGO robots with a high emphasis on colours; therefore, in the context of inclusive education, not only diagnosed and apparent disabilities but also all special needs that can affect learning should be met.

WHAT DO YOU NEED TO START IN EDUCATIONAL ROBOTICS AND WHAT YOU CAN USE?

It is possible to start robotics in the classroom in different ways depending primarily on what kind of skills the educators want to teach, how deep in the study and comprehension of these skills they want to go and, of course, what budget they can devote to the project. Many possibilities are available today on the market: from a ready to use robot, to a robotics kit, until the possibility to create a robot from scratch and few components. What are the differences between these possibilities?

- ❖ A robot ready-to-use can be expensive but an "time saving solution". Frequently it is not a scalable solution so it can allow to work on a specific competence but it can be more challenging to apply it in an interdisciplinary project.
- ❖ A kit to build a robot is a good solution if you want to realize a workshop with a maker’s approach. Assembling a robot allows students to apply hands-on

work, but also engage in skills such as reading comprehension of technical document and communication. It's an excellent practical exercise with an affordable cost.

- Making a robot from scratch can be an economical but time-consuming solution. Learning how to make a robot is a challenge. It involves several skills, a clear process to choose all components, to design the robot, to code the main program. It can be a great experience if you follow a pedagogical approach based on trials and errors.

CONCLUSION:

In the light of the above discussion, it is obvious that a need for rethinking our approaches in Educational Robotics emerges. Robotics has much potential to offer in education, however, the benefits in learning are not guaranteed for students just by the simple introduction of robotics in the classroom, as there are several factors that can determine the outcome; technology alone cannot affect minds. Robots are not the end point for improving learning; the real fundamental issue is not the robot itself; rather, it is the curriculum. Robots are just another tool, and it is the curriculum that will determine the learning result and the alignment of technology with sound theories of learning. An appropriate educational philosophy, namely constructivism and constructionism, the curriculum and the learning environment are some of the important elements that can lead robotics innovation to success. The emphasis should be shifted from the technology towards partnership with learning theories putting the emphasis on the curriculum than on the technology. The curriculum is the keystone in educational robotics and it is necessary to incorporate the basic principles of learning and to set qualitative and quantitative performance metrics for expected outcomes and for validation of the curriculum.

The role of Educational Robotics should be seen as a tool to foster essential life skills (cognitive and personal development, team working) through which people can develop their potential to use their imagination, to express themselves and make original and valued choices in their lives. Robotics benefits are relevant for all children; the target groups in robotics projects and courses should include the whole class and not only the talented in science and technology children. An iterative plan is necessary for the validation of the different strategies and methodologies whereby implementations of the robotics curricula will take place in practice followed by testing, refinement and continuous improvements. Testing should be based on a system of indicators and a standardized evaluation methodology for clearly measured and defined benefits.

Finally, the realisation of the above proposals requires the development of a vibrant and active community in educational robotics that will promote further networking of researchers, teachers and learners. Well-organized and coordinated collective actions will focusing on the following objectives:

- Mobile phones, computers, tablets and other technologies provide both social and entertainment functions for people of the digital era, especially for the younger generation.
- The thoughtful use of technologies can enhance the learning in the classroom, develop learning motivation, support the development of computational thinking, support new generations by preparing them for the interaction with different technologies, not only as the users of the possibilities provided by technologies, but also as the creators of new, innovative solutions.
- At the moment the use of technological solutions in educational settings can be described as "fear and fascination". In some cases, technologies are left out of educational setting and only basic knowledge on the use of computers are accepted.

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