Chapter 225

Public communication of brazilian aerospace science

https://doi.org/ 10.56238/devopinterscie-225

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ABSTRACT
This article analyzes the public communication of aerospace science, and the problem of its definition. Such an approach is necessary considering that the concept of public communication of science is broad and has different meanings, depending on the context, the author, and the country that uses it. The purpose of this work was to insert the public communication of science in the conception that information is a right of citizenship. Methodologically, the research was carried out from a bibliography, from a perspective of integrative review. The analysis proved that the use in South and Central America, as well as in the USA, of the expression "public communication" is a consensus, meaning an information process focused on the public sphere. There was an understanding that this type of communication acts as a link of interaction and transmission of scientific knowledge for the understanding of the public, enabling participation, awareness, citizenship, and dialogue. And this particular type of communication, especially post-pandemic, appears in different ways and different vehicles, whether in print media, electronic media, social networks, research centers, and even museums, which constitute ways of communicating science.

Keywords: Science and society, Media and science, Public communication, Scientific communication.

1 INTRODUCTION

The communication of the achievements of science for a long time, particularly since the end of the nineteenth century, disseminated by scientists themselves, among their peers, and in scientific articles, correspondence, etc. At the beginning of the twentieth century, there was also communication to the general or specialized press, but it was rarely efficient for the lay public since the subjects treated or disseminated often prioritized the far-fetched, scientific language of science. There was also no concern to inform society about the benefits provided by science because it was an intramural communication. Regarding media coverage for science, Massarani and Rocha write:

> "The coverage of science by the media in Brazil began in the nineteenth century, with the arrival of the Portuguese Court, when the ban on printing in our country was suspended (MASSARANI; Moreira, 2016). The first newspapers, such as A Gazeta do Rio de Janeiro and O Patriota, published texts on the subject of science (OLIVEIRA, 1999). Over time, this communication expanded and other media such as radio, television, and the Internet gained importance as tools to communicate science to the general public." (Massarani & Rocha, 2018, p.2).

Over the years and with the increasing access of society to the most diverse means of communication and, consequently, to information, this scenario has been changing, as professionals specialized in disseminating science have emerged, as the executive editor of Ciência Hoje magazine, Ivanissevich (2009), writes, "Despite the difficulties that all professionals involved in scientific dissemination face in a country with the dimensions and cultural diversity of Brazil, I think a lot has been done in the last few decades." The importance of Science and Technology in today's society and the public interest in scientific discoveries have highlighted scientific public communication, which performs the function of disseminating information, but also of being accountable to public opinion.

To the extent that science delves even deeper into social fabrics, according to Manso (2015, p. 6), including social and human forms of organization and production, CPC also moves towards the centrality of social structures.

> "Knowledge about the field of technoscience, its productive processes, its implications for the expansion of knowledge and in the daily life of social life, its importance for the configuration of current life and the constitution of projects in outline becomes decisive. Thus, as an environment of open science conducive to mediations, debates, and interactions between different social groups, ideas, and types of knowledge (including diversification of common knowledge), CPC is pertinent to the attempt to understand this intersection of social and academic life in the present historical period, in which it is possible to observe the repositioning of fields and social interagents in the face of the intense informational flows in the most diverse networks. The very notion of citizenship, in the sense of his condition as an active social actor in social and scientific processes, is in constant formation."

2 METHOD

Technological research in Brazil is largely carried out in public and private universities, as well as research institutes, many of them even of international weight. We mention among these some notable, such as the Oswaldo Cruz Institute - IOC, Butantan Institute - IB, the Department of Aerospace Science and Technology - DCTA, the Brazilian Agricultural Research Corporation - EMBRAPA, National Institute of Research E - INPE, Institute of Technological Research-IPT, among others, whose resources used in research generate results and benefits for society as a whole. It is in this way that we intend this article to deepen the discussion on the theme of public communication of science, which involves the media, culture, and society as a whole.

For the preparation of this article used in addition to books and articles published on the field, also theses and dissertations, and other information that helped us to answer the central question of the work, that is, the public communication of science and the possibility of research results reach the general public, from mass communication, especially today with social media. The case study is characterized as a form

of research in the face of individual phenomena, in this "case" it was extremely important to access information about research and aerospace scientific reality, in which we had great success. The case study is a research strategy that comprises a method that covers specific approaches to data collection and analysis and we use exploratory and descriptive case studies, seeking to encompass different theoretical views on the field and the object, which were fundamental to guide our discussions. Thus, still on the method, it was developed within a theoretical framework, according to the instruments and procedures that were adopted, seeking to compare different sources of information acquired about public communication and how the process takes place in an Aerospace Science Center. As a result of the research it was found how important it is to analyze the communication process of the Center and the lack that exists of these results to reach the lay public, which does not mean that this public has no interest, on the contrary, the research showed that there is an increasingly sensitive public and seeking scientific information, especially in a world society after the coronavirus pandemic.

3 DEPARTMENT OF AEROSPACE SCIENCE

The fields of science and technology in Brazil have achieved in recent decades a prominent position in the international scenario, and one of the examples of a Reference Center in research is located in the region of Vale do Paraíba Paulista which, created at the end of the 1940s, gave rise to one of the largest aviation companies in the world and which, over the past few decades it has gained recognition from the scientific community. It is currently considered one of the most important teaching, research and development centers of the aerospace sector in Latin America (Medeiros and Perilo, 1990). In this way, the Department of Aerospace Science is responsible for achieving the objectives of the national aerospace policy for the science, technology and industry sectors, and contributes to the formation and conduct of the National Policy for the Development of Space Activities. The DCTA and its subordinate institutes make up the Brazilian aerospace scientific-technological complex.

Considered one of the essential elements (institutes) in the development of the complex, the DCTA has, in the teaching area, the Technological Institute of Aeronautics - ITA, created in 1950, to train specialized labor. ITA, an engineering school of excellence, trains highly qualified professionals at the undergraduate and graduate levels and promotes, through education, teaching, research and extension, the progress of science and technology in the aerospace field. A project developed by the Institute is that of the world's jute fiber car, designed and built by students of the ITA-Technological Institute of Aeronautics, from 1987 to 1994, under the guidance of Professor Dr. Hazim Aliqureshi. Due to the decrease in weight provided by jute about the metal, fuel consumption decreases by about 15%. The funds for the project – about US$1,500 – were donated by the Institute for the Promotion of the Production of Vegetable Fibers in the Amazon. The name given to the vehicle is a tribute to the former student of ITA, Marcos Poubel, who died in an automobile accident with a Passat 79, donated by his family and used in the project.

Jute fiber car - Poubel

Figure 1: World's First Jute Fiber Car

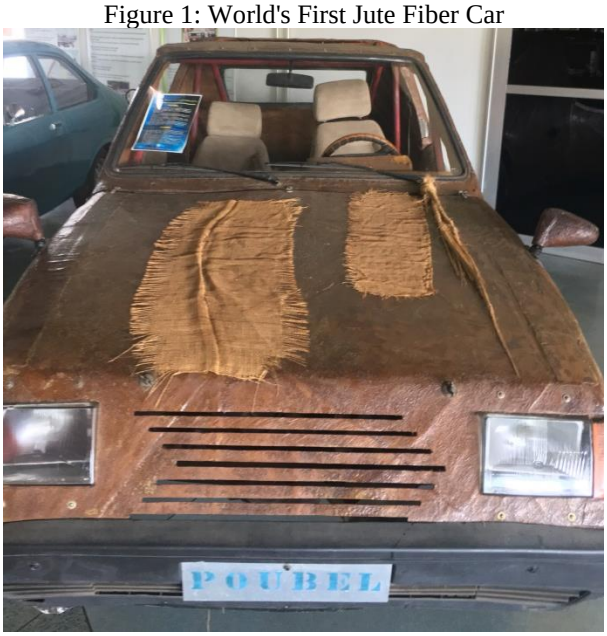

Photo: Fabíola Lêdo, 10/15/2022

In research and development, DCTA relies on the Institute of Aeronautics and Space-IAE. The institute emerged from the merger, in 1991, of the Institute for Research and Development (IPD) and the Institute for Space Activities (IAE), with the mission of conducting research and development in the aerospace area. The Institute of Aeronautics and Space actively participates in the Brazilian Space Program and is responsible for the development of the Satellite Launch Vehicle (VLS), the Microsatellite Launch Vehicle (VLM) and Sounding Vehicles.

At the Institute of Advanced Studies – IEAv, research is developed in several areas of pure and applied sciences, at the frontier of knowledge. One of these projects, which incidentally today is the subject of great controversy, due to the current president of the republic questioning it, but has passed all the tests of fairness of election counting, is the Electronic Voting Machine project. This project was started in 1995 and was conceived and executed by a team composed of technicians from the Superior Electoral Court and representatives of the Ministries of Science and Technology, Communications, Navy, Army and Air Force, Public Prosecutor's Office, Attorney General of the Union and the Superior Court of Justice. In the 1996 Municipal Elections, the Electronic Voting Machine was used in 57 Brazilian municipalities, covering about 33 million voters. In 1998, in the General Elections, this scope was extended to 537 municipalities and 61 million voters, reaching 100% of the 5559 Brazilian municipalities, and reaching a total of 110 million voters in 2000. From then on, this scope was maintained, that is, in all Brazilian municipalities.

Aeronautics was represented by the Institute of Advanced Studies – IEAV-CTA, with the participation of Prof. Dr. Catsumi Imamura. Incredibly, today there is no remembrance or knowledge of any of this by society.

Electronic voting machine

Figure 2: Electronic Urn 1995

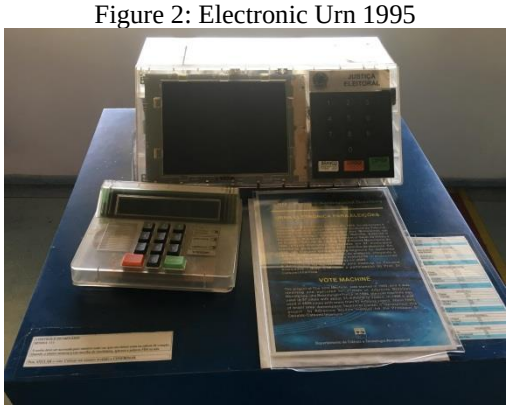

Photo: Fabíola Lêdo, 10/15/2022

The Institute of Industrial Development and Coordination – IFI provides services in the areas of certification, intellectual property, technology transfer, and industrial coordination. It is recognized by the International Accreditation Forum (IAF) as a certification body for quality management systems and as a certification body for aerospace quality management systems.

4 PUBLIC COMMUNICATION OF SCIENCE AND THE BRAZILIAN AEROSPACE MEMORIAL-MAB

To record the history of activities, research, projects, and the level that reaches research and the aerospace industry in the country, it was built, in 2004, the Brazilian Aerospace Memorial – MAB and this Memorial aim to preserve and disseminate the history and memory of the Department of Aerospace Science and Technology - DCTA, former Aerospace Technical Center - CTA and Brazilian aerospace development.

MAB is located next to the airport of São José dos Campos, a municipality in the interior of the state of São Paulo. This municipality is the seat of the Metropolitan Region of Vale do Paraíba and North Coast, located 94 km east of the state capital. It occupies an area of 1100 km², of which 353.9 km² are in the urban perimeter. In 2018, its population was estimated by the IBGE at about 700 thousand inhabitants, being the sixth most populous municipality of São Paulo (São Paulo, Guarulhos, Campinas, São Bernardo do Campo, Santo André, São José dos Campos) and the 26th of the whole country, in addition to the second most populous municipality in the interior of Brazil, behind only Campinas. São José dos Campos discovers its vocation for the area of technology in the second half of the twentieth century, with the development of the industry. The process of industrialization of the municipality is boosted by the installation of the Technological Institute of Aeronautics (ITA) and the Aerospace Technical Center (CTA) in 1950.

Created in 2004, in a complex of 10 thousand square meters, to propagate the results of aerospace research studies, of strategic importance for the country, and also of awakening new vocations for science and technology, especially for aeronautical engineering, MAB is considered one of the most important references on the subject in Latin America, being the most complete Brazilian memory preservation space in this area in Brazil. MAB brings together a collection of more than one hundred historical pieces, models,

and aircraft of national manufacture and rockets of the Brazilian Space Program, with models of the planes Bandeirantes, AMX, Brasília, CBA, Tucano, and the model of Convertiplano plane. Also on display are experimental aircraft and relevant projects, such as the Beija-Flor, the first rigid-rotor helicopter for two people, designed and built in Brazil in addition to the 2nd prototype of the Bandeirante airplane.

Below is the *Heliconair*, known as "Convertiplano", which was the first aeronautical project of the DCTA, began in 1951 and ended in 1956, and was conceived and conducted by the team led by Professor Henrich Focke. The "Convertiplano" was an aircraft capable of taking off vertically, as if it were a helicopter, and moving forward up to 500 km/h, as if it were a propeller plane. Its fuselage was designed and built by DCTA. The project envisaged using the *Double-Mamba* turboshaft engine, of power 3260 HP and approximate weight of 200 kg. The engine was not made available by the English manufacturer, so it was decided to use a Wright piston engine of 2200 Hp, much bulkier than the turboshaft. The Flight Controls are designed to act as cyclic and collective, in helicopter mode, and as a stick and conventional pedal, in airplane mode. The "Convertiplano" became unfeasible because the resulting payload (pilot, fuel and load) becomes less than 300 Kg.

Covertiplane

Figure 3: Convertiplano

Photo: Fabíola Lêdo, 10/15/2022

According to Sousa (2003), one of how it is intended work public communication of science is the science museums, fostering among their attendees the bases of science, knowledge of culture and scientific training and its applications. For the author, science museums are places where public communication of science occurs, hence their importance. He also writes that the message that is conveyed to the public in museums should be clean, clear, scientifically correct and, as far as possible, concise and understandable.

> "[...] a good public communication of science is all the more effective the more it arouses this motivation in a generalized way, for which the means which seek to carry it out use various methods to arouse the attention and interest of those to whom it is directed." (Souza, 2003, p. 7-9).

Concise knowledge and understanding of the basis of aerospace science and technology must constitute a rational way of thinking and acting essential for an authentic democracy. The public communication of science causes the dissemination of information of public interest, leading the lay public

to exercise their right to receive this information and enabling the participation of the debate in the public sphere.

Some countries, according to Brandão (2009), identify public communication as organizational communication, which perceives and treats communication from a strategic and planned perspective, to promote relations with different types of public and build an identity and institutional representation.

> "With this sense, public communication has as its first objective the market, aiming to reach the various audiences of corporations to sell - whether an image, a product, an idea, or a faith - and obtain financial, personal, status or power profit. For this, it will use the entire arsenal of instruments and technologies of mass, group, and interpersonal communication, complemented with various research techniques (public opinion, market, organizational climate, etc.), as well as the entire set of knowledge and techniques of the areas of marketing and organizational communication." (BRANDÃO, 2009, p.02)

It is a consensus in South and Central America, as well as in the USA, the term "public communication" means an information process aimed at the public sphere. Among the Latin Americans, the Colombian Juan Camilo Jaramillo Lópes (2003, 2005, 2010a, 2010b; Lópes *et al*., 2004), but the systematized bibliographies on public communication are by French and Italian authors. The Frenchman Pierre Zémor published, in 1995, the main reference in the studies of public communication as information for the construction of citizenship. In Brazil, in the academic area, the abstract of *the book La Communication Publique* (1995), translated by Elizabeth Pazito Brandão, is the main bibliographic reference on the subject, a milestone in the conception of public communication, because in the country the concept is recent and the bibliography on this subject is scarce.

In the Italian view of public communication of science, the range of authors who are dedicated to research in the field of public communication is vast. Thus, seeking to insert public communication amid the modern theory of democracy, Paolo Mancini (2008) defines the current concept of public communication in complex societies, with the conception of information being a right of citizenship. For Mancini (2008), public institutions are all those that, directly, depending on the State. Semi-public institutions are those that organize their participation in the state, sometimes financed with public money, for example, trade union organizations. The strictly private ones, on the other hand, represent the free action of citizens, not necessarily linked to the field of intervention of the State. Mancini (2008, p. IX) understands by advertising the property of institutions is open, providing information and being accessible to the interest of the public. The concept of public communication of current science considers that advertising can no longer be ensured only by journalistic information since it has as a precondition democracy and advertising in a broader sense.

In the USA, according to Melo (2003, p. 57), several universities can be cited for presenting courses in the area of "*Public Communication*", following the characteristic of the training in the social communication of Hispanic-American universities, whose model adopted, from the 70s, is that of the "multipurpose communicator". In Brazil, specializations were maintained, "the training of with specialized

unicaritors". With a similar sense, each of the particular and distinct meanings referring to the concept of public communication aims at the market, the various audiences, to sell an image, a product, or an idea, obtaining profit not necessarily financial, but translated into status or power. For this, we seek mass communication tools and research techniques in conjunction with the techniques of the *marketing area*.

5 PUBLIC COMMUNICATION IN BRAZIL

Among the various meanings of the expression public communication of science, in Brazil the meaning concerns "[...] communicative process that is established between the State, the government and society to inform for the construction of citizenship" (BRANDÃO, 2009, p. 6).

Faced with the new political reality of the country, since the government of Fernando Henrique Cardoso in the 1990s, when the process of re-democratization was consolidated, the terminology of public communication is identified as a more democratic practice of scientific communication. With the restoration of democracy that, consequently, leads to new forms of experiences with this characteristic, gradually the Brazilian population realized the need for information to be focused on the construction of citizenship, citizenship that is understood less passively, with participatory tendencies.

With an eye toward the public interest, at the service of the collectivity, the public communication of science prioritizes the relationship between the State and society. In addition, it emphasizes the need for facilitation of access to services and public policies, dissemination, and monitoring of political actions, accountability, and openness to popular participation. This approach is based, as previously mentioned, on two of the five principles of public administration defined by the 1988 Constitution (article 37): the constitutional principle of publicity, that is, "[...] the duty of the State to inform and give transparency to its acts, and there can be no concealment of data of interest to those administered" (Kocouski, 2012, p.13).

This type of communication in Brazil, according to Brandão (2009), made history in advertising, that is, in the dissemination of government actions preferably using advertising with placement in the wide-ranging media. Subsequently, it generates an educational imprint in the areas of health and agriculture. The meaning is perceived since the Fernando Henrique Cardoso government, after the establishment of democracy in the country, when the President began to defend public communication as "[...] an inseparable theme of the functioning of democracy, exercising the role of an instrument of an open and frank relationship between the government and the population" (BRANDÃO, 2009, p. 10).

It is necessary to emphasize that the president's statement about the public communication of science arose when he announced the creation of a Continuous Program for Professional Improvement in Government Communication, that is, the executive branch sought to give visibility to its actions before the population, with the use of radio, at the time of Getúlio Vargas, recalling the civic campaigns, political campaigns, government advertisements (including those produced by the military period and those produced in democratic governments), until they reach the marketing strategies used in recent governments.

According to Brandão (2009, p. 11) communication, in its various forms of presentation, has always been and always will be present among rulers, regardless of party or ideology.

Undoubtedly, the communication of science in the past took place almost exclusively in scientific congresses, articles in specialized journals, and scientific books, which reached a specific audience. On scientific communication in mass media, Cruz writes: (2020, p. 43):

> "At the University of Castilla-La Mancha, in collaboration with the region's public radio, Castilla la Mancha Media, a scientific dissemination project was launched, embodied in a weekly radio program where the research of university researchers is known. The format, lasting half an hour, includes interviews with researchers about their work and the results in society, with a brief introduction that allows the generalist listener to understand the scope and need of the research. On the other hand, the new formats of radio communication, with podcasts hosted on websites, allow the creation of a community of followers on social networks such as Twitter and Facebook. This will allow us to quantify the effect of disclosure beyond traditional audience measurement, anchored in research based on listener memory and very ineffective for highly specialized programs and restricted audiences." (Cruz, 2020, p. 43) [1]

We almost always hear in newsrooms that science doesn't give ibope. I was mistaken because what was most discussed during the coronavirus pandemic was the greatness and importance of science, even if "some chloroquines," out of private interest, publicly exposed that the virus was the flu. But was nothing recorded in the press that touched them about the importance of spreading science? it sure stayed! Moreover, surely the newsrooms of both print media, electronic media, and social media, understand the importance of disseminating research results, disseminating science. Today, there is an increasing number of scientists interviewed in this or that vehicle, in this or that means of communication. Many podcasts deal with the subject, undoubtedly, this was the media sector that produced the most scientific works. Among the many institutions, radio and television stations, individuals, who have produced scientific podcasts, stand out, among others, the works of Labi – Open Laboratory of Interactivity, with the podcasts "Media and Science". On the subject, writes Marandino, Iszlaji y Contier (2015):

> "In our view, the role of scientific dissemination is the democratization of Science, to make it closer to everyone in a dynamic, attractive, interactive and practical way. Thus, the means of scientific dissemination, such as school, radio, television, museums, magazines, newspapers, internet (websites and blogs), among others, deserve special attention to promote improvements in the socialization of scientific knowledge in a critical way for the population. According to Albagli (1996), scientific information to be disseminated needs a translation from a specialized technical language to a laywoman, easy to understand, being a great challenge for the popularization of science. Considering this challenge, research has sought to analyze the characteristics, specificities and functions of texts in the process of socialization of scientific knowledge. Many of these works characterize the texts in three types: scientific, scientific dissemination and didactic, seeking to

[1] Since It University from Castilla-La Stain en collaboración Con It radio public of It regionCastilla It Mancha Media, if Ha puesto (disambiguation) en march un Project from Disclosure scientific plasmat en un radio weekly en El that if Of the conocer It Activity researcher of Them miembros from It university. El formato, Con Una duración of average hour, incluye interviews with researchers about Su work y Them findings en It society, Con una breve introduction that allows al oyente Generalist understand El reach y It need from It Research. By Other part Them nuevos formats of communication en radio, Con hosted podcast en Webs allown crear Una Comunidad of followers en networks Social, such as Twitter and Facebook. Ello (disambiguation) will allow us to cuantificar, next to encuestas Direct, El effective from It Disclosure Bad allá from It traditional measurement from Audience, anclada en encuestas basadas en It Memory Del oyente y muy Poco eficaces for programs muy specialized y hearings Restricted.

> analyze the specificities of each of them and how they are used and understood in different contexts of teaching and dissemination." (Marandino, Iszlaji y Contier, 2015, p. 1).

6 PATHS OF SCIENCE COMMUNICATION: PUBLIC OR SCIENTIFIC

Although the description of the relationship between Scientific Communication and the Public Communication of Science may indicate a certain approximation, since the processes refer to the diffusion of information in science and technology, these dimensions address quite different purposes. The Public Communication of Science performs the function of dissemination of information, accountability and, in the perspective of the processes of sharing decisions on the management of public affairs, tools to encourage participation and contribution to the exercise of citizenship (Santos, 2003, p. 2).

Scientific Communication, according to Bueno (2010), aims at the dissemination of specialized information among scientists, intending to make known the results of research, that is, specifically the instruments obtained in the scientific environment. To Ramalho (2020), scientific information can be disseminated through Scientific Communication or Scientific Dissemination:

> "Scientific communication aims to spread information through research results and publications of articles among scientific peers (researchers/scientists). Scientific dissemination, or popularization of science, aims to disseminate this same information to society in general. While scientific communication keeps the community of researchers and scientists up to date, science dissemination shares with society and the population information about research, about the advancement of science and technology." (Bueno, 2010, p. 1)

In Brazil, when outlining the public communication of science, it is possible to infer that the State, public institutions and researchers, even if in isolation and without organization, have fostered or executed actions to bring science to society. Over the course of 30 years, the premises of the concept of public communication have been built, which have in the French Pierre Zémor one of the leading thinkers in the world.

Pierre Zémor (1995, p. 1) argues that the phenomenon occurs in the natural communication space of society, representing "[...] the exchange and sharing of information of public utility" and in an environment in which public institutions have the responsibility to maintain the "social bond". According to the author, public communication has the purpose of:

> "a) inform (bring to knowledge, account, and value); b) listen to demands, expectations, questions and public debate; c) contribute to ensuring the social relationship (feeling of belonging to the collective, awareness of the citizen as an actor); d) to follow the changes, both behavioral and those of the social organization." (Zémor, 1995, p.1).

From the perspective of Science, Technology, and Society, scientific research as an activity of a social nature does not only bring discoveries, as it broadens the range of possible choices for political decision-making.

With the discourse on the importance of democratizing knowledge, there have been many calls for scientists to assume the role of public communicators of science, stimulated by government policies and

the institutions to which they are linked. It is relevant to study this aspect, considering that the communicative process that is established between government and society to inform the citizen about the results of public investments encompasses science, financed with resources mainly from government sources. The State must make transparent the information on the application of resources in research and on the results of each investment.

Therefore, expanding the dissemination in the media brings contributions to expand the knowledge of the citizen, the formation of a critical sense about the activities of science and technology, and also the awareness that investing in science and technology is a need for political and economic survival, for the development and competitiveness of a nation. It is necessary, however, that society and public opinion understand the production of science, in this sense, that the media is fundamental, whether the specialized media or the media of the general public. What has been noticed is that more and more science is gaining media space, not least because the world has gone through a coronavirus pandemic and realized the importance of science. It would be interesting if traditional media and social networks, considering everything that happened during the health crisis, occupied more space with science, even if they are not ordinary entertainment programs, which are often very nonsense. About this, Caldas (1998) writes:

> "Typically, media reports are limited to reporting the finished product of science or technology. Science fascinates. It fascinates public opinion and it also fascinates its disseminators. It fascinates to such an extent that the journalist's critical sense is often blunted by the wonders of the latest discoveries in the scientific world. Not infrequently there are times when researchers complain of distortions in the dissemination of science, which is understandable. Scientists are very concerned about the opinion of their peers, I would even say much greater than with public opinion, which is ultimately paying for the research it produces. On the other hand, the discussion about scientific policy, which mobilizes researchers in their work meetings, practically does not appear in the media. How are priorities for research funding established? Are resource allocations linked to social interests? What areas are decisive to reduce the technological *gap* that distances Brazil from developed countries? In times of globalization, market opening and unbridled competition, what role do Science and Technology play?." (Caldas, 1998).

The Public Communication of Science reveals the social importance of science as an activity for Communication professionals through the media. It is possible to perceive that public institutions, even in isolation, at some point have already fostered or executed actions bringing science to society. The Public Communication of Science, when exercised correctly, causes the dissemination of information of public interest and also makes the receiver exercise his right to perceive the information, creating the opportunity to argue in the public sphere. The Secretariat of Social Communication of the Presidency of the Republic - SECOM defines public communication as the action that is carried out by:

> "[...] articulation of different tools capable of creating, integrating, interacting and fostering communication content aimed at ensuring the exercise of citizenship, access to services and information of public interest, transparency of public policies and accountability of the Federal Executive Branch." (SECOM, 2011, p. 2).

Public Communication in the academic sphere has been gaining more and more space. With the accelerated scientific advance, more dialogue is sought between the various areas of scientific knowledge,

to reach various sectors of society, especially the lay public. For the Frenchman Pierre Zémor (2009), the public communication of science occurs in the natural communication space of society, representing "[...] the exchange and sharing of information of public utility." (Zémor, 1995, p. 1).

Pierre Zémor, who for more than 30 years has been building the premises of the concept of public communication, defines the purpose of public communication as follows:

> "1st to respond to the obligation of public institutions to bring information to their publics; 2nd to establish the relationship and dialogue to play the role that belongs to the public authorities, as well as to allow the public service to meet the needs of the citizen in a more precise way; 3rd to present and promote each of the services offered by the public administration; 4th to make known to the institutions themselves, both by internal and external communication; 5th to develop information campaigns and communication actions of general interest." (Zémor, 2009, p. 5).

Faced with the concept of Public Communication, confused as to its various meanings, some authors prefer to conceptualize what they do not consider public communication. Duarte (2009) declares that it is not "[...] communication about private, private, market, personal, corporate, institutional, commercial, professional or 'a public' interests, and those who practice public communication are convinced of the collective interest of improving the lives of the citizen. Brandão (2006) declares that the expression can be considered "under construction", encompassing five areas of knowledge and professional activity: public communication identified as organizational communication, as state communication, as political communication, as communication strategies of organized civil society and as the creation of channels of integration of science with people's daily lives, to arouse the interest of the citizen in the subjects of science.

According to Freire (1992, p.21), "[...] it is in its structural set that the word, about the others, defines its meaning. Thus, starting from the assumption that within the linguistic structural unit associative relations are established that unfold between the significant fields of the various terms." All definitions deal, at some point, with the term Public Communication of Science. This is the definition considered in this study.

The Public Communication of Science is explored under two tendencies: the unidirectional, which proposes a one-way communication, scientific meaning for society; and, the bidirectional, characterized by dialogues in the communicative process, with strong participation and active posture of the public (Lewenstein, 2010). Amid the policies of scientific dissemination models, this author advocates strengthening scientific dissemination actions in informal environments, such as museums and science centers, to improve science teaching. Duarte (2009) classifies the types of information in:

> "Institutional: refers to the role, responsibilities and functioning of organizations – the apparatus related to the structure, policies, services, responsibilities and functions of public agents, powers, governmental spheres, federative entities, and entities, in addition to the rights and duties of the citizen. What to expect, where to look and complain; Management: related to the decision-making and action process of agents working on issues of public interest. They include discourses, goals, intentions, motivations, priorities and objectives of the agents to clarify, guide and provide the public debate. The citizen and the different actors need to know what is happening in issues related to agreements, political actions, priorities, debates, and execution of actions; Public utility: on topics related to people's day-to-day lives, usually services and orientations. Income tax, vaccination campaigns, signage, social causes, and information about services available and their use are typical examples; Accountability: they concern the explanation and clarification of political decisions and

> the use of public resources. Enables the knowledge, evaluation and supervision of the action of a government; Private interest: those that concern exclusively the citizen, company, or institution. An example: are income tax data, and bank records; Market: refers to products and services that participate in the competition in the market; Public data: is information on state control and that concerns the whole of society and its functioning. Examples: legal norms, statistics, judicial decisions, historical documents, legislation and norms." (Duarte, 2009, p. 62)

Access to science and technology information is fundamental for the full exercise of citizenship (Brandão, 2006). These models, which seek to explain the relations between science and society, starting from different approaches, in practice are strategies of scientific dissemination for the scientific education of citizens in general. According to Zémor (1995), public communication exercises a mediating position between the State and society, instituting dialogue that promotes the link between the government and the lay public, vivifying scientific, technological and innovative knowledge. For Souza (2003), "The essence of science and technology is the public interest in scientific discoveries that highlight scientific public communication."

7 CRYPTIC COMMUNICATION AND INFORMATION

We can say that scientific communication is based, in the understanding of Gregory & Miller (1998), on the difference between the production of scientific knowledge and the public, causing that from this distinction the public is removed from the process of production of scientific knowledge, occurring the institutionalization of science, with defined rules that separate it from other activities. From this separation, which occurred in the seventeenth century, the effort to disseminate science to the public became constant.

The concept of scientific communication in Brazil is defined as:

> "[...] any activity of explanation and diffusion of knowledge, culture and scientific and technical thought, under two conditions: outside official education or equivalent and without the objective of training specialists. Thus, it develops two functions: that of teaching, that is, supplying or expanding the school and of fostering teaching." (Marandino, 2012, p. 5).

In this context, information is of fundamental importance for understanding and generating new knowledge and for the development of society. Thus, there is a need for dissemination, dissemination and sharing of information, which helps to produce among individuals "[...] new social meanings and political positions in front of the world" (Leff, 2004, p. 61).

According to Massarani (2012), scientific communication has existed in Brazil for about 100 years. The professionals who carry out this communication changed their motivations, starting to use science as an ally, as a tool aimed at overcoming social problems and underdevelopment existing in the country. For Fernandes (2011), scientific communication should not be seen only as sharing knowledge of information from scientists, but mainly as a discourse about science, accessible to all, considering mainly its role. Brandão (2006) understands scientific communication as an involvement of various activities and studies, intending to create channels in which the integration of science with the daily lives of people in the society can occur, arouse the interest of the public for scientific subjects and, consequently, seeking answers to

existing curiosities. According to Brandão (2006), scientific knowledge is more than communicating its results, because the acts incorporate a series of concerns (social, political, economic) that go beyond the limits of science, creating the need for a holistic view on the part of institutions so that they can extend this dissemination beyond their areas.

The destiny of scientific dissemination, for Pereira, Serra and Peiriço (2003), is to keep the target audience informed of any changes in their way of life, in addition to cultivating the public. Along these lines, Costa writes; Souza y Mazocco (2010, p. 4) that "Scientific dissemination is inserted in a larger sphere that is the public communication of science".

8 FINAL CONSIDERATIONS

After the research carried out and considering the objectives, the method and the search for sources to account for this, we consider that the public communication of science really acts as a link of interaction and transmission of scientific knowledge for the understanding of the public, enabling participation, awareness, citizenship and dialogue, therefore, there we see the importance of the process for the consolidation of democracy.

Making public communication of science, expanding, modernizing, above all informing the public, promotes initiation to research and incites experiences related to learning and related research. We realize that, in a harmonious process, the public communication of science seeks to introduce innovations to make the achievements of science and technology understandable to the public and also to show society the relevance of the work of scientists, failing to analyze academic scientific dissemination (regarding the publications of scientific articles, presentations in Congresses, among others) to address scientific dissemination to bring scientific knowledge to the public, bringing research and society closer together. As Caldas (1998) argues, "[...] public opinion must understand the processes and mechanisms of science production." For this, the reports regarding the perception and construction of a space focused on science play a fundamental role. It is through these reports that the population is informed about what is happening in the research laboratories of a science and technology center. Communication is of fundamental importance today in public organizations and institutions, and its good practices are decisive in the promotion of science.

The IV National Conference of Science and Technology - CNCTI, in 2010, recommended the establishment and application of the National Program for Popularization and Social Appropriation of Science, Technology and Innovation during the period 2011-2022. The objective of this Program is to contribute to the improvement of scientific dissemination and education, with the participation of the scientific community, governments, companies and civil society. Actions along these lines contribute to highlight the importance of science and technology in the modern world, awakening scientific technological knowledge, stimulating creative and interdisciplinary capacity, in addition to providing greater understanding by the lay public about the functionality of scientific-technological projects, promoting

greater popular participation in science and technology issues and increasing the self-esteem of Brazilians in the field of science and technology.

There is a social expectation, within the scientific field itself, that science is a factor of transformation to improve the quality of life. In this perspective, museums are as important as schools as a factor of transformation. When it comes to learning subjects related to science and technology, museums play this role more efficiently. One of how it is intended to lead the public communication of science is science museums, fostering among their attendees the bases of science, knowledge of culture, and scientific training and its applications. Amplified the demand for standards of culture and scientific literacy to promote public communication of science, museums stand out by making their contribution. They enable diverse modes of teaching, enabling the lay public to understand scientific logic.

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