

# Innovation And Sustainability In Pedagogy Of Engineering In Times Of Pandemic

Haidee Y. Jaramillo<sup>1</sup>, July A. Gómez-Camperos<sup>2\*</sup>, Sir-Alexci Suárez Castrillón<sup>3</sup>

<sup>1</sup>Department of Civil Engineering, Faculty of Engineering, GINSTI Research Group,  
University Francisco de Paula Santander Ocaña, Colombia.

<sup>2</sup> Mechanical Engineering Department, Faculty of Engineering, GINSTI Research  
Group, University Francisco de Paula Santander Ocaña, Colombia.

<sup>3</sup>Department of Systems Engineering, Faculty of Engineering, GRUCITE Research  
Group, University Francisco de Paula Santander Ocaña, Colombia.

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## ABSTRACT:

Education from learning processes centered on practice constructivist, allows classroom projects and continuous interaction from experience help to be an important part of the integrity of the projects and therefore of an education effective, hence since the appearance of the pandemic in the life of the human being allowed the virtuality and social networks will contribute with greater incidence in the application of the processes result, contributing to the connection remote with experts in all areas of the knowledge and application of software as virtual instruments of educational support and research, from there that the students of signatures like construction sustainable saw the relevance of innovation and recursion all from the discipline is why each student realized a research project that generates new knowledge and contributes to the sustainability, resulting in students' skills of leadeness, creativity, assertive communication and adequate planning of time and resources.

**Keywords:** Pedagogy of engineering, Pandemic, innovation, learning processes.

## INTRODUCTION

With the passage of time and the different discoveries of man in search of his well-being and comfort, it has caused nature and many of its resources to have deteriorated, hence in the next few years a call has been made to all the communities of the planet and above all to their leaders to promotes sustainable development practices and care for the environment [1]. UNESCO promotes that education should have a cognitive and holistic content that allow the leading scientific and technological disciplines to contribute to development sustainable of the peoples who inhabit it. That is why learning based on the applied research that generates new practices of innovation and sustainability, from there that the cultural diversity is a value that must be preserved by each people as it contributes to our heritage living as human beings [2],[3]. So the learning imparted is due base on projects allowing the student to apply the knowledge acquired

in search of timely and innovative solutions, all this guided by the teacher thus applying the (PBL) that is the project-based learning [4]. From all academic roles carrying out a systems perspective, customization, discussions, and implementation from the engineering, thus contributing to skills in all fields related to thought systemic, developing interdisciplinary, creativity and sustainable and social innovation [5]. The current challenge of education has as its principle the technical, scientific, and technological innovation, aiming at a process of practical and evolutionary learning solving problems of the everyday environment and current development needs [6]. That's why the current demand in pedagogy is to allow the student to face to research as an experience that will require from them the application of knowledge generating High-level researchers who contribute from science to the social and sustainable development of the territories, with the use of the application of information and communication technology (ICT) as element of innovation in search of educational quality and multidimensional training processes allowing the educational flexibility of the procedures and working methods adapting to a new learning culture [7]. The research processes applied in the classroom of class have shown that they generate effects of scientific advancement and creates in the students attitudes of creative and innovative learning, solving real problems is hence the Civil Engineers of the University Francisco de Paula Santander ocaña sectional have developed different proposals research in materials applied to the construction and engineering sector being a contribution to sustainable construction, so we can define sustainable construction as one that allows a good long-term solution for the conservation of natural resources, reduction of impacts, energy saving and preservation of natural resources [8],[9]. The current training must articulate the technical with the theoretical in contexts that provide answers to challenges current community development, allowing for the acquisition of skills and capacities as learning to do, learning to know of collaborative work and social projection [10] .

Sustainability has generated great impacts in today's society which has allowed a call constant of all the sectors that make up today's society, which has led it to define it as a system can be represented by a non-decreasing function of valuation of outputs, or products of the analyzed system that are of interest [11], hence the Francisco University of Pula Santander sectional Ocaña, has bet on the academic practices face-to-face and virtual which represents a useful teaching process for the application of knowledge with real context determining in the 10 important aspects of sustainability and innovation such as: Ecology, Grey water management, Reduction of drinking water use for non-human consumption tasks, energy efficient, residues, land uses, transport, materials, interior quality of space (comfort), quality of the air [12].

Within the training process that is being implemented in the University Francisco de Paula Santander sectional Ocaña incorporates the articulation of knowledge through the solution of problems that arise real situations from communities need or from of the civil engineering sector , that allows innovation and appropriation of the knowledge, that is where the theory is implemented constructivist i.e. the context of the shared language and the systems of meaning that are develop, persist, and evolve over time thus allowing interaction from the technical experience and the scientific and normative context [13].

The main objective of sustainable construction practices in the civil engineering program, have allowed the experience of the use of ancestral techniques with relevance and impact on the sustainability transcends from generation to generation and can be applied with technical and regulatory rigor for our times, focusing it on the sustainable development goals that have been built to the prevalence of humanity and the proper use of resources integrating economic potential and conservation with nature that articulates technology culture and society in the improvement of their quality of life [14], is thus that innovation and the sustainability in times of pandemic have allowed the globality of connectivity and successful experiences in the face of sustainability in engineering are promoted and visualized every day more to allowing a greater impact on the sharing of practical and theoretical knowledge.

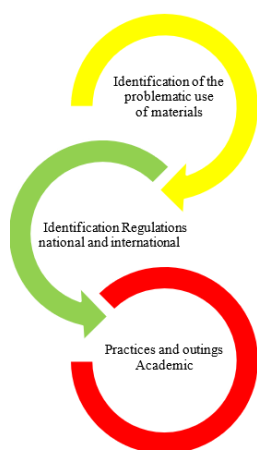
## METHODOLOGY

Context of the Subject of sustainable construction

The subject of sustainable construction is an elective within the civil engineering program which is it offers ninth semester students and is part of the area of applied engineering and the environment. This area provides the identity to the Civil Engineer of the Universidad Francisco de Paula Santander Ocana sectional and contributes to the development of skills and social and professional projection.

Stages of project-based integrated learning methodology

The main objective of the subject is to generate the appropriation of knowledge related to the sustainable construction, which allows to articulate the construction ancestral the technique and the normativity including its costs and its applicability in the field of civil engineering, which is taught from the constructivist approach and applied research of experimental type. The stages that were used note in Figure 1



**Figure 1.** Stages of Learning

Diagnosis for the identification of the problem in the subject of sustainable construction

In the current context of construction and engineering this signature gives fruit of research with quantitative approach of experimental type which allows the transmission of technical knowledge and theory, generating spaces for innovation and creation of new materials, new processes or constructive systems that allow to respond to the needs of the most vulnerable communities of our environment.

In the course of the year 2020 this signature with the support of the high management passes the necessary requisites for the registrant of the superintendency of industry and commerce of Colombia the first patent of the University Francisco de Paula Santander sectional Ocaña as shown in the figure 2, which allows a research advance that will contribute to science and especially to the application of the sustainable construction in the territory of Ocaña Norte de Santander.

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Datos de la solicitud

Referencia del solicitante	P2020/000212	Fecha de radicación	30 oct. 2020
Número de patente	NC2020/0013757		
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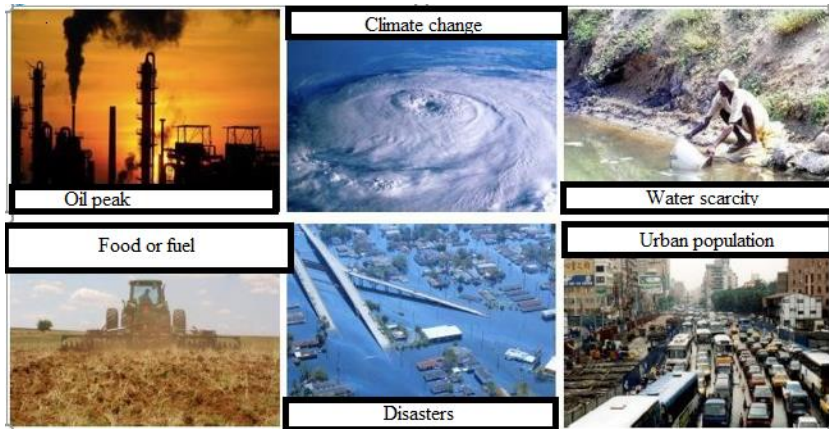
Apuerado	Número de identificación	Nombre(s)	Apellido(s)	Dirección (es)
	79782747	CARLOS REINALDO	OLARTE GARCIA	Dirección Física : Carrera 5 N° 34-03 BOGOTÁ D.C. (CO)

Solicitante(s)	Número de identificación	Nombre(s)	Apellido(s)	Dirección (es)
	800163130	UNIVERSIDAD FRANCISCO DE PAULA	SANTANDER OCAÑA	Dirección Física : Via Acolsure, Sede Algodonal OCAÑA NORTE DE SANTANDER 546552 (CO)

**Figure 2.** Registration of patent application for sustainable material applied to engineering.

### Planning and organization

Throughout the semester different aspects of sustainable construction are touched on, which allows to know the various constructive systems that have been implemented with the passage of time, and it is done emphasis on sustainability and its great impact on civil engineering as shown in Figure 3, which allows to see the changes that the planet earth has had in environmental aspects observed since the execution of civil works since construction through the transformation of materials and materials processes generating infrastructure works in order to meet the basic needs of man, through roads, housing, bridges, airports among others and with this we see the increase in environmental damage which has been generate in recent times.



**Figure 3.** Evidence of environmental damage on planet earth

It is so that the student having clarity of the current problem investigates in front of the possible causes

and alternatives of how to mitigate and contribute to the progressive improvement of decrease of these phenomena that have been caused by man in his pursuit of development and consumption, so the impacts are negative consequence of the various natural disasters resulting from the determined progressivism of the society, this allows the student to have a critical and analytical thought in the face of current needs and especially in the face of the development of his profession as a civil engineer.

After seeing the real and global context of what is happening, practical activities arise and innovative that allow the approach with ancestral techniques and especially with methodologies that contributed to science and applied from the current regulations according to the material or the process constructive. as shown in Figure 4.



**Figure 4.** Ancestral techniques of wall, bahareque and compressed earth block.

#### Execution of the Project

For this stage the student must already have clarity of the technique or process that he wants to deepen and in permanent communication with experts of the subject according to the type

prototypes are developed at scale small that allows satisfactory results that contribute according to the technical and regulatory current aspects. as shown in Figure 5.



**Figure 5.** Deepening of case study

### Evaluation

For the evaluative stage of the course of sustainable construction, practical workshops are carried out applying the educative theory of learning finance and giving continuous with the methodology constructivists, what allow innovative and highly research and social projection, in the same way with this interlace methodology the research processes where the student is supported in the research formative and learning based on real sustainable response projects. as shown in Figure 6.



**Figure 6.** practices of ancestral construction processes such as the wall

## RESULTS AND DISCUSSIONS

As a result, each student delivers a tangible product that solves a real problem, where different construction techniques that contribute to sustainability and innovation agree of the materials applied in the construction of different infrastructures and likewise to the science and the technology as seen in figure 7:



**Figure 7.** Waste products with sustainable applications in the construction of any civil works.

Nowadays, due to the difficulty of the presence due to pandemic, it became necessary and fundamental the process of connectivity and the use of ICT allowed the interaction of knowledge to be given by means of institutional videos that were recorded in the facilities of the University Francisco de Paula Santander sectional Ocaña as seen in Figure 8, which allowed to generate content of academics based on sustainable construction processes with the combination of different methods and with the remote accompaniment of experts in each area of knowledge.



**Figure 8.** Recordings of sustainable processes with recycled concrete.

## CONCLUSIONS

This article shows the importance of constructivist theory and applied research since by project-based learning means responds to the needs that arise in each community, that's why the Civil

Engineering Career is committed to sustainability and innovation from the classrooms, since it allows the student to potentiate their knowledge and skills, which responds to the needs of today's society where a greater commitment to the environment that we inhabit and especially with the external communities that see in the academy the inclusion the innovation and sustainability of the territories.

So, it is shown that the resulted are positive since it awakens in the student a greater awareness of the impacts that are generated with the construction and motivates the student to work collaborative and interdisciplinary permit a planning and articulation from the Practical with theory.

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