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Use of ICT Tools using the PBL Methodology as a Student Learning Strategy

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Abstract. The community of Altos de la Sabana is a population composed of families of limited economic resources and victims of the internal armed conflict in Sucre, located in low-income housing. In this urbanization is the Institution of Higher Education of the Holy Shroud. Given that at present it does not have technological and innovative tools for academic use, information provided by the rector and the academic coordinator of this institution, as well as being considered as a vulnerable community by the national government, which gives them a priority position when implementing educational and social projects; The main objective of this project is to encourage the students of the secondary school of the institution to use technological tools to solve problems in their environment. This research has a quantitative approach and the design of the research focuses on field research and with a pre-experimental method. For the execution of this project, 3 moments were concentrated; initially, an initial test was carried out to validate knowledge in technological tools and the self-directed profile, then some training was carried out using the problem-based methodology and finally a final evaluation to measure acquired competences. The results of the post-test, in contrast to the initial test, revealed that 65% of students in grade 11 of the institution demonstrate an empowerment in the use of ICT tools and concepts in the field of basic analog-digital electronics. This is how ICTs are based on the education system, as they are facilitating tools in the teaching-learning process.

1. Introduction

The speed of adoption and penetration of digital technologies advances rapidly in the different countries of Latin America, access to digital, genders, age groups and the gap between urban and rural areas, is increasing. By 2015, 81% of households in developed countries had access to the Internet, compared to 34% in developing countries and 7% in least developed countries [1]. Other studies from the Economic Commission for Latin America ECLAC, indicate poverty rates in the region of 28% in the countries that comprise it, while the DANE, shows an indicator of poverty for the department of Sucre. 44.7%, Sucre being the fifth department with the highest percentage of poverty, preceded by Chocó 62.8%, La Guajira 53.3%, Córdoba 46.6% and Magdalena 44.8% [2].

Reflecting these inequalities in education, being the main challenge for Latin America, the universalization of basic education and the media, incorporating social sectors, improving quality and massifying higher education. The new teaching systems configured around information and communication technologies must redefine learning techniques to lead them to a more flexible type of teaching processes [3].



With the passing of the years, technology is a fundamental part of the activities of the human being, it is necessary to have knowledge about ICT tools. Since the world has modernized to such a scale that people must adapt to these technological changes, with these tools anyone can develop activities in less time, in addition to providing the society with many forms of communication, education and jobs.

According to the Ministry of National Education of Colombia, the use of technological tools is necessary to bring students' knowledge to the world around them, so it is necessary that they have access to this type of tools for the development of competent skills [4].

Master classes taught in basic and secondary institutions increasingly discourage students, teachers need new resources and tools to generate more didactic classes. The Ministry of National Education proposes an educational revolution to transform the Colombian educational system in terms of magnitude and relevance through strategies that expand coverage with equity criteria, improve the quality of the education system and increase the efficiency and productivity of the sector. Two of the 37 projects that support these postulates include the incorporation of new technologies and methodologies in the country's education. In coverage, higher education and quality in basic and secondary education, with elements such as connectivity and information technology, use of television programs and educational radio.

The OECD, in its educational aspect, is concerned with the quality of education, seeking, analyzing and promoting effective educational environments, based on the results of the students [5]. An in-depth analysis is not necessary to verify that the most innovative environments use new technologies to support their methodology, in order to favor the child's integration into the current real world. The effectiveness in the learning process is much higher when the new technologies are integrated.

UNESCO in its global report on education, points out that virtual learning environments constitute an entirely new form of educational technology and offer a complex set of opportunities and tasks to educational institutions around the world, the environment of Virtual learning defines it as an interactive computer program of a pedagogical nature that has an integrated communication capacity. Virtual learning environments are, therefore, a relatively recent innovation and the result of the convergence of information technology and telecommunications [6].

In Colombia ICT has taken a big boom in the educational field since the Ministry of Information Technologies (MinTic) has made a variety of projects that allow the teacher the flexibility to carry out the teaching-learning process, one of the projects with the highest national recognition is the digital live plan (2014-2018), which supports the strengthening of the education sector, all this is supported by different programs that aim at the following objectives; contribute with the TIC to the reduction of the poverty, to generate employment in our country and to form micro, small and medium companies (Mipymes) with technological tools [7].

Master classes taught in basic and secondary institutions increasingly discourage students, teachers need new resources and tools to generate more didactic classes. The Ministry of National Education proposes an Educational Revolution to transform the Colombian educational system in terms of magnitude and relevance through strategies that expand coverage with criteria of equity, improve the quality of the education system and increase the efficiency and productivity of the sector. Two of the 37 projects that support these postulates include the incorporation of new technologies and methodologies in the country's education. In coverage, higher education and quality in basic and secondary education, with elements such as connectivity and information technology, use of television programs and educational radio.

Based on the research conducted by Pérez, C titled; Sustainable Social Entrepreneurship in Vulnerable Communities: Altos de la Sabana case in the city of Sincelejo; it has been possible to determine that the residents of the Urbanization are vulnerable people, because they are a population that was deprived of their homes because of different types of violence. This Urbanization is part of the 1 million free housing program of the national government [8]. Within the free housing program, an educational facility was built with the capacity of 22 classrooms that allowed 800 students to be accommodated. From the research carried out by the authors mentioned above, it can be deduced that the great majority of students of the Altos de la Sabana Educational Institution have little communication with their parents, since they are working in the informal sector, which leads to bad remuneration, and instability, which by effect forces them to leave a lot of home to survive, evidencing that it is a

community with a high degree of social vulnerability that affects in one way or another the educational performance of many children and young people in this area.

On the other hand, an interview was conducted with the rector Lodis Madera of the Altos de la Sabana Educational Institution, where she manifested the lack of technological resources and the way in which this problem affects the students' learning, since they do not have a classroom appropriate in which interact with technological tools and thus awaken skills that allow improving the teaching-learning processes of the student and teacher role. Currently the institution has a population of approximately 2200 students, with a ratio of 15 computers and two videobeam, evidencing a high technological gap by the number of students and teachers that the institution has.

This research is done in order to provide students with a way to mitigate the technological gap presented by this institution, through didactic prototypes, which will help them to improve their skills and be at the forefront of the technologies used today. in day. Within the public policies of the Colombian government, ICT is a way to strengthen education systems.

Interestingly, vocational guidance is a very important issue when training students with a strategic and assertive professional projection to the current era, which usually has a labor market in constant change. But none of this is possible without professional intervention for the discovery of talents or attitudes relating to an area, in the case of this project computer science. In this way increase the rise of computer professionals passionate about the profession and thus avoid academic desertion in the university stage, which is often the fate of many young people who due to ignorance of their talents, lack of advice and training, end up frustrating their dreams.

Society today demands from educational institutions a greater link with the processes that define the future of the country. As a consequence, great tasks are posed in efficiently fulfilling the training of students capable of facing new problems; consolidating a broad provision regarding the use of information and communication technologies, fostering progress in the generation of knowledge.

Many projects that have emphasized the use of technological tools using the ABP methodology and highlight the lack of mechanisms to take students to improve their learning process in a dynamic way that allows to get out of what is commonly given in the classroom. It is in this way that its authors emphasize the use of the aforementioned methodology and its great influence in the apprehension of knowledge, relying on information and communication tools.

A bibliographic review was carried out at national and international level, where the following antecedents with affinity to the research were found, as evidenced in table 1 [9-13].

1.1 Information of Communication Technologies

Information of Communication Technologies makes part of the most significant basis of the new education, and it represents the new scenario to comprehend the educational phenomenon that implies the new educational and pedagogical culture offering to this purpose a valuable support for its use strengthens the information interaction and exchange in appropriate surroundings and in various contexts that help the movement of competences and knowledge among students, breaking the traditional classroom developments and favouring the students' cooperative work [14].

1.2 Learning based on projects

This learning model requires for the professors to be creators, guiders and facilitators who stimulates the students to learn, discover and feel satisfied with all the knowledge they have acquired, thing that can be achieved if the teaching process, based on projects, is applied the best way. In other words, the learning process can be seen as accumulative, self-adjusted, guided, collaborative and individual [15].

1.3 Innovating technological tools

These tools constitute a learning laboratory about robotic and technological sciences from an integrating perspective that does not separate the other knowledge fields such as arts, design and style. These allow students to achieve new knowledge and develop technological abilities in the fields of basic and digital electronic, building with their own hands projects ranging from lamps, alarm bells and toy cars to handcrafted boats controlled by remote controls [16].

Table 1. Bibliographic review of antecedents of investigation.

Project author (s)	Year of implementation or development.	Project's name	Methodology of the project
Javier Calleja Pascal.	University of La Rioja., Academic year.	ABP and the use of ICT: a proposal to improve education.	The methodology that will be implemented is ABP (Project-based learning). Belted by a constructivist model.
Vanesa Ausín, Víctor Abella, Vanesa Delgado y David Hortigüela.	University of Burgos, Faculty of Education, Department of Education Sciences.	Project Based Learning through ICT. An Experience of Teaching Innovation from the University Classrooms.	Project Based Learning, ABP or PBL, which is part of the active methodologies. Field experimental model.
Ana García, Varcácel Muñoz Repiso, Verónica Basilotta Gómez Pablos	Dept. of Didactics, Organization and Research Methods. University of Salamanca.	Project-Based Learning (PBL): evaluation from the perspective of P-education students.	Based on the ABP, (Project-based learning), supported by the descriptive methodology.
Vicent Estruch, Josep Silva	Dept. of Computer Systems and Computing. Polytechnic university of Valenci	Project-based learning in the Computer Engineering career.	Focused on the ABP methodology, (Project-based learning), supported by innovative pedagogical methods.
Gómez Trigueros, Isabel María.	General Didactic Department and Specific Didactics Social Sciences Area University of Alicante	The didactics of Geography and ICT: new teaching and learning methodologies.	Active methodologies such as Problem Based Learning (PBL), supported by collaborative and cooperative didactic strategies.

1.4 Hackids tools (Arduino set)

These tools constitute a laboratory for learning about robotics and technology sciences from an inclusive perspective that does not separate sciences from other areas of knowledge, such as art, design and fashion. They allow young people to develop knowledge and technological skills in the field of basic and digital electronics, building with their own hands projects that range from flashlights, alarms, toy carts and even craft boats made with recycling objects, managed by remote control [17].

These Are Elements Composed by a great variety of electronic components as sensors, engines, leds, resistors, Arduino panels, etc. whereby research can be generated.

2. Methodological framework of the investigation.

2.1 Design of investigation.

The focus of this research is quantitative, as well as the way, the information, the analysis, the information collected. According to Hernández, Fernández and Baptista, the quantitative approach uses data collection to test hypotheses, with the numerical base and statistical analysis, to establish behavioral patterns and theories [18]. The research is field and with pre-experimental method. The selected sample is of 40 students with ages between 13 and 17 years, degree of the high educational institution of the savannah of the municipality of Sincelejo.

2.2 Technological resources.

The technological means with which the objectives of the project will be achieved are:

- Computer.
- Internet connection.
- Printer.
- Digital camera.
- Academic database.
- Office automation applications.
- CAD software for electronic design.
- Programming software.
- Procedures of the investigation.

2.3 Procedures of the investigation.

For the development of this research data is collected in three phase.

Initially for the first diagnostic phase of the investigation, we proceed to the application of an instrument that measures the degree of appropriation of knowledge that students have of the average of the Educational Institution Altos de la Sabana, in terms of analogical electronics concepts and digital; frequency of use of social networks in terms of academic part and self-directed profile.

In the second phase begins with the transfer of knowledge about the use of innovative technological tools, following the methodology based on projects, where students learn to build their own knowledge by applying the tools and the needs of their social environment.

In the third phase, an application is developed through the use of innovative technological tools Hackids or other digital electronic components, where young people develop a project together with CORPOSUCRE research seed students, showing their skills acquired in the transfer phase of the project. knowledge. Also elaborating an ex post analysis, through the application of the same diagnostic instrument applied in the initial phase, which allows to reflect the degree of knowledge acquired by the students, in terms of the use of the tools.

3. Results

This research will work in several moments, a pre-evaluation and a post-evaluation in order to encourage the use of ICT in the media of the high school of La Sabana in the municipality of Sincelejo. From the general analysis of the results of the initial test, we can affirm that the vast majority of students do not have knowledge about the technological tools, concepts and basic topics of electronics. They do not use the web frequently for educational purposes, but to check social networks such as (Facebook, Instagram) and YouTube. This could be a reason why students have academic deficiencies because they do not use the teaching tools properly. Another fundamental reason why students show flaws is that the vast

majority do not have Internet and computers. Important and fundamental tools for independent learning of each one.

For the second time, training sessions were held over a period of 5 months between the month of June and October of 2018, where 6 students and two teachers of the electronic engineering programs and system of the Antonio José de Sucre University Corporation, they worked on concepts related to analogue and digital electronics using the project-based methodology. The training cycle is evident in the following figure 1.



Figure 1. Trainings in technological tools using the PBL methodology.

For the third time the students carried out different projects focused on needs related to their environment, punctually in security, energy, unemployment, water, among others. Below, some elaborate rapid prototypes are evidenced in figure 2;

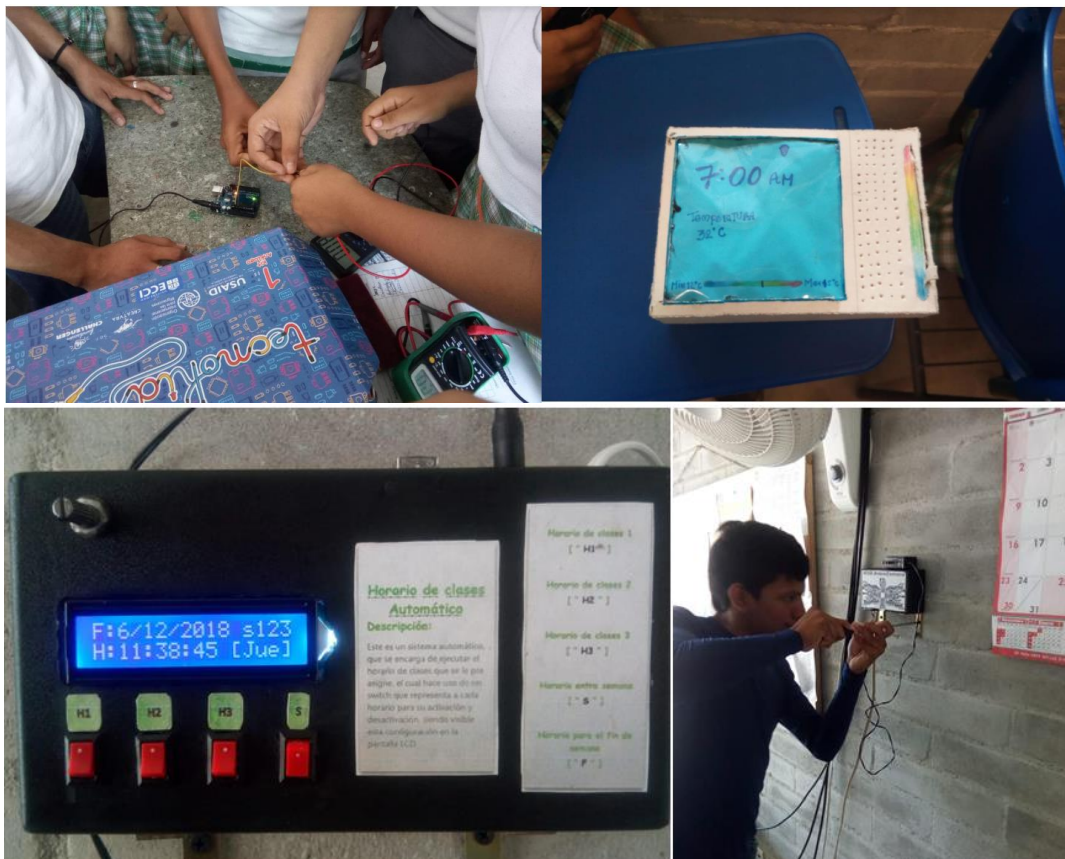


Figure 2. Design of rapid prototypes using the PBL methodology.

The contrast of the initial test and the final test related to the attitudinal part and concepts related to ICT is shown below in figure 3, figure 4, figure 5 and figure 6. for the test related to the ICT concepts, it is valued if the students answered correctly (good), incorrectly (bad) and does not know (does not know). In the table 2, the type of response of the attitudinal part is specified.

Table 2. Likert response of the attitudinal part

Minimization	Answer
(S)	I always feel and think like that
(CS)	I almost always feel and think like that
(O)	Occasionally I feel and think like that
(CN)	I almost never feel and think like that
(N)	I never feel and think like that.

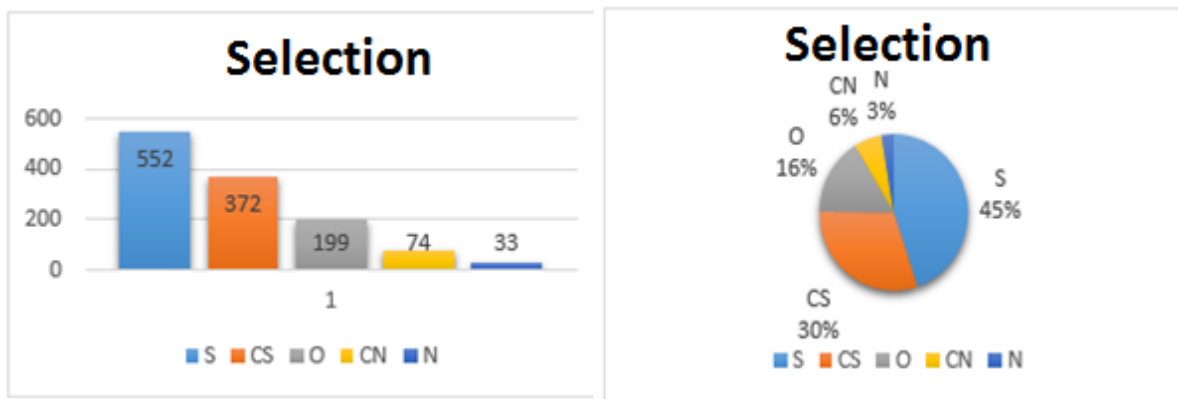


Figure 3. Results of the initial attitudinal test

75% of the students showed a positive result in the questions related to decision making, social value, attitudes, motivation and identify alternatives for solving problems.

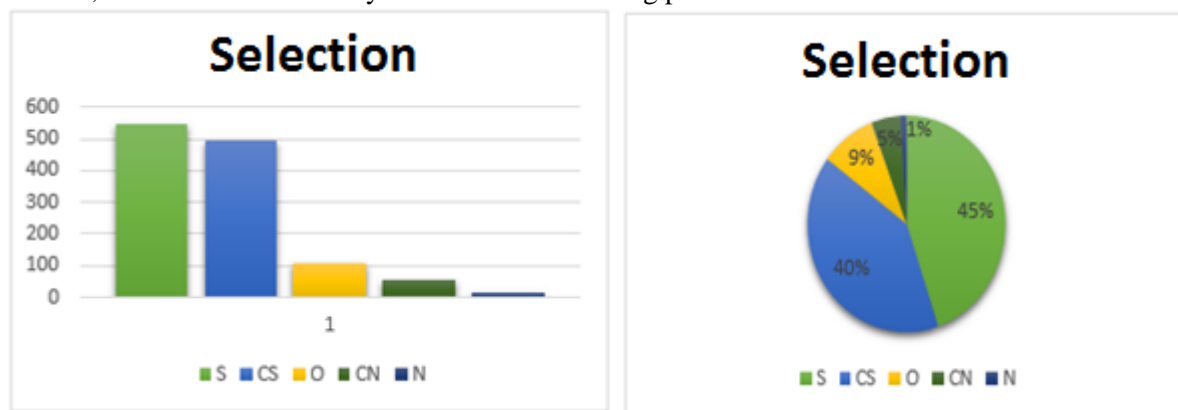


Figure 4. Results of the final test of the attitudinal part

85% of the students showed a positive result in the questions related to decision making, social value, attitudes, motivation and identify alternatives for solving problems.

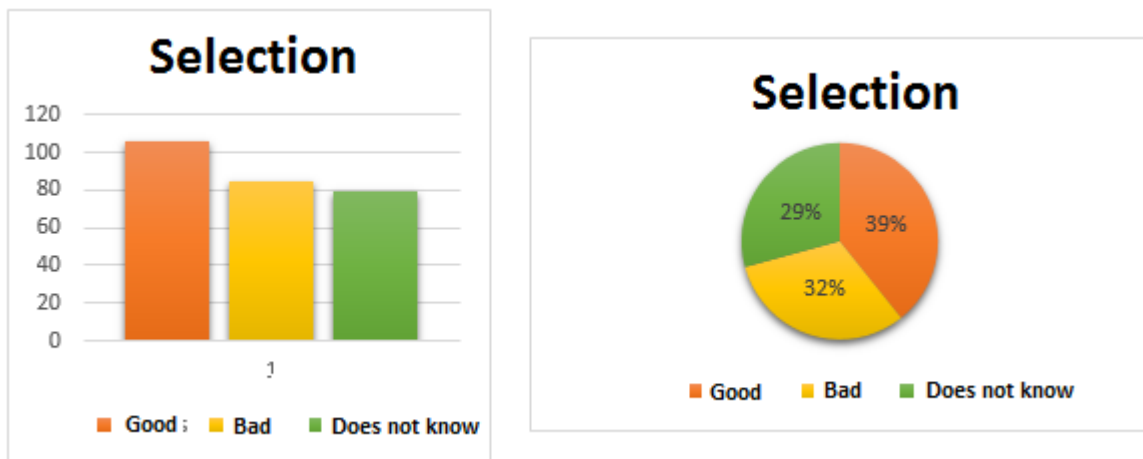


Figure 5. Results of the initial test part of concepts related to ICT

61% of students showed significant shortcomings in basic electronics concepts and also in terms of recognition of electronic components and units of measurement.

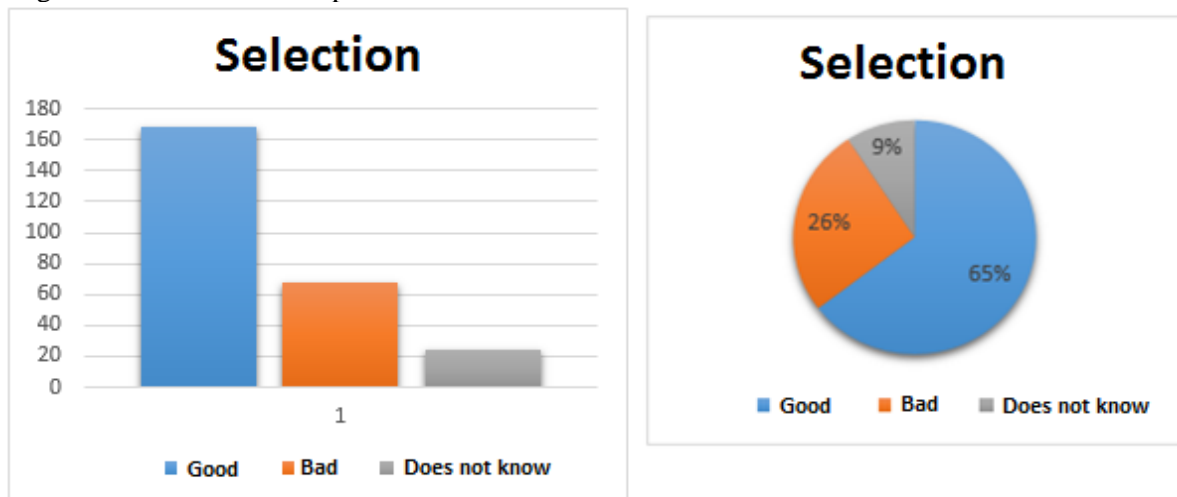


Figure 6. Results of the final test part of concepts related to ICT

65% of the students had the knowledge when answering the questions referring to basic electronics concepts and also in terms of recognition of electronic components and units of measurement.

4. Conclusion.

In a conclusive way we can affirm, from the results of this investigation, the benefits that can contribute to the educative institution of the savannah of the municipality of Sincelejo are the following:

- Democratization of culture, through technologies currently live in a globalized world in which we can access large amounts of information from anywhere in the world
- Appropriation of ICT for social inclusion, as a challenge to promote suitable scenarios of orientation of technologies for the approach of vulnerable populations to these tools.
- The ICT allow generating new teaching methodologies for teachers, abolishing the monotony of the master classes that have been working for a long time and generating more didactic spaces for students.

- With this type of tools, students can generate a sense of belonging for their environment, managing to solve problems in their communities.
- This class of modules mitigates technological illiteracy, generating skills and abilities that allow reducing the social, economic and labor gap in young people who are opposed to adapting to the use of the tools that surround them.
- The methodology of problem-based learning used in this research can be very positive for students, with it they can acquire skills related to creativity, problem solving and critical thinking, which will allow a better performance in the classrooms. It will also support the development of skills and life skills.
- Through this research, collaborative work is encouraged in students from classrooms, fostering values and good school life in a society increasingly deteriorated by individual behavior and social competitiveness.
- It would be pertinent to replicate this type of project in other highly vulnerable educational institutions, which do not have this type of technological tools.

With this research, it was possible to encourage and encourage the use of ICT using Arduino technology as a teaching and learning strategy in the students of the Altos de la Sabana Educational Institution, improving the teaching-student role. Finally, it is intended to replicate this project in another institution.

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