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# EDUCATIONAL ROBOTICS INCLUSIVE AND TECHNOLOGY EDUCATION

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## Abstract

Computational thinking is a fundamental competence in the training. The fundamental motivation is to be found in the ability, which must be transversal, to learn methods of approach to problem solving. A skill that goes beyond simple problem solving but is configured as intelligence and as such can be trained and developed. At the same time, it becomes essential to put oneself in the perspective of an education that is inclusive. An education attentive to inclusion is an education attentive to the enhancement of the skills of each one to develop skills. On the other hand, we must pay continuous attention to emerging technologies, evaluating, and integrating them into learning paths, aware that they are integrated into a complex framework. Starting from these considerations, we intend to reflect and propose educational paths that use educational robotics not with the aim of learning the programming or the functions of an android, but configuring themselves as an innovative approach to teaching, a pedagogical method to increase the centrality of the student in the learning-teaching processes, promote an individualization aimed at the inclusion of all the children in the class. The background of this reflection is the focus of some eidetic structures that mark the new processes of knowledge in the world of robotics; this means going in search of the connective structures of robotic systems within the weaving of relationships with the context, then identifying the nodes that make the parts of the same system interdependent in relation to educational instances.



*Keywords:* Computational Thinking, Educational Robotics, Education, Inclusion

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## 1. Introduction

M Developing a critical and objective analysis that deals with reality certainly has significant elements of difficulty.

It is objectively complex, a complexity that becomes more complicated when we talk about the younger generations and we are interested in and enter the world of children.

One of the first and most important difficulties arises from a kind of nostalgia for the time when we were children, a natural and uncontrolled impulse to compare what age has represented in our personal experience. It is easy to fall into a moralistic reading of this growing reality in our society. There is a lack of a local reading of the world of children because the widespread diffusion of the mass media and the consequent communication society have made this universe uniformly variegated and more in need of valorisation than continuous analysis. We are witnessing the multiplication of initiatives that various organizations dedicate to young people, but too often they satisfy the need of an adult world that needs to feel proposing, rather than the concrete need to enhance the creative strength of young people. However, I believe that, regardless of the motivation, open spaces, so that children can express +*++initiatives dedicated to them, whether they are of an educational, recreational or cultural nature, today's reality affirms its vitality in its truest expression. I believe that a careful look at the world of children can only lead us to a re-evaluation for what it is today and not in view of a future that will see them as adults and therefore worthy of consideration. Children are not that mass of video addicts, refractory to any reading or cultural stimulus as they have been defined in recent years, but people with expressive canons and their own needs who seek, rather than develop, to channel an adult world into understandable canons, with a completely one-sided interpretation of adaptation. It is therefore a matter of noting the lack of spaces dedicated to children but the need for their restructuring. A restructuring for a protagonist less and less desired by adults and more and more experienced by children. In this way, speaking of the world of children, we will no longer have the impression of referring to an antechamber of reality, but we will have the certainty that without this component no reality can be said to be complete (Poletti, 1983, p. 3).

Rereading this small article that I wrote in 1983 in relation to pastoral and catechetical actions, I think that, except for the modifications and updating of some terms, it is and has always been appropriate to reflect constantly on the relationship between technological reality and educational reality.

We now live immersed in a world pervaded by technologies for an extended period, over forty years, so the reflection on the relationship between technologies, training and learning must be affected by this long "attendance", which seems not yet metabolized starting from the continuous reference to multimedia, interactivity, and the world of information technologies as “new technologies.”

To underline the spirit of this reflection it is interesting to frame the term of new technologies not in a temporal perspective or in the sense of "latest generation" techniques; we must refer, with the focus on new technologies for teaching, to new technological tools but with reference to teaching practices, which contribute to the concrete and effective realization of the educational process.

An approach that has deep roots, already in the fifties with Burrhus Skinner (1954) who publishes the article The science of learning and the art of teaching on the Harvard Educational Review where he highlights and supports from a theoretical point of view the need for the introduction of teaching machines in the learning process, framing it in his theory of reinforcement.

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The vision that considers that the school, as well as the informal and non-formal training environments, are part of the social sphere, in which individual needs linked to administrative practices converge, but also to participatory processes, which require the use of technologies and network tools to be lived and participated (Calvani, 2005).

It must be borne in mind that digital media and interactive communication are undoubtedly the most striking phenomena of social change, cultural development, and training processes at the beginning of the new millennium. We must confront ourselves with the new digital culture, that is, the affirmation of a communicative style oriented to interaction, content production and sharing that are the habitat in which we grow today (Ferri, 2011; Ferri & Morigi, 2018).

You may or may not share some cultural and sociological interpretations of these social dynamics and learning styles, but the curiosity of the new generations and the desire to know has certainly grown and has accelerated thanks to new devices and the Internet. We are facing the challenges that have been thrown at us as a society and as individuals since the era we are living in, an era that economist Jeremy Rifkin calls "the era of access". The era of access is ours today, it is a reality, a new panorama in which the concept of property loses meaning. It becomes essential for anyone to have access to the network, so as not to be excluded from the knowledge information society (Rifkin, 2000). We therefore return to underline the importance of acquiring digital skills and taking care of them, developing a critical spirit and a continuous learning style that supports not only learning but promotes inclusion.

Speaking and referring to eidetic structures means going in search of connective structures of robotic systems within the weaving of relationships with the context, then identifying the nodes that make the parts of the same system interdependent in relation to educational instances (Rivoltella, 2022).

In the development of the concepts, Piaget's constructivism and genetic epistemology are used to highlight how educational robotics methodologies can affect the quality of learning-teaching processes.

The world that declined in the perspective of educational robotics declines and evolves the concept of learning environments in that of ecosystem in which all the actors of the training processes coexist from people to tools to technologies (Damasio, 2003).

Among these robotic technologies and Artificial Intelligence (AI) can be identified as a tool and, even before, methodology in learning-teaching processes.

AI and Educational Robotics are both a content and a tool/methodology of cognition and metacognition for the acquisition of specific skills, and transversal skills (Dillenbourg, 2016).

The fundamental knot to which we intend to refer, on the conceptual level, of this educational reflection is a meta dimension that is instantaneous in the "knowledge of knowledge" (Morin, 1989).

Placing ourselves in a new perspective, that of the infosphere, it is evident that we find ourselves in an environment in which the boundaries between an online existence and experience and an offline life are gradually blurred, until they disappear. This new environment makes it necessary to prepare a data analysis that goes beyond quantitative statistics. The analytics referred to is a type that allows effective machine learning to be contextualized and included in training and educational contexts.

This analysis must be placed in a serious and motivated inclusive perspective.

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An inclusion that is supported not only by the possibility that these educational methodologies make available but also by the possibility of constantly having a semantic evaluation system of the development of individual learning paths.

In today's intrinsically technological and virtualizing context, it is essential to consider that in this way the information society on the one hand tends to evolve communication methods and on the other hand causes traditional organizational structures to become increasingly participatory.

This reflection leads to a strong correlation between the use of machine learning and deep learning and big data, with a view to educational robotics

Educational robotics in this field of reflection and as an analysis of the information that is extracted from reality is functional to the processes that allow to obtain data and knowledge from the contents and the structure with an analysis of the connections and reconstruction, a data-relationship structure, attributable to a model of knowledge.

When the parameters that have been identified and analyzed must be interpreted, it is possible to perceive ways to go, for example, for the verification of empirical hypotheses on phenomena of interest.

Our era, the contemporary era, is the era of an ever wider interaction, ever more globalized and ever more characterized by local repercussions and reflections on the personal.

Also for the data it is possible to work in the perspective that the study of the facts can lead to the change of one's points of view, using and interpreting the term of reciprocity explicitly recalling the concept of hermeneutical circle.

## 2. A model for research: educational robotics and coding

### 2.1. Coding

Generally, for coding we choose a playful approach, the use of the game as a challenge, we learn to solve a problem, making use and developing computational thinking (Wing, 2006), as well as then it will materialize in the use of educational robotics.

It is essential to underline the need to develop this problem-solving ability, and even before understanding the structure of problems, as it helps children to understand the aspects of how to use their skills in the distinct aspects of daily, social and communication life.

Not a secondary aspect is also the increase in awareness in the use of technologies conscious use of technology, which tends to favour what we could call free will; free will allows to limit and prevent the problems that can generate technologies, the different dependencies, leaving room for learning, the serene approach to the technologies themselves, both for learning and for communication; understand the opportunities that technologies offer; coding, in short, allows you to develop creativity and creativity enhances your self-esteem.

Coding allows you to apply interdisciplinary strategies and to transform the exercises in play, into challenges that starting from the knowledge acquired allow you to achieve set goals; it is possible to affirm that the teaching of coding has as its main objective to develop reasoning and logic skills to learn to solve a problem that stands between an individual and his goal; the game and the playful dimension

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also in this case seems to be an effective methodology, programming, fun and challenge produce learning and learning tools.

The game is in this perspective one of the main methods to convey through these technologies a path of inclusion that starts from the awareness of the importance of everyone's contribution.

But what can be, in a meaningful summary, the reasons for teaching coding with a wide-ranging inclusion tool perspective?

A first reason is that coding allows students, and people to create content and not just to be passive users; a creation that goes beyond what are the classic tools known from WEB 2.0, it is about learning tools that can allow you to create personalized and interactive content even outside the standard channels. Linked to the possibility of creating content, coding allows an enrichment of tools and gives, to those who learn it, the opportunity to express themselves, to enhance communication, to stimulate interpersonal relationships in a relational perspective.

In relation to this perspective, it is interesting the relationship with the methods of which reinforces the belief that coding allows people to discover the power of technology, change the way they think and get the most out of the world around them.

Coding, as it is also for robotics, allows you to take risks in a safe and constructive way; with this feature we mean the possibility of simulating, once again also using the playful dimension, situations, and solutions to problems without risks and making the error an opportunity for learning. Think of the possibility of defining and implementing simulation games by formalizing environments and rules.

From a social point of view, coding is inclusive, it allows everyone to contribute significantly to projects, increasing self-confidence; in particular, it is important to be able to see concretely the fruit of one's work.

Didactically it is important to note that coding is based on many mathematical principles, so it facilitates the learning of logical structures.

As a gym of computational thinking, coding also teaches the art of problem solving, and as is well known, some games are nothing more than the search for solutions to problems; the game thus becomes especially useful to simulate processes and behaviours that we find both in problem setting and in problem solving.

Coding must be taught because in the age of communication and information it is a new type of literacy, a language necessary to be active protagonists of the world around us.

Coding, as evidenced in its dimension as a tool to increase self-esteem, stimulates and helps teamwork by favouring the acquisition of the skills necessary to manage a collaborative dimension of acting.

Perhaps with an excess of optimism but with the intention of highlighting the non-technological aspect, we hear the world of education affirm that coding can help humanity, understood as the emotional side of individuals.

### 2.2. Educational robotics

In the panorama that sees as reference points the game and its value as a teaching method and technologies, with coding and computational thinking it is natural to refer to robotics, and in its

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declination of educational robotics, thus completing a first framework of inclusive learning-teaching processes.

The field of investigation of Educational Robotics focuses on the formative value of the use and development of real digital devices, inserted within worlds in which they can interact with each other and with the world itself in an autonomous way.

This field of research does not aim to emulate the characteristics of human intelligence, but to create artifacts that introduce methodologies that can improve the conditions that facilitate the learning process (Strollo, 2008). Educational robotics is also based on the principles of learning by doing and as seen for coding it is classifiable as a tool for learning and creativity.

There are many kits that allow you to design and create educational paths with the use of educational robotics, suitable and adaptable to different ages, different cognitive styles, and different operational skills.

This has meant that educational robotics integrated and interacted with coding bringing with it those characteristics of a tool for inclusion, collaboration, creativity and learning by mistake that according to different perspectives represent the cornerstones of both coding and the structure of computational thinking.

Interesting evidence of this relationship between robotics, play and learning are the events of RoboCup Junior, which took place in Italy until 2019, a section of RoboCup, which aims to spread robotics and artificial intelligence with an educational and training intent.

RoboCup Junior is widespread in schools and uses a playful and competitive dimension by organizing championships with different specialties that include many of the skills that educational robotics can develop.

Of interest, especially for the dimension of creativity that underlie, are, among others, the OnStage competitions in which the teams must design and develop a scenic performance using autonomous robots designed, built, and programmed and that can interact both with objects and with people according to events. To emphasize the interest and the non-merely technical level of these races, the regulation clarifies that: the teams are judged in the following areas: technical demonstration, technical interview, OnStage performance and a technical descriptive document; highlighting an analysis also of the level of computational thinking that has been developed also in relation to the ability to describe and formalize the work done.

Moreover, the observation of these activities has highlighted the extremely high degree of inclusiveness of the method, where both the learning by mistake and the collaborative dimension are widely developed.

Educational robotics in this field of reflection and as an analysis of the information that is extracted from reality is functional to the processes that allow to obtain data and knowledge from the contents and the structure with an analysis of the connections and reconstruction, a data-relationship structure, attributable to a model of knowledge.

In the phase of interpretation of the analysed parameters it is possible to have suggestions, for example, for the verification of empirical hypotheses on phenomena of interest.

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Our era, the contemporary era, is the era of ever wider interaction, increasingly globalized and increasingly characterized by a local fallout and reflections in the staff.

A profound modification has been generated, a profound change not only in the thought of the world but also in the thought of each one, stimulating an in-depth reflection on how knowledge is built, because only by formalizing the principles of this process can computable models be generated.

Technologies are present and active in formal, informal, and non-formal training environments and question the way school is.

It is not possible to identify the impact of technologies without analyzing the scenarios that place it in educational contexts from which it cannot ignore but must draw effectiveness and meaning from the epistemological and cultural dimension.

It is recognized and recognized that every educational process is indispensable to the constant and significant interaction between the teacher and each individual learner; technology cannot ignore or worse make the fundamental human relationship seem useless.

We are called to build a vision of education in the digital age, through a process that allows students to face, interpret and support a lifelong learning logic and in every context, we live formal, informal and non-formal (for life).

This framework and various training interventions for teachers of schools of all levels, as well as the training of future teachers and the theoretical and practical study lead to the enhancement of educational robotics.

### 2.3. Research and inclusion

It should be noted that so far, the debate that is taking place on educational robotics (Cheng et al., 2018; Lepuschitz et al., 2018) is oriented to frame it as a true area of interdisciplinary research freeing it from an instrumental vision.

The project that we intend to structure starting from these considerations is to investigate the function of educational robotics as an interdisciplinary element that by instantiating logic allows a development of the cognitive abilities of each one by implementing the inclusiveness of teaching.

This vision is becoming increasingly popular in the field of scientific research, and in educational research with a particular emphasis on the multidisciplinary study key to the harmonious development of skills, personalization of paths and cooperative learning.

The analysis of learning mechanisms is fundamental to understand the development of human cognitive and social processes since it seems to relate to the dynamics of encephalization and with the acquisition of new skills.

In addition, this analysis, correlated with the methodologies of educational robotics, helps to highlight key aspects in the field of cognitive and behavioural sciences, especially about motor coordination, lateralization, language development, acculturation, and the ability to learn by mistake. Investigating the origin of cognition linked to the design and creation of artifacts sheds light on new avenues of deepening in the field of cognitive sciences.

The artisanal knowledge of the assembly of elements to obtain artifacts and manage relationships has an excellent value in the development of individuals and in their enhancement.

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Learning, as is the case with the parts of educational robotics, produces changes in mental configurations. These changes bring about a complexification of these configurations, that is, a quantitative increase that generates a qualitative increase. The qualitative increase in turn refers to the number of relationships between the elements of learning and the organizational plans of the configurations.

Education prepares the circumstances in which the subject learns the way to deal with a question, to solve a problem, in a word: to complexify his mental representations but also his behaviours and his technical skills. In fact, the construction of these technical skills does not lead to a different configuration of symbols also because it is inherent in the social role that the subject plays in his community and this ignites a long series of considerations.

To reconstruct the learning and relational mechanisms of class groups, and consequently clarify the organization of spaces and relational structure but of group dynamics, different disciplinary areas (technological and humanistic) will be examined, whose results, both in terms of learning and in terms of cooperation and inclusion. These results will be added to the experimental research present and developed both nationally and internationally.

The study of learning structures allows us to understand the phenomenon of acculturation in a perspective of development and integration.

The epistemological-constructivist approach to learning-teaching in the processes triggered by educational robotics implies a fluid conception of knowledge formation. In fact, socio-cultural processes typical of a given context participate in the latter, which are decisive for the configuration of a dynamic system of ideas, which mediates the learning of technical systems, the formation of knowledge and the relationship with others. This process of co-construction of knowledge culminates in the transformation of the learning of the technique into competence, skills, and enhancement of the other.

The aim of the project is to highlight the peculiarities characteristic of the learning mechanisms supported by educational robotics considering environmental and cultural differences and skills.

Therefore, the proposal is to investigate the potential of educational robotics as a transversal, interdisciplinary and inclusive methodology in learning-teaching paths, and teacher training, in successive steps.

## 3. Conclusions

Schools are equipping themselves with technologies and often make a purely instrumental use of them, the importance of these themes in which the thesis is developed is the translation or updating of a motto that I found myself sharing many years ago: "we must move from the computer science class to computer science in the classroom" and today I can say that we are called to "technology in the classroom" not as a simple aid, but, like educational robotics, it allows a new real instantiation of what has been a process of virtualization of knowledge.

We must make sure that educational robotics is a method to understand and enhance cognitive styles in learning-teaching processes.

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In this brief reflection, it is important to remember how the network and the context of knowledge, as a relational structure, has also given rise to the concept of collective intelligence that the network has instantiated and highlighted.

Educational robotics is a new modality and a challenge for educational theorises, an area where learning, knowledge, mind, and intelligence compare, interact, and show the network of mutual interconnection and enhancement.

A methodology that helps students through robotics to the analysis and signification of data and to a conscious management of time and resources, considering how learning by mistake can be introduced as a method.

The use of educational robotics puts us in the perspective of a transition from "objects with which to think" to "objects with which to think and get excited", a connection, to an interconnection between computational thinking and emotional intelligence.

An educational robotics that allows a multidisciplinary framework where it is interesting to note how Aristotle combined play with joy and virtue; he writes in the Nicomachean Ethics that "there are activities that deserve to be chosen for themselves, not for anything else, such as happiness" and among them he cites play, and educational robotics has the playful dimension that enhances its effectiveness.

It is important to understand and experience how technologies, both online and physical, can be an effective tool in teaching-learning processes.

Schools are equipping themselves with technologies and often make a purely instrumental use of them, the importance of these themes in which the thesis is developed is the translation or updating of a motto that I found myself sharing many years ago: “we must move from the computer science class to computer science in the classroom” and today I can say that we are called to “technology in the classroom” not as a simple aid, but, like educational robotics, it allows a new real instantiation of what has been a process of virtualization of knowledge.

We must make sure that technology, and educational robotics, is a method to understand and enhance cognitive styles and personalization in learning-teaching processes. As we often find ourselves finding it is difficult to reach conclusions and if it is a question of reflecting on pedagogical processes, cognitive styles and the relationship with the reality that surrounds us in a "playful" and inclusive way, we could refer to Matz's Maxim, written in the book of scientific semi-paradoxes "Murphy's Law" by the writer Arthur Bloch: "The conclusion is where you got tired of thinking."

But this is exactly what we do not intend to do, we started from computational thinking precisely because it allows us to develop tools of abstraction for an understanding and a continuous interaction with reality according to the creative style, way to inclusion.

Technologies also in this context can re-emerge humanity and play as a style of learning and enhancement of people and their abilities; a thought and attention that finds both in robotics and in coding a habitat in which to develop all its potential that educational processes must make their own.

There is the awareness that all the actors of the didactic-educational processes that have at heart the harmonious growth of people, teachers, trainers, and parents, and are brain coaches and feeders of emotions, beyond any theory that is shared.

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The formative paths are emotion, ethics, inclusion, dialogue, learning and teaching and without these tensions there can be no meaningful educational relationship; we cannot therefore ignore the value of the technologies that support this relational and educational fabric.

We must not forget that certain attentions and methodologies are intrinsic to take control of and must be cultivated with the tools that evolution and scientific and social progress make available to us.

If, in the common sense, the meaning of the word "game" has a completely different connotation, if not antithetical to the "serious", we remember what Michel De Montaigne, philosopher and writer French of the sixteenth century said: "Children's games are not games, and we must consider them as their most serious actions" and this can probably be said of every age of life.

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