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Artículos de investigación científica y tecnológica

THE INFLUENCE OF MOTIVATION AND COOPERATION OF PRIMARY SCHOOL STUDENTS IN EDUCATIONAL ROBOTICS: A CASE STUDY

La influencia de la motivación y la cooperación del alumnado de primaria con robótica educativa

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Abstract: In recent years and more and more frequently, children's behavior in a classroom, calls for an educational change. The image reflects unmotivated children, with no interest in learning and lacking educational aspirations. This review article focuses on an educational robotics project in a primary education classroom and intends to search the literature to find which reasons and aspects influence student motivation, as well as the benefits of cooperative work within this project, in order to find out whether educational robotics can be a good incentive for the change children are demanding. In terms of the analysis, research shows two main currents in literature: students' motivation and classroom cooperation. Future research can use these two concepts to appropriate solutions, address research projects and thus, find applications for teachers. Educational robotics, motivation, cooperation, primary education, educative technology.

Keywords: Educational robotics, motivation, cooperation, primary education, educative technology.

Resumen: En los últimos años y cada vez con más frecuencia, cuando entramos a un aula nos encontramos con que los niños, a través de su comportamiento, nos están pidiendo un cambio educativo a gritos. Nos encontramos con niños desmotivados, sin interés por su aprendizaje y sin aspiraciones educativas. Es por ello por lo que, en el presente artículo de revisión, partiendo de un proyecto de robótica educativa en un aula de educación primaria, tenemos como objetivo encontrar en la literatura cuáles son los motivos ylos aspectos que influyen en la motivación del alumnado, así como los beneficiosde un trabajo cooperativo dentro de este proyecto, con el fin de averiguar si la robótica educativa puede ser un buen aliciente para el cambio que se está pidiendo. Esta investi-gación arroja dos corrientes principales en literatura a este respecto para el análisis de esta tendencia: primero, la motivación en el alumnado y, segundo, la cooperación en el aula. Futuras investigaciones pueden utilizar estos dos conceptos para apropiar soluciones y abordar proyectos de investigación, y así encontrar caminos de aplicación para los docentes.

Palabras clave: robótica educativa, motivación, cooperación, Educación Primaria, tecnología educativa.

INTRODUCTION

This article is part of the research line "ICT and training in the new digital era", more specifically in the spere of educational robotics, given that, despite the fact that more information and research has become available in recent years, a lack of investigation and scientific contribution is still evident in this field, from its pedagogical justification to its evaluation and methodological grounds.

Curricular and extracurricular formats that have implemented educational robotics have resources and contributions to provide in this area, yet the truth is that there is still much research to undertake. Which is why this article intends to look for the connection between educational robotics and the factors that influence students' motivation in a robotics project, while justifying cooperative work, with the objective of knowing if educational robotics can be part of the classroom's educational change, from a methodological and procedural perspective.

In both matters, motivation and cooperative work have been analyzed considering the homeroom teacher's opinions and needs.

The importance of this work is apparent based on interest in the proposed topic, in order to achieve the educational change we are discussing (which is the main goal of this research), it is important to get to know what it is that drives students to undertake some tasks with interest and motivation, as well as the methodologies that add benefits throughout the learning process. This will constitute the starting point for the intended educational change, it is expected to provide assistance to teachers aimed at innovating and resorting to new techniques and resources to adapt the classroom to students' needs and capacities.

Barrera (2015) highlights the need for a change in classrooms, students ought to be active agents in their teaching-learning process, as well as a source of information, the teacher acts as a guide in this process while learning from students' contributions.

With this need in mind, educational robotics has been regarded as an educational element that is capable of achieving change based on its contributions to students' motivation and interest; also, because of the benefits it delivers through collaborative work.

Ruiz (2007) comments that educational robotics has led to a generation enabled to create technological learning environments that constitute significant change based on interdisciplinarity, development of untapped skills and holistic views of learning, where the student interacts with peers and applies collaborative work to create its own learning, seeks solutions to arising conflicts and challenges proposed with a common goal.

In that regard, Cabero, Fernandez and Marin (2017 p.170) explain that "one of the main originators of learning is practice and how it is conducted, since it seems conditioned by the students' degree of motivation", consequently, "the level of students' motivation towards material or teaching methods is a fundamental element at the moment of planning teaching-learning processes". (Merino, Villena, Gonzalez and Cozar, 2017 p. 165).

Merino, Villena, Gonzalez and Cozar, (2017) identify robotics as one of the most important resources in educational technology, contributing to a constructivist environment within classrooms and with great interest in different educational spheres.

Garcia and Reyes (2012) add that educational robotics has a direct relationship with cooperative learning due to the connection and benefits attributed when working with this methodology in an educational robotics project.

Hence, educational robotics is a useful tool that presents a great opportunity to turn cooperative work into an active and efficient methodology, creating effective learning environments to activate cognitive and social processes aimed at attaining meaningful learning and the much needed educational change in the classrooms (Hernandez, 2016; Morales, 2017; Fernandez, 2006).

Gonzalez, Paez and Roldan (2013, p. 50) conclude their study emphasizing that "motivation and teamwork are two distinguishing elements taking place when robots are used in education because they allow developing projects that require the integration of different areas of knowledge into a problem's solution".

The general objective of this research is to verify if educational robotics is a good technological resource to induce educational change in the classroom, based on an analysis of its influence in aspects that affect motivation, as well as cooperative work.

Based on this general objective, the following specific objectives will be defined:

- · Analyzing how educational robotics (ER) influence the different factors that drive primary education students' motivation.
  · Studying the effect of cooperative methodology in students within the research with an educational robotics project.

METHODOLOGY

The topic has led to a theoretical review intended to prove the need of more research in the framework of educational robotics and how it relates to motivation and cooperative work.

To do so, a qualitative model with descriptive nature has been applied, it allows answering the theoretical needs by consulting different types of documents whether journal articles, research or books in connection with the object of our study.

To conduct this research, the Dialnet and Scopus data bases have been used, providing large amounts of material to analyze, yet the search of material pertaining the topic of educational robotics has resulted in many documents that fail to be connected with primary education and classroom work, not extracurricular activities, thus the number has been significantly reduced.

But that number of documents has gone down again when seeking a connection between educational robotics and motivation, as well as cooperative work, the scope of interest of this research.

We cannot leave aside the book by Jimenez (2017) "Power and the Science of Motivation", which has provided insight as to how motivation influences a person and has allowed us to relate it to the work taking place in an educational robotics classroom and with cooperative work.

Finally, a complete theoretical review has delivered interesting results, as follows.

EDUCATIONAL ROBOTICS IN PRIMARY EDUCATION

The space that technologies occupy in current society is evident on a daily basis. Yet, there is a wide gap between current society and schools. This gap is emphasized more and more with students' outcry for change, for an approach to new technologies in the classroom. We are faced with an educational context in which students feel demotivated, have no interest or wish to learn because the way in which learning is presented has nothing to do with their interest and motivations. Which is why we have set out to find an approach between the schools and society to new technologies, either as an extracurricular activity and ideally in school activities. As stated by Tezanos (2001), lately it is clear that our society is overpowered by the technological era, therefore, the analysis schemes that were used to observe the world have been rendered obsolete to understand the new reality in which we live in.

Subsequently, this implies a need for change in the classroom in order to alternate traditional and unidirectional practices with more alternative ones in which educational technology adds diverse resources and didactic materials to sustain bidirectional teaching-learning processes, in which students may act as sources of information, as said by Barrera (2015), and in which the teacher is a guide in the process who can learn from the contributions of his/her students.

Among the wide array of new technologies and resources we can use inside the classroom, for instance: augmented reality, 3D print, 3D modelling, robotics and thousands of tools with which we may work in a diversity of school content from a more real and technological perspective. The NMC Horizon Report (Moreno, Leiva and Lopez, 2016) portray how these emerging technologies intend to innovate in every aspect of the educational practice, namely, organizational, curricular, methodological, training, didactic, among others.

Out of all of these resources, this project will focus on educational robotics (hereinafter, ER), which is "an area of pedagogy that introduces some aspects of robotics and automation into training processes as a mediating example to attain learning" (Garcia and Reyes, 2012, p. 47), or as Jofili (2002), citing Vigueras and Villalba (2017), puts it "an environment that may train a teacher to stimulate students towards reflecting about their own ideas, encouraging them to compare said ideas with known and accepted scientific knowledge, and to establish a link between these types of knowledge" (p. 3). Also, it can be understood as "the object of displaying the subject's capacity to explore and manipulate at the service of constructing meaning from their own educational experience" (Barrera. 2015 p. 218).

Espino and Gonzalez (2015) outline the importance of educational centers moving towards the development of skills to adapt to the world and the reality in which we live, by learning and acquiring new mechanisms and ways to solve problems. Learning aimed at solving "computer problems effectively, since these are applicable to a multitude of different contexts, in personal, social and/or academic areas" (Feierherd, Depetris and Jerez, 2001 cited in Espino and Gonzalez, 2015, p. 2).

A generation appears, as mentioned by Ruiz (2007), which enabled by ER, creates technological learning environments that constitute a significant change mostly due to is interdisciplinary nature, the development of untapped skills, and the development of a holistic perspective on learning, where students interact with peers and work cooperatively to create their own learning, seeking solutions to solve arising conflicts or proposed challenges with a common goal.

The concept of neo education comes into the scene, it is known as the new paradigm in education and understood as a natural process of the individual in which learning and play go hand in hand with the intention to encourage an individual's potential and self-knowledge, each individual is the active lead in his/her self-discovery of skills, and the teacher accompanies the individual in this discovery process. This is substantiated by neuroscience (Gonzalez and Redondo, 2013).

To cover the needs mentioned by these authors and to favor said skills, computer thinking needs to be considered, these "solve a complex problem using another problem to which we know the solution, be it by reduction, composition, transformation or simulation. It also entails resourceful thinking, i.e., interpretation of code as information and information as code" (Espino and Gonzalez, 2015, p. 3). In that regard, we find different initiatives and projects that apply this line of thinking through the use of robotics, gamification or augmented reality, since it favors the solution of problems arising from the creation process, aiding students' trial and error, autonomy and self-knowledge; students become active participants of their self-learning and discovery, which they undertake through making, building and designing.

In the educational sphere, ER is considered a tool or resource that offers diverse benefits to students' teaching-learning process, this is why a great diversity of authors verifying this fact were found. These include Barrera (2015), who emphasizes the enthusiasm felt by students when they construct knowledge, favoring a responsible and critical use of technology. Moreover, as we have commented, the change in educational practices driven by these tools shifts to a bidirectional education that focuses on student learning through new digital tools, considering ICT as a new source of information that has changed the way in which we see the teaching-learning process, suggesting new roles (one of them being robotics) as an excuse to understand, create and relearn the reality in which we live.

Cabrera (2015), underlines that the cross-sectional skills developed with the use of computer programming, such as: analytical thinking, problem-solving, teamwork and creativity, benefit future computing studies prospects and ITC-related careers. While Garcia and Reyes (2012) emphasize diverse research demonstrating that ER has a positive effect on classroom motivation, citing the research by Carbonaro, Rex and Chambers (2004) or Barker and Ansorge (2007). On the other hand, Fagin and Merke's (2003) research highlights the effectiveness of robotics and its positive impact on students' learning, as well as the high degree of interest evinced in students for robotics, all of which foster classroom participation and promote interest for careers in mathematics and science.

In order to create or assemble robots, knowledge on engineering, electronics and computers is needed, as well as on mathematics and scientific aspects, moreover, individuals need a critical and resolute conception of the process. "This interdisciplinary character means that when students learn to design robots, they inevitably learn about many other disciplines involved in robotics" (Papert, 1980; Rogers and Portsmore, 2004 cited in Garcia and Reyes, 2012, p. 48). It was also found that robotics acts a didactic resource for problem-solving, as affirmed by Sullivan (2008), engaging four of the six distinctive characteristics of scientific literacy: computers, estimates, manipulation and observation. ER enables motivation based on encouraging students' scientific curiosity, inquiry and experimentation, as well as on the construction of knowledge created through scientific knowledge and people's daily wisdom, as mentioned by Barrera (2015).

This is why ER may be suggested as a technological learning environment, which, as interpreted by Acosta, Forigua and Navas (2015, p. 18) helps discover a natural medium for the student where "through play, pupils may interact and perform a role within didactic situations deriving from reality; these make them generate strategies to plan, execute and solve a problem statement," through the design, programming and manipulation of the robot.

Despite the positive benefits of ER, a lack of rigorous qualitative research on the topic was found, as mentioned by Garcia and Reyes (2012), a large number of research is conducted from a quantitative perspective, neglecting in-dept exploration of different scopes in the field of robotics.

A thorough search on this topic led to diverse studies on ER in the primary education classroom. Cabrera (2015), investigates ER in different countries, highlighting its evolution and wide acceptance within classrooms in different countries, indicating that the European Commission has invited several members of the European Union to support digital training of teachers and families, offering an opportunity to learn computer programming in school, although similar classroom activities were found to take place before.

Countries such as Estonia or England, as described by Cabrera (2015), have incorporated ER into their curriculums, as well as 3D printing or augmented reality, with the aim of encouraging innovation and new technologies in classrooms based on its proven benefits and on the need to offer a change in classrooms and students' attitudes towards teaching-learning processes; this initiative has been supported by major technological companies with technological projects at school and national levels, from primary education to specific training. These projects now have more expanded and specific objectives, increasing its quality and effectiveness.

The author continues explaining that in Estonia, for instance, the "ProgeTiger" project is financed by the government and works with technology and innovation applying the Scratch programming language (used with different areas of knowledge) and is offered by the institution's curriculum, children may select different technological areas, e.g., robotics, programming, 3D design and others.

England fosters educational technology by sharing experiences, knowledge or ideas, it promotes public policies and facilitates information to the public, Cabrera (2015). Computing at School is an association of volunteers that participates and promotes support to schools concerning educational technology in the country.

Cabrera (2015) adds that Spain has begun modifying its teaching practices with computer programming and robotics in primary and secondary education. Although the programming content of the national or autonomous governments' curriculum could not be found, some shy and sporadic projects taking place in educational centers were found as an extracurricular activity mostly in primary education classrooms. For this level, autonomous communities were found to offer autonomous configuration subjects in which they begin working on programming and robotics projects. Yet, the secondary education level has more projects related to programming and robotics, without them being a referent yet because of an evident need for training, initiative and investment.

In terms of robotics in the region of Murcia, further explains the author, its secondary education curriculum comprises an elective called "Robotics", which allows schools to work with computer programming and use robots in any course; but, also in this region, no evidence was found of this at the primary education level. The region of Navarra has created a virtual space that offers training on computer programming and robotics, as well as resources and materials and extensive information on the topic; this space is available for the educational community with the participation of Universidad de Navarra, the Department of Education and Planetario de Pamplona (Pina, 2017).

This curricular review at national level in Spain indicates a lack of presence and prominence of educational robotics at pedagogical level, despite the benefits it offers students, as analyzed and commented throughout this project.

In order for ER to take place in classrooms, there is a variety of resources that should be adapted and adjusted to the needs of each group of students. One methodology in particular stands out based on its extensive presence in primary education and its didactic project: STEAM,which comprises the fields of Science Technology, Technology, Engineering, Arts, and Mathematics. Lego has created a didactic proposal alongside Grupo Edelvives (a publishing company) to provide materials to classrooms which are ready to use and do not require specific training in robotics, they come with a simple, practical and appealing interface (Lego, 2011).

These materials include Lego WeDo 2.0, the current version of Lego WeDo., which contributes a pack of materials to assemble different types of robots and a platform to program them, WeDo 2.0, this platform is connected from a tablet or computer via Bluetooth to the robot to be programmed, it has many possibilities depending on the design of the robot, e.g., movements in loop or on an established time, to the possibility of recording and/or producing sounds and actions, among many others. To widen the programming alternatives, robots have sensors that allow creating movement sequences.

This type of platforms can be used with children up to 10-12 years of age, specifically in primary education. From then on (depending on their training and previous experience), children can start using Lego Mindstorms, packs including 521 pieces to design and build diverse robots, as well as to program them using the Mindstorms software to test if the robots can execute complex tasks, record data, respond to environmental changes and other actions (Robotix., s/f.).

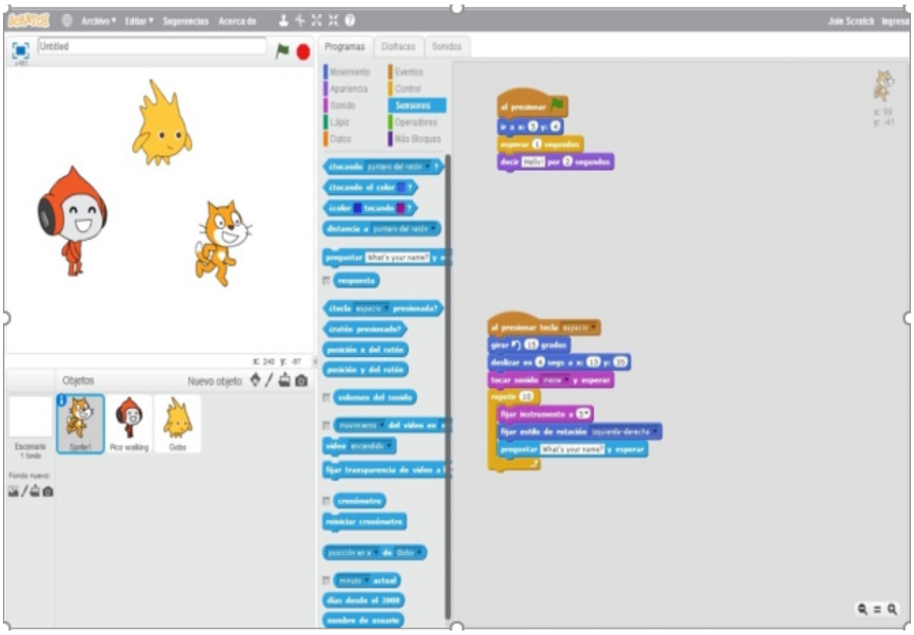
For levels below primary (early ages of primary education, without experience in robotics), Lego has STEM parks and simple machines to design and play while working on didactic aspects for these levels.

As mentioned, Lego is the most popular platform with resources and materials in the area of ER in primary education; some other noteworthy examples are educational robots such as BeeBot, extremely popular in children's' classrooms. bMaker, is leaving its mark in schools in ER since its methodology is based on the "STEAM philosophy and on active, cooperative and practical learning" (bMaker, s/f), targeting students from 8 to 15 and ensuring content learning due to its collaboration with MacMillan on pedagogy and didactics.

bMaker. has three levels of contents with six projects each and five sessions per project, different content is covered in different educational levels and it assists teachers in the classroom by contributing resources to work in sessions, e.g., work methodologies, animations or cooperative work techniques, since its methodology derives on project-based learning, cooperative work, design thinking and gamification.

Aside from this robotic platforms, other robots with less prominence exist and can be used in the classroom applying methodologies and didactics adapted for the student group, these are found through an online search.

The following are the platforms and software with which robot programming can be done (besides the foregoing). Scratch and Arduino are the most used software in elementary classrooms due to its multifunctional nature and variety it offers.



Fgure 1.
Screenshot of the Scratch interface.
Source: compiled by the authors

Scratch. is a visual programming language in which children and adults can create stories and videogames through programming, and program robots compatible with the software, for instance, Lego WeDo 2.0 robots. Its interface (refer to Figure 1) is simple, appealing and dynamic, and uses blocks of movement to animate figures, and different challenges in the case of videogames.

Arduino., unlike Scratch, is a platform that builds different single-boards with open-source hardware and software in order to move different objects used on a daily basis using circuits in the boards. Its usefulness spans different professional and everyday areas, one of which is education, advancing as many projects as students' imaginations can develop.

After becoming aware of the different resources that can be applied in ER in classrooms, the following is an analysis of some projects conducted by several people. Gonzalez and Redondo (2013) have developed the AIToy project, aimed at producing a toy with educational purposes through the AISoy robot, an emotional robot adapted for linguistic, social and communicative competences. This project begins with the use of an interface to program the robot to make it say and do things, while conducting educational games that fit the needs and preferences of students. Then, the platform is activated and different content and resources are developed with the programmed robot and with the interaction of students. Students must understand that they need to teach things to this robot, students become aware that they can teach it to react to stimuli such as strokes or sounds.

Programming these reactions is done through AIDIA, a simple platform to program the simplest movements and reactions and more complex ones (for higher-level students). This robot works with students' emotional intelligence, and its games work with linguistic rules in different grammatical levels. This project has been conducted in 3 children's schools, 5 elementary schools and 4 secondary schools, using 6 different types of robots that have been adapted to the level and needs of each student group.

The authors also mention that Japan and South Korea already have teaching robots, and refer to the lagging situation of Spain, where, aside from the theoretical framework, not much variety of projects or platforms is found, unlike in other countries.

Also, Cubides, Cuvi, Cuzco and Ordoñez (2012) have undertaken a project based on design, construction and implementation of a multifunctional robotics platform with didactic means, Dingo 1.0, aimed at being used by programmers, students, researchers or any person interested in robotics, as the authors claim.

This robot is shaped like a caterpillar, it is a mobile robot with an easy and attractive platform and diverse functions and applications at didactic level. Is can be manipulated, the authors say, "through PS3, Nintendo Wii controllers, a cellphone with wi-fi, via Internet, radar or with applications for iPad, iPod and any device with supported technology. The software [...] has been made with the LABVIEW program" (pp. 32-33)

Cervera and Casañ (2015, p. 63) analyze the RPN network, an initiative aimed at creating a "network of educational robotics laboratories. with remote programming capacities. It consists of open online materials and servers that are prepared for students to test their programs while developing them".

Pina (2017) references three possible formats of robotic activities developed in Navarra, the First Lego League competitions, summer camps for teachers and students and the school network working with ER in primary education.

The author has studied ER in the three formats using "Scratch and Beebots in the first cycle of elementary and Scratch/BYOB/SNAP and Lego Mindstorms NXT/Lego EV3 robots in the other cycles of elementary" (p. 20), he concludes that through robotics, practically every key competence in the curriculum has been worked with, as well as a diversity of content in it, thus "an integration of robotic activities is feasible" (p. 23) in classrooms.

In terms of results connected with First Lego League competitions, Pina (2017) affirms that learning is based on teamwork, while learning attained in school derives from perseverance and individual courage, which is partly responsible for school failure.

In Spain, starting in 2006, several autonomous communities have been found to organize the First Lego League (FLL), a more prestigious educational robotics competition; in its last three editions participant enrollment has increased substantially, as well as its influence and popularity at national level. The FLL is for students aged 10-16 and it begins with a microFLL, which grants access to FLL's qualifying tournaments. The winners of said tournaments move forward to the Great FLL Final in Spain, and the winners may participate in international FLL tournaments, as explained by Espino and Gonzalez (2015) and as found in its official website..

In this competition, participation is based in groups that face a problem of the real world than must be solved with the creation of a robot incorporating the Lego Mindstorms technology, program included; participants need to work globally with content included in the curriculum, computer thinking and different skills needed to work in groups and solve problems. To prepare for these championships, teams are organized in extracurricular activities or programming projects in classrooms.

There is also a Junior FLL for students aged 6-9, which works with elements of LEGO. Education WeDo 2.0 for robot programming and movement.

The third modality has less to do with our project, the FLL Tech Challenge is aimed at youths aged 16-20, participants design, create, test and program autonomous robots controlled with controllers and which must perform missions in a concrete space.

As its website explains, FLL is famous for its values (Discovery, Innovation, Impact, Inclusion, Collaboration and Fun), while projects are developed, the First Lego League values are incorporated, a fundamental pillar of FIRST.. These values are special because they teach participants to exercise "a friendly competition with mutual benefit, in which teamwork is based on respect towards others".

The foregoing intend to adapt schools to the society we live in and contribute necessary tools and resources to students in order to adjust to the needs they may face on a daily basis. To do so, investment in teacher training is crucial, as well as providing material and technological resources required to efficiently develop these kinds of projects.

All of the measures taken by these countries need "material resources, adequate teacher training, and (often most reluctantly) time to be effective" (Cabrera, 2015, p. 3); time allocated to preparing and executing projects. If an educational system, school or teacher is not willing or does not have or lacks some elements, this practice will most likely fail to deliver the expected results, and the opportunity given to computer programming and robotics to benefit classrooms may not adjust to the expected needs, therefore the result will go against what is expected and needed. Consequently, the quality of the computing network of each school interested in applying this type of technology must not be neglected. A low-quality Internet connection prevents devices needed in projects to work properly and to waste time accessing platforms used to design and undertake the project.

The Spanish educational system has a great number of professionals, especially of advanced age, who fail to have training in ICT in order to cover the needs demanded by these type of resources, renovations caused by updates and new digital resources that come up almost daily.

It is vital to invest in teacher training if progress is to be made in the volatile digital world that offers so many opportunities in resources and tools for the teaching-learning process, and to learn to recognize the difference between innovative and top-quality digital resources adapted to students' needs or a digital resource that copies the activity of the book but with animations to make it more appealing, leading to a mechanic development.

The aforementioned is intended to "deliver knowledge by generating a more interactive relationship with teachers, collaborative learning attitudes and more student satisfaction for being in control of his/her learning process" (Gonzalez and Redondo, 2013, p. 53), with the purpose, as the author adds, of generating socioeconomic transformations in this trend taking place, increasing individuals' creativity and diversifying the job market.

Therefore, ER is an educational tool or resource that does not pursue learning as an end but as the means to attain it, as confirmed by Barrera (2015) or Garcia and Reyes (2012), students are not intended to become professional programmers, but ER's benefits in the classroom aim at students acquiring knowledge of less or more complexity, with meaning, and that awake their interest and motivation for their teaching-learning process, making them understand that it is up to them and that an active, collaborative and participative attitude towards classmates and teachers, based on learning from mistakes, using them as necessary steps instead of failures, may lead to discovering useful and practical ideas and learning. Or in the words of Ruiz (2007), for learning to exist, it is necessary for students to intervene in the construction of that knowledge.

Moreover, for this type of learning to exist, the teacher's attitude and engagement is paramount because "he/she plays the role of mediator, but to the extent in which the process takes place, the role shifts towards a facilitating agent in the educational process" (Barrera, 2015, p. 2019).

Form the teacher's point of view, Pina (2017) analyzes some experiences of different teachers in different schools who have had to work with ER, some examples are: the inclusion of programming language in the primary education curriculum, or with a weekly hour of robotics in every course. Javier Tellechea refers to the difficulty of managing a group working with robotics in a classroom, some groups are large (25-28 students) and everything needs to be organized and the technological material has to run perfectly. Itziar Ayensa (p. 26) comments "thanks to robotics, our students are much more autonomous to undertake any task, are more thoughtful, work in groups and value the help of others".

But in order to produce learning in a child, an emotion must exist, without it, there is no change in the cognitive structure, and thus, no learning takes place. As mentioned by Gomez (2014) emotional or affective factors are needed to undertake cognitive processes, it is complicated or almost impossible to act if these are lacking.

Gomez (2014, p. 15) considers that "using affective components as essential elements in the decision-making processes may lead to improved interactions between robotic agents and users".

To achieve it, robotics play an important part since it is one of its main challenges, as the author affirms, relevant models are intended to be developed through simple platforms at an affordable price. The author adds that the end of robotics is to simulate empathy based on robots.

Which is why this research will focus on students' motivation in an educational robotics project with the objective of knowing which factors influence motivation more and allows them to develop certain actions with interest and emotion, leading to new and more complex learning.

MOTIVATION IN PRIMARY EDUCATION PUPILS

There is a longstanding outcry concerning classrooms filled with discouragement, disinterest, disrespect towards classmates and teachers, school failure and elevated school absenteeism; whoever has been in a classroom has quickly noticed that the foregoing are true, this explains mounting children school failure rates, as well as low educational levels of members of the school system, as per Ayuso (2016).

Frequently, some people fail to do what they must or have to do, maybe due to unwillingness or to satisfy imminent pleasure, but if those pleasures are put aside and people focus on things that lead them to long-term objectives, satisfaction is inevitable, Jimenez (2017), but it requires a will that is sometimes hard to find in the task at hand or within us (or factors that motivate and encourage us to pleasurably do something instead of intrinsically). Therefore, it is helpful to be aware of the factors that "drive us to do something" with more pleasure and satisfaction above other things.

Although it is well known that that "something" that makes a person do something or the reason why people do what they have to do instead of what they want to do is not a matter of will but of motivation, more concisely, of factors that drive said motivation, those will be the focus of this research.

A search on the definition of motivation leads to thousands of similar definitions adapted to the field of study of the research showing it, but as mentioned before, these have aspects in common. In order to define motivation and its dimensions, the work herein will use Jimenez (2017) and his book "Power and the Science of Motivation", in it, he thoroughly defines it and substantiates it on what is known as the "Cycle of Motivation", which will be explained ahead, and addresses the dimensions or interest and desires taking place at the moment of making a decision; motivation may be defined as "the activation mechanisms with relatively direct access to the motor system, which have the potential to facilitate and direct certain motor circuits while inhibiting others", meaning, "mechanisms that make us want and decide to do certain things" (Jimenez, 2017, p. 23).

Motivation makes people do things without expecting extraordinary results, i.e., people do not need the satisfaction deriving from the result to do what they do,, it is as Jimenez (2017) says ""the fuel" that keeps the engine of our actions running", it is something positive that makes people follow goals and pursue objectives, resulting in feelings of satisfaction and wellbeing.

With the concept of motivation clear, the following is Jimenez's justification of the Cycle of Motivation, as per his book. This requires understanding two key concepts, deciding and desire.

Jimenez (2017) explains that decision-making processes take place through a neuronal process that is fully functional at all times, it is considered that everything a person has done or not done comes from this decision-making, thus deciding, whether automatically or more thoughtfully, although science has proven that this type of decisions are mostly automatic, intuitive and unaware, with the brain creating a "kind of justified self-deceit", an argumentative construction to explain the reasons for said behavior" (Libet, Gleason, Wright and Pearl, (1983) cited in Jimenez (2017, p. 26)), meaning, the reasons why we decide to do something are found after having doing it, which is when a two-faced struggle begins, instinct and rationale. Another way to see it, as per the author, is through a mix of variables that have been acquired and modified through time and experience, which lead to a final result, or a final sound (as he calls it) that forces people to act, do something, step up.

Another aspect that affects people's feeling of motivation or lack thereof is desire, captured through the senses (taste, smell or vision), aside from producing metabolic and physiological changes originated by hormones that accentuate said feeling, or not, as Jimenez (2017, p. 28) says, this desire is nothing more than "the consequence of certain metabolic predisposition and certain external signs [...] that at enough intensity will drive a person to make a decision" (Hughes and Zaki, 2015).

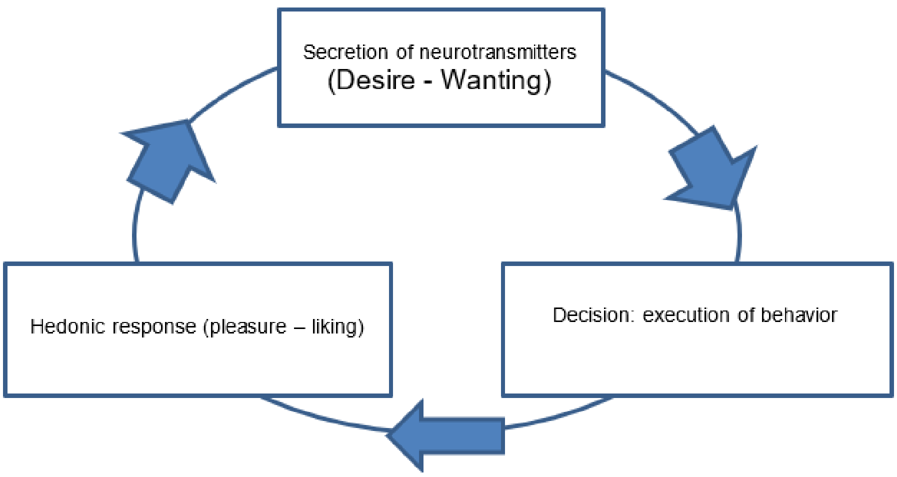


Figure 2
Cycle of Motivation.
Source: Jimenez, (2017).

These two aspects, deciding and desire (wanting), along with the pleasurable and hedonistic response (pleasure - liking) experienced when an action generates motivation and strengthens the neural connections mentioned before, makes it easy for this action to have future repetition, and thus creating a closed process that provides feedback in time, which is known as the "Cycle of Motivation" (Figure 2).

After the foregoing, and taking the Cycle of Motivation into account, we may infer that the more a satisfactory action is conducted and the more times the cycle turns around "neural interconnections causing it will be better consolidated and will be more easily interconnected in the future [...]", as explained by Jimenez (2017, p. 30), meaning that these connections are responsible for people's attraction or dislike towards an action, "[...] simplifying the brain's complex functioning".

Understanding this cycle can help comprehend many pathologies, diseases or addictions occurring on a daily basis, it helps understand our behavior and that of others, since, the author adds, overstimulation or unbalance of one of the factors may lead to certain pathologies, and scarce stimulation or unrooted neural connections would also generate an unbalanced cycle.

This can all be summarized in Jimenez's quote (2017, p. 32, de Vohs and Baumeister, 2008), this process ought to be understood as "a circular and self-nurtured process in which our neurons secrete certain neurotransmitters that make us feel desire, which in turn encourages us to make decisions and execute actions that provide wellbeing, which in turn reinforces the sensitivity towards the initial desire", thus, people do not do what they do because they prefer it, they do it because they are motivated.

Underlying motivation is the satisfaction of certain desires that give sense to behavior, that internal unrest which drives us to do what we do, is the need and desire to satisfy them.

Based on this Cycle of Motivation, it can be affirmed that these desires we seek to satisfy act as the engine (desire will be covered ahead) with the objective of looking for the reason why we feel more motivated to do one thing compared to another, we could also say that about the decision not to do something.

To analyze this basic desires, this research will rely on Steven Reiss, an expert who has worked with motivation and used also by Jimenez (2017) on his book, his findings describe the basic desires that drive motivation. He, as commented by Jimenez (2017, p. 47, de McDougall, 1908) stated that "basic desires are those that boost human psyche and have the capacity to explain a wide array of experiences".

This author enlists 16 basic desires that influence people and, as he says, would be the target end of every decision, activity and behavior, thus fulfilling desire throughout our life. These are: romance, food, family, physical activity, tranquility, savings, order, independence, approval, social contact, honor, curiosity, winning, power, status and idealism.

The aforementioned are not prioritized with the same intensity by people, its classification and customization depends on each one's interests, the more intense the desire is the greater the influence over a person and, according to Reiss, it is a reference at the moment of feeling emotions.

Special care needs to be taken with classifying desire as good or bad, an assessment such as this would be entirely subjective, and as Jimenez (2017) says, the motives pursued by each individual to satisfy their desires can be very diverse and could be influenced by other factors such as context, principles or coexistence with different desires, it would me more accurate to think that people simply have other motivations.

The author considers the list to be incomplete, he tries to complete it as per Edward L. Deci and Richard M. Ryan's "Theory of Self-determination" based on two great pillars, intrinsic motivation, understood as "motivation arising as consequence of personal and internal desire [...], and autonomy, referring to volition and freedom of choice [...] because without liberty there would be no authentic motivation" (Jimenez, 2017, p. 61), considering the evolution of both concepts throughout the years.

In the end, this self-determination theory advances and concludes with three fundamental pillars that influence a person's motivation, as follows:

Firstly, autonomy, implying not just that people do things for themselves without help, but that they do things to feel autonomous, capable of managing situations and being motivated.

Secondly in the Theory of Self-determination regarded by Deci and Ryan is competence, understood as "the set of capacities and skills required to attain certain degree of effectiveness and sufficiency or success" (Elliot and Dweck, (2005), cited in Jimenez, 2017, p. 69), which is linked to motivation towards improvement and perfection.

The third pillar is relationships, advantages of cooperative and group work include the possibility of "combining forces, sharing resources, helping each other and divide tasks" (Baumeister and Leary (1995), cited in Jimenez, 2017, p. 71).

The intention is to "create a context in which the person feels he/she is deciding for him/herself, supported by the resources and enough capacity to manage important matters" (Jimenez, 2017, p. 66).

The following is the connection between this theory and desires. As commented by the author, both theories deal with motivation as a personal thing, arising from each one of us, of our needs or desires seeking fulfillment, through the three pillars of self-determination (competence, autonomy and relationships) and through the 16 basic desires that drive motivation. These theories have been carefully selected due to its complementarity and rigor in its development, with a complete list of wishes and needs to satisfy through motivation, yet its combination requires several modifications.

- Ø Out of the 16 desires, social contact and independence will be eliminated because they could count as relationships and autonomy, respectively.

  Ø On the other hand, the concepts of "needs" and "basic desires" will be unified to keep vocabulary cohesiveness.

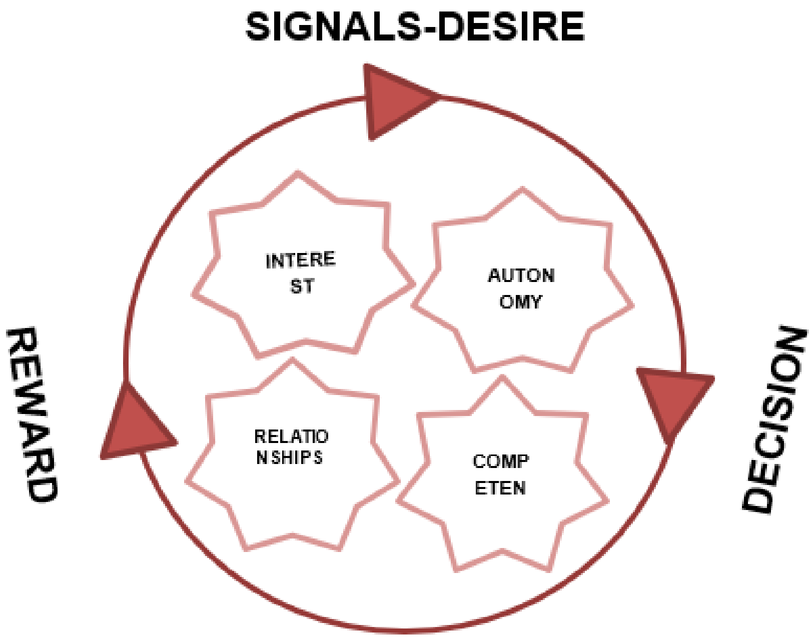


Figure 3
Final Cycle of Motivation
Source: Jimenez, (2017).

To conclude, a “new need” has been created: interest, which will contemplate 14 of the 16 basic desires that affect motivation.

These four needs (see Figure 3) are not independent entities, they overlap and interact, and start a cycle named Cycle of Motivation.

As explained by Jimenez (2017, p. 78) “desires and needs would be the elements or mechanisms that set this cycle in motion, generating desire, making us decide and execute behavior with a reward when fulfilled.” The author concludes that this Cycle of Motivation is not a magical or infallible recipe to awaken motivation in people, the exact motive by which a person in a specific moment wishes and decides to do something concrete or not to do it is still unknown, “this magical moment is still a secret our brain keeps well”, although this emphasis helps us optimize or modify the context or the situation to foster motivation, adds Jimenez (2017, p. 80), “we still do not have the master key, but we can knock on the door and, sometimes it opens”.

The Cycle of Motivation will be applied throughout this research, the intention is to get to know which are the desires and needs that drive a group of students to take on actions on a robotics project, and if said project influences the students’ motivation towards its teaching-learning process.

Based on the thoughts of the author of the book we have referred to, motivation is key in teaching and education, more motivation means more engagement and better results by the students.

This is connected to an aspect that has generated a lot of notoriety in recent years due to the fact that education is one of the social spheres with less evolution in terms of methodology in comparison with the social evolution taking place lately (especially technologically-wise), yet in the classroom is almost non-existent. In terms of methodology, work is done in the same way as in the time of our parents, through an explanation of content, with an exercise, solving doubts, strengthening knowledge and, if something has not been done in class, it will be assigned as homework, in the end an evaluation takes place. In this process, children are passive agents of their learning process, and teachers direct and control the teaching-learning process.

Aside from the aforementioned regarding motivation and basic desires, the following is a description of the two types of motivation, intrinsic and extrinsic.

Intrinsic motivation "refers to motivation provided by the activity in itself" (Morris and Maisto, 2005, p.332), no external stimuli is required to drive interest for this action. On the other hand, extrinsic motivation is "configured by external incentives in terms of prizes and rewards, and leads to the action through a sociably desirable behavior (support or prize) or to the elimination or eradication of sociably undesirable behaviors (punishment)" (Rivera, 2014, p. 32), it is provoked by external stimuli, by people or actions as rewards or punishment.

There is confirmation that emotions are an important part of the teaching-learning process, whether positive or negative ones, therefore, it is imperative to manage emotions effectively with the aim of creating positive and advantageous situations. As commented by Lopez and Yuste (2017, p. 84) "emotional capacity is a necessary element of education", teachers are responsible for teaching how to manage emotions implementing strategies and resources.

In that sense, Cabero, Fernandez and Marin (2017 p.170) explain that "one of the main causes of learning is practice, and it seems to be conditioned by the degree of students' motivation", consequently, "the level of students' motivation to any material or method of teaching constitutes a fundamental element when planning teaching-learning processes" (Merino, Villena, Gonzalez and Cozar, 2017, p. 165).

Lopez and Yuste (2017) remark that ER is a resource that influences said management of emotions to create efficient and top-quality learning processes. Focusing on educational motivation, Merino, Villena, Gonzalez and Cezar (2017), identify robotics as one of the most important resources in educational technology, contributing a constructivist environment in the classroom and developing large interest in different educational spheres.

"Robots are used in the classroom as a tool that fosters different approaches to curriculum content, and based on its own characteristics, facilitate learning through inquiry", as explained by Moreno et al. (2012 p. 79). Merino, Villena, Gonzalez an Cozar (2017, p. 171); Cabero, Fernandez and Marin (2017), emphasize that for students "motivation awakened by the use of programmable robots to solve proposed activities can be regarded as positive. Robotics may heighten curiosity, help them sustain attention required for tasks, generate a larger degree of satisfaction during learning", assisting their performance because, as stated by Moreno et al. (2012 p.78), "learning becomes richer and understanding becomes deeper when knowledge from an object is transferred and observed in another context. [...] Another aspect that needs to be highlighted is that students learn that it is acceptable, especially if those mistakes lead to improved solutions".

The foregoing authors specify in their project that the use of robotics in the classroom as a resource or tool throughout the learning process "improves students' attention as well as teachers' productivity [...] renovating their commitment for remaining up to date and their degree of satisfaction in terms of the teaching-learning process is much higher" (2012, p. 88). Students have reported that the use of robotics awakens their interest in research and in searching for solutions that generate new knowledge.

Garcia and Reyes (2012) are in the same path, they introduce the fact that several research, such as Barker and Ansorge (2007); Carbonaro, Rex and Chambers (2004); Gura (2007); Nourbakhsh et al. (2005), refer to the positive effect of motivation in the classroom based on the use of robotics; research by Fagin and Merkle (2003) emphasizes on the potential of educational robotics to positively highlight learning. Overall, they conclude that robotics generates a higher degree of interest in the students, favoring participation in class.

Pisciotta, Vello, Bordo and Morgavi (2010) focus on robot competitions, commenting on their popularity due to the large extrinsic motivation they pose for students, since it favors groupwork skills and helps identify and evaluate the different options available in order to solve the challenges they face.

Robotics, as has been explained herein, has a multidisciplinary nature that, as stated by Garcia and Reyes (2012), benefits students' motivation and provides multiple advantages when developing content, as well as specific skills, it is flexible because it allows to address a large number of diverse content in an efficient way, moreover, it provides a positive and constructivist learning environment in order for students to tackle contextualized problems and challenges and develop diverse complex skills.

Garcia and Reyes (2012) add that ER also has a direct relationship with cooperative learning due to connections and benefits attributed when working with this methodology in the development of an educational robotics project. Therefore, the following section will focus on collaborative work taking place when working with ER.

With the aim of taking advantage of the benefits offered by robotics in the primary education classroom and to implement it as a means in the teaching-learning process turns out to be an "innovative and interesting field from the cognoscitive point of view, and highly significant for the educational sphere, it enables the development of didactics that revolve around the construction of meaningful learning" (Acosta, Forigua and Navas, 2015 p. 18) through cooperative methodologies, encouraging students' interest alongside motivation.

Gonzalez, Paez and Rolda (2013, p. 50) conclude their research saying that "motivation and teamwork are two elements that stand out when using robots in education, they allow developing projects that require an integration of different areas of knowledge in the solution of a problem", thus, it is important to connect these three aspects of education in one research.

CLASSROOM COOPERATION IN PRIMARY SCHOOL

As we have commented in the beginning of this theoretical framework, current society is immersed in constant change, an "evolution of industrial society towards a society of information and knowledge that is characterized by incessant change", (Ruiz, 2017, p.65). Therefore, the current world poses new challenges that differ from the usual ones, thus, educational methodologies and strategies are needed to cover those needs. From all of the possibilities, this research will focus on an active methodology based on cooperative work in the primary education's classroom.

Active methodology is defined as a student-centered methodology, meaning students are responsible for their learning, which requires total involvement and commitment to result in meaningful learning and in a connection between the different contexts and situations with which they are working (Fernandez, 2006); i.e., the "responsibility of learning directly depends on the student, generating deeper, more significant and lasting learning that facilitates transferring it to more heterogeneous contexts" (Ayuso, 2016, p. 23).

Pinedo, Caballero and Fernandez, (2016) cited in Ayuso (2016 p. 23), comment that these active methodologies "are the most appropriate methodologies to train competences and are positively valued by students and teachers", work is based on trial and error and mistakes are assumed as a step to attain knowledge and learning, not as negative elements of learning but as necessary elements.

This is why it is evident that active methodologies benefit the child, because they teach groupwork, discussion, argumentation, respect and listening to classmates, evaluating their work from an individual and group perspective from situations that are contextualized in the real world that is familiar to them.

Cooperation techniques can be used to deal with these different interactions in order to "analyze each case and seeking to adapt, integrate and create new variants, generating new techniques thus giving vital importance to communication and exchange of information by the agents; from collaboration, coordination and solution of conflicts" (Acosta, Forigua and Navas, 2015, p. 15).

According to Johnson, Johnson and Holubec (2004, p.14) "cooperative learning is the didactic usage of small groups in which students work jointly to maximize their own learning and that of others" or Johnson and Johnson (1999) define it as the use of small groups in which students work and take full advantage of their learning through interaction.

With this type of learning, the task is divided in simpler sub-tasks that the members must complete through the acquisition of roles with the aim of fulfilling criteria, objectives or goals set to be delivered through cooperation (Acosta, Forigua and Navas, 2015).

These authors affirm that a collaborative learning group needs to understand that in order to work together, it is essential to optimize results through their performance, although there is a risk for the opposite to happen because one of several members of the group may falter and disregard their task and the role assigned to them, leading to a failed learning process. Therefore, it is critical for each member of the group to assume their given role and responsibility within the group to effectively deliver the proposed challenge and with top quality learning at individual and group level.

According to Johnson, Johnson and Smith (1991), cooperative work has five basic elements:

- · Positive Independence: refers to how every member of the group benefits from individual work of the other members as well as him/herself.

  · Face-to-face Interaction: group members help each other, share, exchange ideas and materials to attain more meaningful learning.

  · Individual Responsibility: each member's accountability aimed at fulfilling individual and group objectives without taking advantage of someone's work or failing to do his/her part.

  · Interpersonal and Small Group Skills: attitudes of style, leadership, respect towards classmates, decision-making, work and trust climate, problem-solving, etc.

  · Individual and group Reflection: individual and group reflection that questions aspects such as responsibility and participation in the group, achieving objectives or work relationships with classmates, among others.

Trujillo (1998, p. 2) highlights the importance of cooperation in terms of competitiveness, stating that "helping, sharing, collaborating and cooperating are the permanent guideline, fostered in chores with positive interdependence, which swaps competitiveness for building good relationships among members of the group", profiting individual and group cognitive development.

It can be said that this is yet another benefit of cooperative work for students. It has been demonstrated that competitiveness adds individual and selfish values to the person practicing it, instead, cooperation provides values that teach students and people how to live in a more positive society in which help is a source of information and knowledge that leads to solutions with added quality. This is why shifting society to modify its course of competitiveness and turn to cooperation as a philosophy of life may bring added social advantages.

Applying a cooperation methodology means that teachers play an important part, as mentioned by Johnson, Johnson and Holubec (1998) cited in Fernandez (2006), their role is defined in four stages:

- · Previous decision-making: defining the formal aspects of the work, such as defining objectives, group size, roles and class organization, as well as acquiring the necessary materials.

  · Explaining the task and setting up the cooperative structure: sharing this work methodology with the students, as well as the task to undertake, solving any doubts that may arise.

  Surveilling students' learning and providing assistance: the teacher only intervenes in groupwork when it is necessary, leveraging students' responsibility and acting as a learning guide only

  · Evaluating students' learning and encouraging group reflection: assessing and evaluating the quality of goals achieved, making sure students reflect upon their process and designing an improvement plan.

As seen and as affirmed by Acosta, Forigua and Navas (2015) and Heredero and Oliva (2014) although the teacher designs and maintains control of the interactions, the resulting learning depends entirely on the students because they decide which strategy to follow to solve a problem or challenge they contemplated.

On the other hand, teachers act as mediators and champion the students' learning process, they provide the tools needed and crate learning situations with the purpose of developing autonomy and competences needed to face a fulfilling life in society (Heredero and Oliva, 2014).

In the words of Trujillo (1998 p.4) the teacher "must shape the communicative and social dexterities that are expected from the students", since cooperative work requires help and collaboration to be effective, it is the teacher's responsibility to give it the deserving importance and work it as a rule and routine alongside the methodology. This can be achieved with a variety of games and cooperative tasks that make this process simpler and more dynamic.

The author also emphasizes the existing connection between cooperative work and student motivation, where the teacher plays a critical role as an active and coordinated agent for this connection to be effective and planned tasks to be delivered, encouraging students to debate and developing social skills, teaching how to listen instead of imposing ideas and helping them understand that questions assist thinking and finding a solution while developing critical thinking.

Another important aspect mentioned by authors Heredero and Oliva (2014) is classroom organization, adding that heterogeneous grouping is indispensable to create cooperative learning environments among equals, children benefit from this process, gaining personal rewards, learning to accept, tolerate and understand their peers better. "We need to share and enrich ourselves with experiences, going further to integrate ourselves in a society that goes beyond learning knowledge" (p. 280).

Going back to Trujillo (1998), cooperative learning has the following advantages:

- · Achieving objectives is qualitatively richer in terms of content, since proposals and solutions are offered by several people in the group, as well as different points of view.

  · It increases learning because the learning experience is more enriching due to the fact that each member of the group is contributing knowledge and everyone benefits from it. It increases motivation

  · It increases motivation to work since there is a greater connection between the members of the group, social skills are also practiced, thus students can feel part of a social group.

Given ER's multidisciplinary nature justified by Acosta, Forigua and Navas (2015); Garcia and Reyes (2012); Ruiz-Velasco (2007); and Sanchez, Rodriguez and Narvaez (s/f), plus its versatile nature, and as per the analysis of Acosta, Forigua and Navas (2015, p. 17), it can help "develop and implement a technological culture, enabling understanding, enhancement and development of proprietary technologies deriving from practical and collaborative projects to learn how to learn based on the construction and control of different robotic prototypes with didactic purposes."

Or as Ruiz (2007) puts it, in this technological generation ER enables working in technological environments that build meaningful change within the educational model, transforming the student into an active and participative agent in his/her learning process and developing skills such as respect, problem-solving and working in teams and cooperatively, applying a holistic view of this process.

Similarly, Gonzalez, Rodriguez and Roldan (2013) relate ER with cooperative learning and consider it a "strategy that fosters collaborative participation among students, with the goal of practicing mutual support to jointly achieve their individual objectives" (p. 49).

It can be emphasized that it is possible to work with new information and communications technologies (ICT) applying pedagogy through students' active and participative work, introducing them to scientific environments that follow the STEAM philosophy from early ages.

Gonzalez, Rodriguez and Roldan (2013) comment on research about the existing connection between ER and cooperative work, e.g., Brigitte and Sylviane (2001) indicate the importance entailed by learning how to work with others in a collaborative way using robots to solve problems. On the other hand, Mitnik, Recabarren, Nussbaum and Soto (2010) have developed a project based on a cooperative work learning strategy to program and evaluate behavior of previously programmed robots.

Thus, ER is a useful tool and an extensive opportunity to turn cooperative work into an active and efficient methodology, whereby effective learning environments are created to practice cognitive and social processes with the aim of attaining meaningful learning and driving a much-needed educational change in classrooms (Hernandez, 2016; Morales, 2017; Fernandez, 2006), in their workgroups, students in this methodology work with common goals, trying to solve proposed problems or challenges for which they need to apply their skills and knowledge and cooperate with each other, thus reinforcing social skills, as mentioned by Owens, Granader, Humphery and Baron-Cohen (2008) or Mitnik, Nussbaum and Soto (2008).

Morales (2017, p. 7) has been able to verify "how educational robotics has helped children to work better and more as a team, listen to others' points of view and reach solutions among them because they comprehend the significance of teamwork". When they work like that, they learn to relate to others, to work with others, to reach agreements, the list is extensive in terms of skills that benefit the person developing them. Therefore, "cooperation would be the result of applying a strategy to attain an objective in which people involved would associate to try and achieve it". (Morales, 2017, p. 3).

In their study, Gonzalez and Jimenez (2009) conclude that the work they have conducted with robotics has led them to observe a development of civic, democratic, artistic, cooperative and collaborative skills in children, these had not been present from the beginning but were an added value of the undertaken learning process; it has been proven that, even without applying the cooperative methodology, working with robotics implies cooperation techniques with which students learn social skills.

After a comprehensive examination of existing research connecting cooperative learning with educational robotics, it is evident that seldom have both topics been entirely and thoroughly analyzed, few references on both educational aspects are found in terms of how important and necessary the aforementioned are in sustaining the change in classrooms that drives this research project.

DISCUSSION

Following this research and after focusing on a theoretical review of educational robotics from the point of view of students' motivation and cooperative work, the following are the key takeaways and conclusions:

- · Educational robotics fosters increased motivation and classroom interest in students, causing more significant results in their teaching-learning process.
  · A cooperative working methodology invites positive benefits in students, both academic and social.

Thus, as per Jofili (2002), cited in Vigueras and Villalba (2017), and Ruiz (2007) educational robotics may lead to creating technological learning environments based on a cooperative learning methodology in which students reflect, search, and compare to create knowledge, develop cognitive and social skills and are encouraged through a holistic perspective on learning.

To achieve an effective technological environment, it is necessary to consider the emotions that might influence students, since in order to produce learning, it is necessary to spark an emotion on children, if the emotion is positive, then learning will be meaningful due to motivation, as Jimenez (2017) explains in his book.

In terms of educational robotics and cooperative learning, Morales (2017) affirms that it allows students to work more and better, developing social skills to create problem-solving strategies, strategies that would fail to be encouraged with individual work. Consequently, this will develop socially-competent people, as explained by Gonzalez and Jimenez (2009).

The difficulties found in this literature review process are mostly the lack of literature in terms of educational robotics experiences in the primary education classroom, as well as a scant connection with cooperative work.

This aspect is often related with increased student motivation, but that analysis usually focuses on general aspects, a limitation that was also found is the lack of deep and detailed analysis about educational robotics and student motivation and the different aspects involved in these spheres of study.

Thus, considering the limitations of the study, the following are the suggested future lines of research to complement this study:

- · Including educational robotics in different curricular areas to get to know how it influences students, tracking motivation in those fields of work compared to increases of motivation when working with robotics specifically.

  · Opening a research line about the FIRST LEGO League, participating students and its different levels of competition, linking it to cooperation, competitiveness or implications on students, among other possibilities.

  · Working with a group of students on the influence of motivation and cooperative work through a robotics project, inside and outside the classroom.

  · Taking into account teachers and their thoughts and experiences in education pertaining these fields of study.

These are some prospective lines of research, these are mere suggestions because many other options that are interesting and dynamic are still open, all of which could lead to surprising and effective results to be applied in classrooms as innovative and motivating resources for students, thus improving the quality of their teaching-learning processes.

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