

## Participatory science communication for transformation in Colombia

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### Abstract

This essay approaches the question: *What does participatory science communication for transformation mean in Colombia?* The answer comes from an examination of the public policy instruments that have promoted participatory scientific communication through the concept of social appropriation of science, technology, and innovation (STI). In the gaze of these public policy instruments, it is evident how the social appropriation of STI has been intended as a means of transformation.

### Keywords

Public engagement with science and technology; Science and policy-making; Science centres and museums

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To answer the question about what participatory scientific communication means for transformation in Colombia, we have looked at some aspects of public policy instruments where this concept is relevant. The sources for these answers were the doctoral research on “Practices for Public Communication of Science and Technology in science museums” and the work carried out independently by the authors as consultants in state organizations.

### The concept of appropriation and its relationship with participation in science communication

The state of the art of science communication in Latin America [Massarani, 2018] identifies and highlights the concepts or expressions used in the region to talk about scientific communication. These concepts are Scientific Literacy, Social Appropriation of Science and Technology, Social Appropriation of Knowledge, Public Understanding of Science, Scientific Dissemination, Popularization of Science and Promotion of Scientific Culture; and they can be found in the public policies of Latin American countries in reference to Scientific Communication, the development of Scientific Culture, and, more recently, to Public Communication of Science and Technology.

The report on science education in Latin America from CILAC (Open Forum of Science of Latin America and the Caribbean) [Macedo, 2016] emphasizes the need

for the general public and, especially, children and young people to become a generation with a better degree of scientific culture to face the challenges of climate change or environmental changes. In Latin America this preparation requires an enormous work with the community, and, due to it, scientific communication must relate to actions that allow citizens to receive, understand and appropriate all possible scientific knowledge. Therefore, in Colombia participatory scientific communication has been linked to the concept of Social Appropriation of Science and Technology (SAS&T) in academic work, in research, and in the development of public policy instruments. This concept of SAS&T first appeared in a national document in 2005 [Colciencias, 2005; Colciencias, 2010; Colciencias, 2016; Arboleda Castrillón, 2007; Arboleda Castrillón and Daza-Caicedo, 2016] and has been maintained in subsequent national policy documents, as well as in local research. The document proposed the SAS&T concept as a strategy for encouraging citizens to get interested in the knowledge produced in the country, to validate it and to use it in solving specific problems in their communities [Daza-Caicedo et al., 2017; Colciencias, 2016; Chingaté-Hernández and Molano, 2016].

After the appearance of the SAS&T concept came the Law 1286 of 2009 (Ley 1286 de 2009, known as the Science and Technology Law),<sup>1</sup> which transformed the office in charge of science and technology activities COLCIENCIAS into the Administrative Department of Science, Technology and Innovation, which was in charge of defining the policies, strategies and specific actions related to the generation and transfer of scientific knowledge. The Article 2 of this Law, dedicated to the objectives, includes “Strengthening a culture based on the generation, **appropriation** and dissemination of knowledge and scientific research” (Law 1286/2009, of January 23); while article 7 defines as one of its functions the generation of strategies *for the social appropriation* of science, technology, and innovation.

During 2016, Decree 849 modified the structure of this Administrative Department and created a unit in charge of the development of “Mentality and Culture for Science, Technology and Innovation” (called in Spanish: Unidad para la mentalidad y cultura para la ciencia, la tecnología y la innovación, as it’s literally translated). The functions of this unit include the public communication of science through the generation of social mobilization and communication processes that can promote the appropriation of science, citizen participation and scientific culture. In 2018, Resolution 674 updated the Policy on Science, Technology, and Innovation for Sustainable Development with the Green Book [Colciencias, 2018]. This policy document introduces the transformative policy approach and sustainable development goals. The document proffers participation as one of its objectives and principles, defining it as the dialogue between all actors involved in the generation, use, access, and innovation of knowledge.

Finally, Law 1951 of 2019 (Ley 1951 de 2019)<sup>2</sup> creates the Ministry of Science, Technology and Innovation, scheduling its operation for the year 2020 and

<sup>1</sup>Ley 1286 de 2009. Por la cual se modifica la Ley 29 de 1990, se transforma a Colciencias en Departamento Administrativo, se fortalece el Sistema Nacional de Ciencia, Tecnología e Innovación en Colombia y se dictan otras disposiciones. 23 de enero de 2009.

<sup>2</sup>Ley 1951 de 2019. Por la cual crea el Ministerio de Ciencia, Tecnología e Innovación, se fortalece el sistema nacional de ciencia, tecnología e innovación y se dictan otras disposiciones. 24 de enero de 2019.

ratifying previous advances related to communication and scientific culture. The section on general objectives of Article 2 proposes to “Establish transfer strategies and Social appropriation of Science, Technology, Innovation and Entrepreneurship for the consolidation of a Knowledge-based Society” [p. 1]. And, in the section of general objectives of Art.2, it indicates to “Strengthen a culture based on the generation, appropriation and dissemination of knowledge and scientific research, technological development, innovation and lifelong learning” [p. 2].

Arboleda Castrillón and Daza-Caicedo [2016], Avellaneda [2016], Pérez-Bustos et al. [2012] and Hermelin [2018], Colombian researchers who have reviewed the initiatives of social appropriation of science and technology in Colombia, point out that the initiatives of social appropriation have been created, executed and led by the state with the participation of the universities and, since 2013, strategies that directly involve the community have also been included.

Falla et al. [2015] consider that SAS&T practices are mediation processes in which all actors would have the same possibility of participation and where production and reception of content is mediated by culture. Arboleda Castrillón and Daza-Caicedo [2016] describe part of the evolution of the SAS&T in Colombia between 2007 and 2016 by looking at the activities that seek to communicate, share, transfer and exchange knowledge and information about SAS&T. They show the coexistence of the concepts of science communication and social appropriation of science, and the challenges it brings up for communication.

Daza-Caicedo et al. [2017] affirm that the progress of the implementation of the SAS&T National Strategy in 2010 is especially visible in the interaction of the actors. They highlight that the science, technology, and society communication line of the strategy has made evident the need for the participation of more researchers in the area, not only to develop theoretical reflections, but also to support the communicative actions of the strategy. They also emphasize the need to deal in more detail with the components of the communication actions of the national strategies. They refer to the targeted actors, channels, intentions, characteristics of the audiences and, in general, to the communication strategies that may be more pertinent according to the needs of the communities and the scientific production of the country.

Avellaneda [2016] focuses on the importance of dialogue between actors related to SAS&T in institutional settings that can legitimize knowledge and work at the border between science and society, including museums and science centers. The study written by Daza-Caicedo et al. [2017] evidences the need to formulate indicators that allow establishing a measurement of the impact of SAS&T practices, and proposes the development of initial qualitative indicators that consider: interest and learning in science and technology, the inclusion of groups in vulnerable situations, the exchange and co-production of knowledge, the incentive for scientific vocations, informed decision-making, and the development of capacities for SAS&T.

**The policy of social appropriation of knowledge as a mechanism for the transformation of communities and other government initiatives**

One of the milestones of appropriation as a mechanism for participation and transformation is the publication of the National Strategy for Social Appropriation of Science, Technology and Innovation, carried out by the Administrative Department of Science, Technology and Innovation — COLCIENCIAS in the year 2010 [Colciencias, 2010]. This document presents the state's view on communication and appropriation of science and the potential it has for social transformation. This national strategy had a direct impact on both public investment and the practices of the actors of the country's National Science, Technology and Innovation System.

COLCIENCIAS proposed the following definition for the Social Appropriation of science, technology, and innovation: "process of understanding and intervention of the relations between technoscience and society, built from the active participation of the various social groups that generate knowledge" [Colciencias, 2010]. The participatory component is identified as the driving force behind the strategy for the design of interventions and public financing. The Strategy for the Social Appropriation of Science, Technology and Innovation was structured in four lines of action as follows:

- Citizen participation in public policies of science, technology, and innovation
- Communication with a focus on the relationships between science, technology, and society
- Exchange and transfer of knowledge
- Knowledge management for the social appropriation of science, technology, and innovation

These lines point out transversal components which are related to a critical and reflective approach about science; the interaction between science experts and other actors outside of scientific practice promotes collaborative work to foster the relationship between scientific knowledge and other forms of social knowledge (knowledge developed by farmer communities, for example coffee growers). The implementation of the Strategy during 2010–2020 was led by COLCIENCIAS as a national government actor. Resulting from the implementation of this strategy, programs and projects were designed to facilitate participatory communication of science, thus overcoming existing models of one-way communication. Examples of this new approach are *Ideas for Change*, *A Ciencia Cierta* (To Certain Science) and *Todo es Ciencia* (Everything is Science).

In particular, the *Ideas for Change* [MinCiencias, 2021b] program was developed under the line of Knowledge Exchange and Transfer and evolved to be one of the programs with the highest effect on generating transformations in communities in conditions of vulnerability. Official documents describe the program with the following objective: "to promote experimental and focused spaces for the social appropriation of Science and Technology, based on challenges and problems that are addressed through collaborative work between experts in science, technology, and innovation, and communities or grassroots organizations, for the generation of innovative solutions based on scientific-technological knowledge, with the capacity to transform and improve the quality of life of citizens" [MinCiencias, 2021b].

Currently ongoing, the program has addressed issues such as access to drinking water, renewable energy, peace, and climate change, among others. It has received recognition from the OECD and the Inter-American Development Bank for its innovative methodologies in the process of participation and transformation of conditions, where the scientific communication, social appropriation of science's strategies and local knowledge exchange are key instruments to foster community empowerment and design solutions where needed.

The differential factor of *Ideas for Change* is challenging researchers and scientists to work as a team with community organizations to solve local problems, through building a relationship that is based on collective well-being. In this scheme, relationships are based on respect between peers; academic titles do not grant authority but trust. Implementation of this program resulted, among others, in plans for the recovery and sustainable use of ecosystems, energy systems with renewable sources, sustainable local production processes. All of these were collaboratively designed and not only solved a specific problem in the community, but also led to a resignification of scientific knowledge and empowerment of the local people who recognize themselves as managers of their own development.

The *A Ciencia Cierta* [MinCiencias, 2021a] program starts from a community experience; that means, from a process that has been developed within the same community to solve a problem from a resilient perspective. When the project is advanced, a volunteer scientist joins to collaborate and contribute to the process with scientific knowledge. MinCiencias describes it as follows: "Program for the social appropriation of knowledge, which identifies, makes visible, recognizes and strengthens experiences developed by community organizations on issues of Science, Technology and Innovation, which provides a solution to a specific problem and that can be shared with other Colombians for the benefit of their social groups, based on citizen participation and dialogue of knowledge" [MinCiencias, 2021a].

In this case, the communication of the scientist is a key point. The scientist participates in the process by invitation, as a guide who works voluntarily and contributes to the progress of the community. The program, under the figure of scientific volunteering, seeks to establish closer and emotional relationships that can last over time as direct scientific communication relationships which contribute to social transformation. *A Ciencia Cierta* has managed, within its experimental process, to strengthen more than sixty community organizations and impact 20,000 people. In terms of scientific volunteering, approximately 200 scientists have been tutors of these community organizations.

There are several projects of these two programs which have become study cases. As an example of this, and out from the *Ideas for Change* program, there is the case of the construction of an eco-touristic path for the sustainable harnessing of mangrove and the dry tropical forest in Isla Grande (Bolívar), with the participation of the Afro Colombian Community Council of Islas del Rosario who worked together with the Cartagena University' Group of Medicines Chemistry Investigation. From the *A Ciencia Cierta* program, there is the experience of the Community Organization APISRED (beekeeping net), which produces and processes bees' honey, which strengthened its productive process and integrated other community organizations in the scaling of the production through the social appropriation of scientific knowledge.

*Todo es Ciencia* is the transmedia strategy of the Ministry of Science that is responsible for mass scientific communication aimed at the public to transform their perception and relationship with science. This strategy generates multiplatform content for various audiences, involving television programs, documentaries, capsules, podcasts, and face-to-face interventions, which circulate through analog and digital channels. Unlike the other programs, *Todo es Ciencia* seeks to present science as an opportunity to rethink things and, with the purpose of reaching large audiences, the strategy relies on the narrative of the everyday life so that people can easily identify with the content being communicated.

The most relevant milestone in this sequence is the publication of the National Policy for the Social Appropriation of Knowledge [MinCiencias, 2021c] with a defined scope until 2030. With this policy, the government hopes to achieve a higher level of impact and transformation in the most vulnerable communities, as well as approach concepts such as transformative innovation, open science, and citizen science. Although this document could be interpreted as an evolved version of the National Strategy for SAS&T of 2010, some differential factors can be identified such as:

- a. The objective is that the processes go beyond consultation or dialogue to impact transformation processes of local contexts to address global problems.
- b. The identification of building trust as a fundamental element in the relationships that mediate communication and appropriation of science, leading to the discussion of ethics within participatory processes in science.
- c. A wider view of the territory, which provides a broadening panorama of the actors that interact there, and the need to interpret the context in addressing problems that may give the opportunity to appropriate knowledge to transform.

The challenge for this policy lies in the ability of the recently created Ministry of Science to assign the financial resources to implement the new policy to bring together scientific and non-scientific actors in permanent dialogue, and to direct communication science to generate changes that can improve welfare conditions and, when needed, transform the relationship between actors.

On the other hand, the development of different public policy instruments has given a guideline to science, technology, and innovation actors to transform their practices, and open spaces for the participation of citizens as subjects who carry knowledge, with the ability to decide and influence scientific practice, to make science an instrument for solving real problems. In this sense, we find points of intersection with the conceptual views of social innovation or citizen science with an important level of maturity in Colombia.



**Science centers as teachers of participation and social transformation from the communication of science**

The relevance of science centers in scientific communication in Colombia is recent. The SAS&T National Strategy [Colciencias, 2010] reported that 69% of the actions for scientific communication between 1995 and 2004 were carried out in science centers [Colciencias, 2010] but it took almost two decades to be relevant to science communication policy. The National Policy of Actors of the National System of Science and Technology was promoted in 2016 declaring science centers as organizations that facilitate the use and appropriation of science, technology, and innovation in the community [Colciencias, 2016].

Authors such as Bandelli and Konijn [2013] and Bandelli and Konijn [2021], Barriault [2016]; and Bruyas and Riccio [2013] have studied the trajectory of science centers as platforms to promote sustainable science, technology, and innovation. Bandelli and Konijn [2021] highlights that their nature is the direct contact and intervention within the community, with very wide ranges of impact based on the number of visitors and the ways of intervention outside the museum and through its digital developments. In Colombia, science centers have addressed very specific objectives in the national strategy to communicate science to citizens; they develop methodologies with scientific, museological, educational and communicative practices, and are translators and mediators of science in society. The National Policy for Actors defines science centers as "Institutions of a public, private or mixed nature, non-profit, with legal recognition, with a physical plant permanently open to the public and that have SAS&T at the core of their mission or corporate purpose" [Colciencias, 2016, p. 19]. Science centers must recognize the cultural, economic, and social diversity of the communities, promote the principles of democratic access to information and knowledge, and contribute to strengthening the scientific culture in the country through educational programs and activities.

The policy considers the following types of science centers: Biospaces such as aquariums, botanical gardens, and zoos; Spaces for exact, physical, social and technological sciences such as Science and Technology Museums, Exact Science Museums, Planetariums and Observatories; Citizen construction spaces in Science, Technology and Innovation: such as Maker Spaces, Citizen Workshops; and Mixed spaces such as Interactive Centers, Natural History Museums, Theme Parks. Some of these are Maloka, located in Bogotá (founded in 1998); the Imagenia Interactive Center, located in Barranquilla (founded in 2000); the Interactive Museum of Science and Games — SAMOGA, of the National University of Colombia (founded in 2001); the Museum of Marine Natural History of Colombia INVEMAR, located in Santa Marta (founded in 2001); the Abrakadabra Museum of the Valle del Cauca Departmental Library, located in Cali (founded in 2002); and the Parque Explora, located in Medellín (founded in 2008), which has established itself as the most recognized interactive science museum in the country and the region, and has acted as a model in the design and development of strategies for scientific communication and social appropriation of knowledge.

The policy recognizes other actors of the national science and technology system such as research centers, technological development centers, R&D units, research results transfer offices, and science, technology and innovation parks, all of them with a very relevant component of scientific communication in their mission and objectives [Colciencias, 2016]. Since the policy promotes the creation of these types of "actors" at the national level, local capacities related to scientific communication and participatory work with communities have increased. Following the principles

of total museology and social museology [Wagensberg, 2001; Wagensberg, 2005; Castellanos Pineda, 2008], science centers have increasingly included spaces for dialogue, collaboration, and co-creation with the community. Science centers such as Parque Explora in Medellín or Maloka in Bogotá develop diverse scientific communication activities where different actors from the community are involved, such as scientists, educators, mediators, students of primary and secondary education, parents, and vulnerable populations.

As the first result of this public policy instrument, science centers have become relevant national actors in the planning and development of projects for citizen participation in science, exchange of knowledge between communities, and support in other projects related to scientific communication. Science centers present a continuous scenario where the public can advance between accessing science, dialoguing with science, and even participating in its creation together with other citizens who may or may not be scientists. This type of neutral scenario has allowed the development of the social dimension of scientific communication, not only in the sense of responsibility with those who have less possibilities of access to scientific culture, but also in the sense of generating a scientific communication that is fun and able to interest everyone.

As a second result, it has been mentioned before that the capacities for scientific communication have increased in science centers and, therefore, also in other spaces. Previously, the development of research on scientific communication and social appropriation of science and technology allowed the consolidation of a large group of national researchers. The work of science centers and the development of projects for new science centers has allowed increased the number of professionals from various disciplines working in scientific communication and social appropriation of knowledge. The science centers have developed, among others, their content, education, mediation, and innovation departments, leading social appropriation projects with an impact on national communities.

As a third result, the movement of science centers have contributed to the development of other spaces for scientific communication, the social appropriation of knowledge, and the participation of citizens. Libraries, community centers, art museums and other spaces such as houses of culture have begun to develop specific programs dedicated to the communication of science and the appropriation and participation of the community in activities related to science. Some of these programs have even begun to build maker or collaborative creation spaces that invite the public to participate. These initiatives are recent, so they still do not have reports that can account for the impact in the country, but they will surely later be the object of study and measurements on national scientific communication in cultural spaces.



**The new mechanisms and actors for the transformation of communities with the communication of science**

In 2012, the article 361 of the Political Constitution of Colombia and Law 1530 (Ley 1530 de 2012)<sup>3</sup> were modified to allocate 10% of the country's total royalties to investment in science and technology. The royalties come from the payment made by multinational mining and oil companies to Colombia for the exploitation of natural resources. This change in public investment in Science, Technology and Innovation in Colombia made it possible to design and implement macro-projects with direct impact on the territory. The Social Appropriation of Science and, therefore, scientific communication, have been one of the priority actions with the aim of generating social transformations from the communication and implementation of science in the territories. In October 2015, COLCIENCIAS published the Sector Guide for Science, Technology and Innovation projects, a document that categorizes the sector and provides a reference on the type of programs and projects which can be financed with resources from royalties. The document dedicated a chapter to SAS&T, giving greater scope to the participatory approach and the creation and strengthening of Science Centers.

According to the Observatorio Colombiano de Ciencia y Tecnología OCyT [2020], the General Royalties System has invested \$ 676,867,092,891 COP (approximately US \$ 180,000,000) between 2012 and 2018 in projects of SAS&T. An important amount without precedent in Colombia, regarding the investment of public resources that consider the importance of communication and the appropriation of science to solve territorial and national problems. Subsequently, Law 2056 of 2020 (Ley 2056 de 2020)<sup>4</sup> modified the operation of the General Royalties System, updating the process to access royalty resources. With this new Law, territorial governments can establish alliances or consortia with public or private organizations in the educational, productive or citizen sectors. This strategy was designed to structure and manage public, open, and competitive calls for the definition of eligible investment projects in science, technology, and innovation, generating changes in the actors involved in these projects and, consequently, changes in the actors related to the scientific communication and the social appropriation of knowledge.

The change in the legal framework of the system opened an opportunity for the intervention of various types of actors in the development of megaprojects of scientific communication and social appropriation of knowledge. The new projects involve at least three levels of actors linked to scientific communication and the social appropriation of knowledge. Decision makers, responsible for formulating territorial strategies, and leaders of projects related to scientific communication are at the first level. Managers, developers of content and format, communicators, and producers of strategies and specific activities related to scientific communication can be found at the second level. The third level is for those who have direct contact with the community such as technical experts, scientific communicators, educators, and mediators.

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<sup>3</sup>Ley 1530 de 2012. Por la cual se regula la organización y el funcionamiento del Sistema General de Regalías. 17 de mayo de 2012.

<sup>4</sup>Ley 2056 de 2020. Por la cual se regula la organización y el funcionamiento del Sistema General de Regalías. 30 de septiembre de 2020.

To conclude, the evolution of public policy instruments and strategies with colombian communities have shown the importance of developing a participatory science communication that allows transformation. At the same time, participatory science communication requires the development of specific capacities that allow improving the relationship between citizens and science.

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