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REVISTA LUSÓFONA DE ESTUDOS CULTURAIS

NEW DOMAINS OF THE SCIENCE-SOCIETY BINOMIAL
Open Science, Citizen Science and Informal Contexts of Public Engagement

NOVOS DOMÍNIOS DO BINÓMIO CIÊNCIA-SOCIEDADE
Ciência Aberta, Ciência Cidadã e Contextos Informais de Envolvimento do Público

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New Domains of the Science-Society Binomial: Open Science, Citizen Science and Informal Contexts of Public Engagement

Novos Domínios do Binómio Ciência-Sociedade: Ciência Aberta, Ciência Cidadã e Contextos Informais de Envolvimento do Público

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Science impacts various dimensions of human life. Social and economic development is closely intertwined with the capacity to incorporate scientific advances. In some cases, the affirmation of a political decision-making process based on scientific evidence, for example, during the pandemic in European democracies, has shown the growing relevance of experts in driving the destinies of society. Even leisure moments are increasingly enjoyed in technological contexts facilitated by science. Societies today are richer, more comfortable, safer and more diverse due to science.

While the role that science plays today in the daily lives of citizens and social order is unquestionable, its image and place in society face continuous challenges that may undermine public confidence in the scientific system. In some cases, such challenges stem from legitimate positions and real concerns about the risks and possible misuse of science motivated by vested interests. However, the profuse proliferation of fake news, pseudoscience and disinformation strategies has kept researchers, scientific organisations, policymakers, and other social stakeholders continuously alert. This apparent paradox, the growing mistrust toward science at a time when it is part of nearly all areas of human life, challenges everyone, especially researchers working on science communication issues and its relationship with society.

Promoting initiatives for a scientific culture among citizens and a greater dialogue between scientists, science institutions, and society has increasingly been the path to strengthening the recognition of and public trust in science. In this respect, a long way has been walked. It started with the "public understanding of science" paradigm and the "deficit" model (where citizens are seen as mere receptors of scientific information) up to the "public engagement with science" paradigm and the "dialogue" model (where citizens are seen as a constituent part of the scientific construction process). However,

we must further deepen the reflection on the reasoning, the evidence and experiences that have contributed to the enhancement of this bilateral relationship. Such is the case of citizen science and open science, and the new practices emerging in these contexts as important initiatives enabling this dialogue with citizens.

This issue of the *Lusophone Journal of Cultural Studies* (LJCS) should be read in this context as it seeks to motivate reflection and deepen the knowledge about the new practices that strengthen the relationship between science and society, opening the vast field of knowledge to the wider participation of citizens. The authors' responses to this call have been mainly translated into contributions addressing the topics of citizen science and, to a lesser extent, related to open science. Proposals of historical and conceptual approaches and experiences in these two domains are also paired with papers tackling the public perception of science and the possibilities of dialogues between society and the scientific enterprise.

This edition highlights the consolidation of the "citizen science" movement, which stems from different forms of direct participation of citizens in scientific projects. The concept of "citizen science", coined in the 1990s by Alan Irwin (1995), has evolved to include the participatory perspectives that have gained ground in recent decades. Although initially, the concept referred mainly to the idea of scientific citizenship, based on the need to open science and scientific policies to the public, some developments were already anticipated but little explored in the definition of the English sociologist. Thus, besides arguing that science should respond to the concerns and needs of citizens, Irwin (1995) also anticipated the possibility of citizens producing reliable scientific knowledge.

The concept of "citizen science" has added new dimensions, namely the possibility for citizens to participate in collecting scientific data, co-create research agendas, and discuss results and their social implications. The democratisation of science, in this context, involves opening science to a greater engagement from the public in the research process itself and not only learning about it after its conclusion. In essence, it means inviting citizens to join the scientific enterprise and not just letting them observe it through a window.

Naturally, this process does not apply to all contexts, nor does it always and only bring unquestionable benefits. Citizen science is a movement under construction, which still seeks affirmation and recognition in a wide range of fields of scientific knowledge production. The projects developed under this framework are mostly local, and their results are not easily applicable to other contexts. Although there is greater acceptance of this practice, some doubts persist about validating the knowledge produced in these circumstances, namely on the part of editors and reviewers of scientific publications (Bonney et al., 2014). The contributions to the debate opened by this issue of LJCS provide clues about the conditions of effective participation of citizens in the production of scientific knowledge. There will still be much to explore on citizen science — its potentials and limitations — but this issue shows that this concept is moving towards consolidation.

This issue also features contributions to the debate on the "open science" movement. This movement designates the various efforts to put scientific research (including publications, data and physical samples) and its access within reach of all groups of society, laymen or experts. In one of the first considerations on the topic, Chubin (1985) describes the participation process, in this context, as an opportunity for stakeholders, including scientists in the field, but also other researchers and non-scientists, to appropriate and evaluate new knowledge.

The movement has received support in several parts of the world. At various levels, scientific and political, translated, for example, in the increase of open access scientific journals, the availability of databases and the growth of institutional repositories with knowledge open to society. Reinforced open science policies at the international level emerged recently at the hand of the United Nations Educational, Scientific and Cultural Organization General Assembly, which, in November 2021, approved a recommendation on open science (United Nations Educational, Scientific and Cultural Organization, 2020), calling on member states to develop policies and incentives in this area.

These two movements seek to further, at different levels, the relationship of non-specialised publics with science as a social enterprise of knowledge production with its opportunities and limitations. It is important to reflect on these new contexts of public engagement and their potential for the development of scientific culture. In contrast, more consolidated themes, such as the public perception of science and the contexts that promote dialogue between society and scientists, are still worthy of our attention. The articles in this issue of LJCS delve deeper into these issues by reflecting on outreach communication and its role in public engagement.

This issue of LJCS introduces an article by Toss Gascoigne, Jenni Metcalfe and Michelle Riedlinger, in which the authors propose an analytical model for citizens' exercise of power in citizen science contexts based on the ladder of participation model proposed by Arnstein (1969). By analysing the different possible forms of citizen participation in citizen science projects, the authors note that there is room for different types of science communication depending on their suitability for different social contexts.

Cristina Luís' contribution also focuses on the different expressions of citizen science, proposing a journey through time and the different projects that implemented it in Portugal. This historical revisitation provides a better understanding of the space and role of citizen science in the last few centuries while mapping experiences identifies the scientific areas where the movement is more consolidated.

The work of Elaine Santana, Rosa Silva, Ana Filipa Cardoso, Filipa Ventura, Joana Bernardo and João Apóstolo explores concrete practices of open science. It analyses how the main international scientific institutions in the health field involve citizens in their digital platforms for science communication. This article highlights some innovations in the field by identifying the various strategies developed.

Focusing on the city of Rio de Janeiro and its publics, the article by Ione Maria Mendes, Luisa Massarani and Yurij Castelfranchi addresses the issues of social appropriation and the use of techno-scientific knowledge by young adults. By showing that these presented a positive view of science and technology, recognising its benefits and risks, the study points to the existing possibilities for establishing dialogues and communicational processes between science and this community which grew up with the internet.

Also seeking to understand the field of dialogue between science and society, based on the identification of the publics, Claudia Irene Quadros, Regiane Regina Ribeiro, Chirlei Diana Kohls and Patricia Goedert Melo present the experience of an agency of the Federal University of Paraná. Within the scope of the project *Pergunte aos Cientistas* (Ask the Scientists), citizens were invited to ask questions to the scientific community, mediated by the agency's services, which allowed for a deeper approximation between society and scientists.

Back to the realm of citizen science, Rafael Vitame Kauano and Alessandra Fernandes Bizerra propose a bridge between the conceptualisation of citizen science and the theories of situated learning proposed by Lave and Wenger (1991), based on the experience of a local community. Addressing biodiversity issues from the problem of biological invasions, the authors evaluate the activity of picking as a social-scientific practice that amplifies the learning processes on issues related to biological invasions, thus bringing the community closer to science.

This issue closes with the article by Evelin Gabriella Hargitai, Attila Sik, Alexandra Samoczi and Milan Hathazi, which describes a new experience in citizen science based on the assumption that it is possible to establish more reciprocal relations between citizens and scientific institutions. The study outlines the methodological challenges in mentoring citizen science projects while highlighting this process's possible advantages to the scientific community.

Translation: Anabela Delgado

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Thematic articles | *Artigos temáticos*

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The Ladder of Power: Science Communication and Citizen Science

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Abstract

On March 28, 2022, the *Journal of Science Communication* published a special issue on participatory science communication featuring 15 papers and essays. The *Journal of Science Communication* special issue sparked a debate among the four editors over the wording of the call for papers. What is the difference between "participatory science communication" and "citizen science"? Are they different points along a continuum stretching from "simple" to "more involved"? Does "citizen science" incorporate "participatory science communication"? And is all citizen science participatory? A key consideration is the level of involvement by "citizens" in these endeavours, and that consideration translates to questions of power. This essay explores definitions of participatory science communication and citizen science. It examines each of these concepts through the framework of shifting relationships and the implicit power imbalance between scientists and various publics. In doing this, we revisited Sherry Arnstein's (1969) paper, "A Ladder of Citizen Participation", and constructed complementary ladders for science communication and citizen science.

Keywords

participatory science communication, citizen science, ladder of participation

A Escada do Poder: Comunicação de Ciência e Ciência Cidadã

Resumo

A 28 de março de 2022, a *Journal of Science Communication* publicou um número especial sobre comunicação participativa de ciência com 15 artigos e ensaios. A edição especial da *Journal of Science Communication* suscitou um debate entre os quatro editores sobre a formulação da chamada de trabalhos. Qual é a diferença entre "comunicação participativa de ciência" e "ciência cidadã"? Serão pontos distintos ao longo de um continuum entre "simples" e "mais envolvidos"? Será que a "ciência cidadã" engloba a "comunicação participativa de ciência"? E será que toda a "ciência cidadã" é participativa? Uma das principais considerações será o nível

de envolvimento dos "cidadãos" nestes esforços e que tal consideração se traduz em questões de poder. Este ensaio explora as definições de comunicação participativa de ciência e ciência cidadã. Examina cada um destes conceitos através do quadro das relações de mudança e do desequilíbrio de poder implícito entre cientistas e vários públicos. Ao fazê-lo, revisitamos o trabalho de Sherry Arnstein (1969), "Ladder of Citizen Participation" (Escada de Participação Cidadã), e construímos escadas complementares para a comunicação da ciência e da ciência cidadã.

Palavras-chave

comunicação participativa de ciência, ciência cidadã, escada de participação

1. Introduction

On March 28, 2022, the *Journal of Science Communication* (JCOM) published a special issue on participatory science communication (Metcalfe et al., 2022). It featured 15 papers and essays, all extensions and additions to discussion sessions at the "2020+1 Conference" of the Network for the Public Communication of Science and Technology.

The JCOM special issue sparked a debate among the four editors over the wording of the call for papers. Our difficulty lay in establishing the distinction between "participatory science communication" and "citizen science". Are they different points along a continuum stretching from "simple" to "more involved"? Does "citizen science" incorporate "participatory science communication"? And is all citizen science participatory?

We suggest that a key consideration is the level of involvement by "citizens" in these endeavours and that consideration translates to questions of power. Who instigates the research? Who designs the experiments? Who conducts the analysis and determines the way the results will be disseminated? Full participatory science communication has publics playing at least an equal role in all phases. As Anne Leitch (2022) said in her article in the special issue: "power includes who decides who is invited (or not invited or actively excluded) to participate and how that process unfolds. It also includes notions of what is counted as expertise, and thus included or omitted in the process" (p. 2).

This essay explores definitions of participatory science communication and citizen science, examining each of them through the framework of shifting relationships and the implicit power imbalance between scientists and various publics.

2. Arnstein's "Ladder of Participation" Shows Progressive Increase in Power

One approach to assess levels of participation and power, whether in science communication or citizen science, was set out by Sherry Arnstein (1969) in her much-cited "A Ladder of Citizen Participation" paper of 1969. In an analysis described as "penetrating, no-nonsense, even pugnacious" (Organizing Engagement, n.d., para. 2), she examined urban renewal and anti-poverty programs in the United Sates, where the communities she studied were invited to participate in new programs to improve their neighbourhoods.

Arnstein's (1969) eight-level "ladder of participation" (see Figure 1) illustrates her observations. The two lowest levels are labelled "manipulation" and "therapy", and subsequent rungs employ similar value-laden terminology.

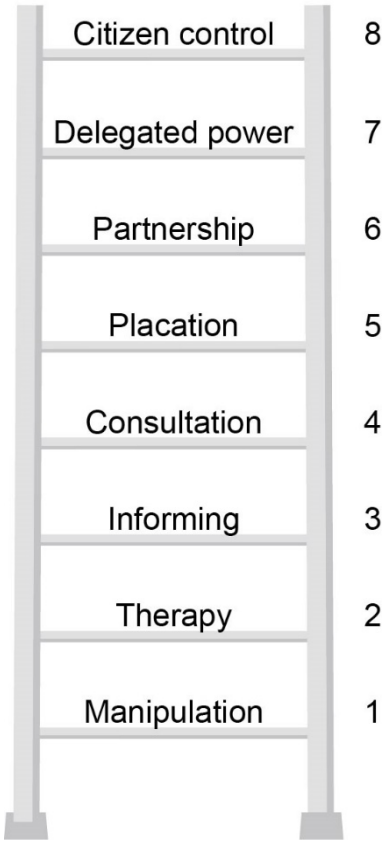

Figure 1 *Arnstein's ladder of participation*

Source. Adapted from Arnstein, 1969, p. 217

Arnstein (1969) works on the principle that participation equating to higher rungs on her ladder is more worthy because of their power-sharing potential. In describing the lower rungs of the ladder, she explains:

> these two [bottom] rungs describe levels of "non-participation" that have been contrived by some to substitute for genuine participation. Their real objective is not to enable people to participate in planning or conducting programs, but to enable powerholders to "educate" or "cure" the participants. (p. 217)

Arnstein (1969) claimed the lower rungs of participation gave officials the licence to placate, to muzzle or to "educate" disadvantaged groups. To her, the urban renewal programs were often "chicanery" and "a sham" (Arnstein, 1969, p. 218). But as citizens participated more fully and more meaningfully and moved to the higher rungs, they had greater powers: to negotiate, to partner and eventually, on the top rung, to have full control.

For a project to be genuinely participatory, Arnstein (1969) felt a program had to include a redistribution of power.

> Citizen participation is citizen power. Without an authentic reallocation of power—in the form of money or decision-making authority, for example—participation merely "allows the powerholders to claim that all sides were considered but makes it possible for only some of those sides to benefit. It maintains the status quo". (Arnstein, 1969, p. 216)

While the simplicity of Arnstein's (1969) ladder is attractive, it masks some limitations. Arnstein believed that higher levels of participation are always better than lower levels when she considered her (familiar) field of urban renewal projects. But in other projects and in other disciplines, participation at lower levels may have significant value, and participating at the higher rungs may be unrealistic. For instance, citizens may be perfectly capable of counting birds accurately or learning the skills needed to collect and analyse data reliably but may benefit from researchers developing identification apps or publicly searchable databases that can be interrogated based on citizens' needs.

There is a parallel in science communication, where some scholars see participatory science communication as a desired evolutionary endpoint that replaces deficit and dialogue-style science communication (Metcalfe, 2019). But, just as linear science communication can have value and even be demanded by various publics (for example, to satisfy their need for information), it is also likely that lower levels of participation in urban renewal projects have value.

3. Postulating a Ladder of "Participatory Science Communication"

In our call for papers for the JCOM special issue, we chose to define participatory science communication in terms of recognising citizen equality:

> participatory forms of science communication appear to be different to popularisation, science literacy and dialogue in that they recognise and acknowledge various publics as being equal in terms of the power and knowledge they hold when compared with scientists and policy makers. (Metcalfe et al., 2022, p. 4)

However, some authors in the JCOM series thought it better to avoid an explicit definition. Anne Leitch (2022) advised avoiding "prescriptive definitions, recognising that the rationale and process of participation are context-specific and should be tailored and revised throughout" (p. 5). That does illustrate some of the definitional challenges associated with participatory science communication.

The fluid nature of participatory science communication was also recognised by Chi-I Lin (2022), who discussed the "constant dialogue, exchange of knowledge and

negotiation" that happens between farmers and scientists in her study (p. 3). Lin perceives linear forms of science communication (dialogue, exchange of information) as part of the spectrum of participation.

In exploring the nature of participatory science communication, other authors in the JCOM special issue recognise how power dynamics change compared with linear forms of science communication. Standerfer et al. (2022) describe participatory science communication as "a discursive space that recognises and values participants' lived experiences and community knowledge" (p. 2). Their description is echoed by Rita Campos (2022), who talks about "giving the same weight to both scientific and local or indigenous knowledge" (p. 4). The point "the same weight" is crucial because it highlights power sharing.

Ayure and Triana (2022) emphasise the importance of levelling power relationships with participatory science communication in their Colombian project:

> 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. (p. 5)

Another group of JCOM authors looked at how participatory science communication can achieve a level of interaction between scientists and publics that goes beyond valuing participants' knowledge and experience. Thomas and Cassidy (2022) recognise the democratic potential of participatory science communication, describing it as "engaged research", quoting Holliman et al. (2015): "researchers meaningfully interact with various stakeholders over any or all stages of a research process, from issue formulation through the production or co-production of new knowledge, to knowledge evaluation and dissemination" (p. 1).

All these interpretations demonstrate intentions for extending the transmission or exchange of information and ideas to a stage where various publics are deliberatively engaged with scientists and the research process on an equal basis. While much of this participation is still initiated and framed by scientists, science communicators and their institutions, it does indicate a willingness to shift power and agency in projects toward publics.

Considering this work, we provided a revised definition for participatory science communication in the introduction to the JCOM special issue:

> "participatory science communication happens when scientists and/or science communicators interact with various publics in a dynamic process where different forms of knowledge and experiences are acknowledged, shared, valued and negotiated, and where power relations are levelled." We consider that such participatory processes can lead to more inclusive and democratic perspectives of collective knowledge sharing and appropriation. (Metcalfe et al., 2022, p. 5)

We have adapted Arnstein's (1969) ladder to offer a similar ladder of science communication, with the most participatory forms at the top of the ladder (see the middle ladder in Figure 2).

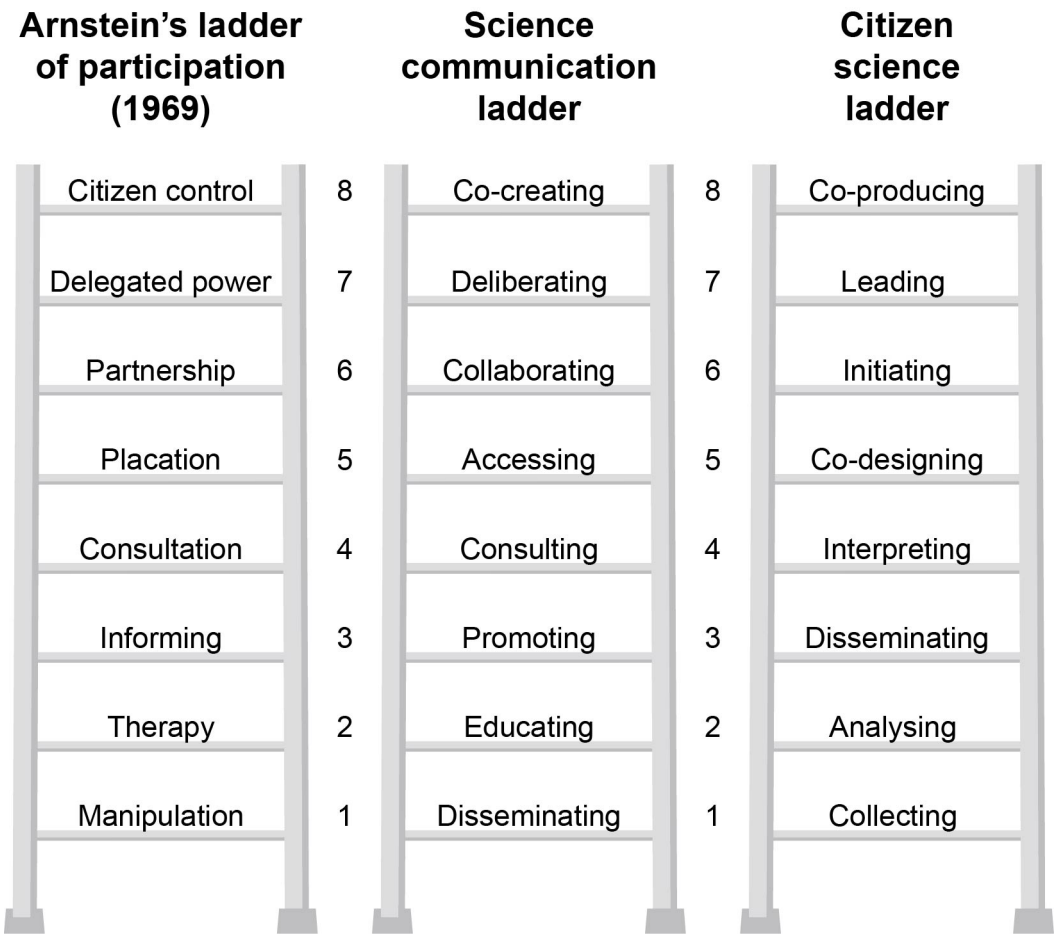

Figure 2 *Arnstein's ladder of participation compared with proposed science communication and citizen science ladders*

The first three rungs on the science communication ladder are dominated by one-way communication from scientists to various publics. "Dissemination" is the straight transfer of information from scientists to publics. While scientists have most of the power here, they may be responding to publics' demand for knowledge rather than a perceived public deficit. The "education" rung of the ladder also implies a transfer of information or knowledge from those with notional expertise (scientists) to those without information or knowledge (publics). However, interactions between scientists and publics through educative processes can move communication beyond mere dissemination. The "promotion" of science can also occur through more interactive or participatory processes.

A more deliberative dialogue between scientists and the publics starts with "consulting" activities. Here scientists acknowledge that publics may have concerns or knowledge which must be considered in the research processes. However, consultation is still

directed largely by scientists and their institutions. "Accessing" provides publics with more direct pathways to scientists, their research and the knowledge produced by that research. By having this access, publics are gaining greater opportunities to influence the scientific process.

The top three rungs of the science communication ladder are far more participatory in nature. "Collaboration" implies that the publics are at least contributing their knowledge and/or skills to scientific processes, including the generation of new knowledge, even if they do not have equal status to scientists. "Deliberating" gives the publics more power as they become actively involved alongside scientists in knowledge generation and problem-solving. The top rung of the ladder, "co-creating", means that the publics are now participating on an equal basis with scientists and may even be initiating research activities.

The science communication ladder does not imply a higher value to the top rung activities. There can be value in communication activities performed at any of these levels (for instance, providing farmers with an analysis of their soils). We recognise the importance and indeed likelihood of a mix of styles in any science communication program (e.g., see Metcalfe's [2022], paper, in JCOM on the Australian Climate Champion Program), including in programs where citizens co-create or lead communication activities.

4. Creating a Ladder of Citizen Science Participation

When we defined participatory science communication in our introduction to the JCOM special journal (Metcalfe et al., 2022), we distinguished between these activities and citizen science:

> participatory science communication differs from the common definition of citizen science projects where citizens collect data separately to any deliberation or analysis by scientists. But citizen science is a broad field, and in its more extended form can involve publics in problem definition, collection and data analysis. (p. 4)

The broad and diverse nature of citizen science has led to a range of definitions of what it is and how it should be enacted. These definitions often vary according to the level of participation and the power those citizens have in a citizen science program.

"Citizen science" came to prominence as a term in about 1995. But the idea is a lot older: for instance, Bonney (1996, as cited in Hecker et al., 2018) describes lighthouse keepers collecting data about bird strikes in 1880. Bonney worked at the Cornell Lab of Ornithology Citizen for 4 decades from the early 1980s. He was director of citizen science and director of public engagement in science programs; and has published widely on citizen science (see Cornell Lab, n.d.).

In 2009, Bonney and colleagues published a nine-step model for the development of a citizen science project, with the steps set out in chronological order (Bonney et al., 2009). That saw a limited role for citizen participants who were recruited for a simple purpose: to

count birds. The possibility that participants might have expertise in bird recognition or knowledge of the local environment that might shape the project was never entertained. Citizens were not involved in the design of the experiment, analysis and interpretation of the data or dissemination of the results.

Such definitions were typical of the citizen science movement in the United States, which largely involved large-scale data collection by citizens. We would argue that this style of citizen science is unlikely to be participatory science communication. The role of citizens in gathering data is important and useful, but the power still resides with the scientists, and their communication with citizens is likely to be linear in nature: providing information and responding to any questions they might have.

This perception of citizen science contrasted with European notions of citizen science in the early part of the 21st century, which looked at the engagement of the public in scientific discourse and policy making. For example, Irwin (1995) conceives of citizen science as a form of citizen engagement, which translates into political activity designed to facilitate high-risk decision and policy making. This style of citizen science would suggest a much more participatory form of science communication, with citizens involved at all stages right up to the co-production of policy.

Between 2013 and 2015, European groups worked on bringing a better understanding of the field with their "Ten Principles of Citizen Science" (Robinson et al., 2018). These principles recognise the different roles (and hence power) that citizens can play in citizen science projects. The history and wording of the principles were explored and dissected by Lucy Robinson et al. (2018), who describe how the principles were developed. "Citizens may act as contributors, collaborators, or as project leader and have a meaningful role in the project... [which] may include developing the research question, designing the method, gathering and analysing data, and communicating the results" (Robinson et al., 2018, p. 29).

Friedman and Rosen (2021) go beyond the 10 principles to set out a case for co-production in citizen science in their extraordinary story of Israeli citizens winning a battle against the development of oil shale fields. The secretive plans by powerful interests in Israel were discovered by a pair of mountain bikers in the Elah Valley. The pair drew together eight local residents who met, allocated tasks (setting up a website, raising funds, contacting politicians) and waged a battle the authors labelled "David versus Goliath". Their victory was a result of the determination, hard work and the bringing together of a group of people with disparate skills:

> Co-production also has a more prescriptive understanding and refers to the activity of co-producing knowledge for a project or policy. As a prescriptive agenda, the goal of co-production is to generate policy via the input of as many stakeholders as possible from various levels of governance and the citizenry, thereby creating a means whereby social and scientific knowledge and processes continually inform one another. (Friedman & Rosen, 2021, p. 4)

This type of activity is similar to what many scholars theorise as high-level participatory science communication. In this type of citizen science, the public shares power with scientists.

It appears that citizen science, like science communication and urban citizen participation, can be captured and described in a hierarchical ladder that demonstrates different levels of participation and, therefore, citizen power. This notion of a hierarchy is also found in one of the special-issue JCOM papers, which looked at citizen science in solar energy research (Barbosa et al., 2022). The authors define citizen science within the context of participatory science communication by saying it "can be categorized into three practices: contributory, collaborative or co-created" (Barbosa et al., 2022, p. 2). They saw co-created citizen science as the most participatory.

We used these definitions and explanations of citizen science to construct a citizen science ladder (Figure 2). The first three rungs on this ladder (collecting, analysing and disseminating) match what Barbosa et al. (2022) call "contributory". With "collecting" and "analysing", citizen scientists are performing relatively simple tasks that aid scientists in their research activities. When citizen scientists get involved in "disseminating", they are helping scientists transfer the information that has been generated from the citizen science activity. That differs from "disseminating" in the science communication ladder, where scientists perform the communication.

The next three rungs (interpreting, co-designing and initiating) reflect "collaborative" activities between citizens and scientists. When citizens get involved with "interpreting" and "co-designing", they are exercising more power in the scientific process than when engaged in the previous rungs of the ladder. Scientists are now valuing the ability of citizens to interpret data and design research activities.

The top two rungs (leading and co-producing) will likely lead to scientists and citizens "co-creating" new knowledge or policy. That is where there is likely to be a much greater sharing of power, and citizens will have a hand in driving the project. "Co-producing" is more participatory than "leading" as citizens are more likely to be working alongside scientists rather than driving what scientists do.

This citizen science ladder is hierarchical rather than sequential; each activity captured in the ladder does not depend on the completion of previous activity steps to occur. For example, citizens can be engaged in co-designing a project without ever being involved in collecting data. Like our proposed science communication ladder, progression up the ladder rather shows increasing citizen participation in the scientific process which comes with a shift of power from scientists to the publics. While citizens are likely to have more power when "leading" compared to "co-producing", we have placed co-producing at the top of the ladder because this is when citizens are likely to be participating with scientists on an equal basis.

Like the science communication ladder, the citizen science ladder differs from Arnstein's (1969) ladder because it sees a potentially important role for all the steps in the ladder, from collecting data upwards.

5. Conclusion

We opened this article with questions revolving around the distinction between "participatory science communication" and "citizen science" and the role of non-scientists in these projects. After examining many discussions and definitions, we conclude that citizen science activities can align on a continuum based on the power that citizens hold within a citizen science project and that this continuum parallels the power sharing ladder along which participatory science communication activities can be categorised.

When a citizen science project involves citizens leading a project and/or co-producing outcomes from a project, then the project likely involves the highest levels of participatory science communication. Citizens working with scientists to interpret results, co-design projects and/or initiate projects are also likely to be involved in participatory forms of science communication. Citizen science projects that only involve citizens in collecting, analysing and disseminating are likely to be dominated by more linear forms of science communication. Citizens are participating in the science through contributory efforts but are unlikely to be involved in participatory communication with scientists.

However, unlike Arnstein's (1969) "A Ladder of Citizen Participation", where she uses value-laden terminology to make a critique of participation on the lower rungs, we would emphasise that all levels in science communication and citizen science ladders have value. Moreover, it is likely that the higher rungs in the ladders depend on the activities of the lower rungs.

Understandings of "good" science communication are changing. Participatory approaches recognise the value of what citizens bring to science communication, and this is imbuing the field with new approaches. Despite the attractiveness of these approaches for the science communication field, adopting these approaches has not come easily for many researchers and institutions because it requires recognising the limitations of formalised scientific knowledge and the value of the knowledge of people who may not have had the same educational experiences. It calls for a shift in power and a new humility for professional scientists and the institutions that support them. The emergence of responsible research and innovation is bringing new momentum to shift "science in society" to "science with and for society".

Melanie Smallman et al. (2020) argue that responsible research and innovation has significant implications for science communicators involved in public participation:

> the concept has arguably shifted the role of the science communicator from one who explains science to the public to one who helps scientists and technology developers understand society. Arguably the objective of helping science to succeed remains, but it is achieved by helping science do more socially acceptable research. (p. 947)

In tandem with the notion of "participation" that is spreading through both science communication and citizen science, there is growing recognition by researchers

and practitioners for creating space for different types of communication. For some situations, the dissemination of expert advice is appropriate. Other situations call for dialogue between researchers, science communication practitioners and various citizen groups, so the knowledge and views of all can be heard, debated and resolved. The third approach is participatory, where researchers work on equal footing with citizens and citizen groups to start a project, frame the research questions and approaches to collecting and interpreting data, and collectively engaging others with the results.

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Citizen Science: Past, Present and Future of Public Engagement in Scientific Research

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Abstract

When the relationship between science and society takes on a more prominent role, initiatives that allow greater engagement and dialogue between both parties become increasingly relevant. In this context, the past decade has seen an enormous growth of a practice known as citizen science as a form of public participation in scientific research that promotes the faster advance of scientific knowledge and contributes to greater collaboration between science and society. This article presents a brief overview of the main aspects of citizen science, how this practice emerged and how it mobilised the engagement of society in the past, particularly by analysing examples related to biodiversity recording and outlining the current situation in Portugal. It includes some suggestions for developing future actions in this field, particularly studies that analyse the motivations to participate in scientific research, allowing for a more open and shared science.

Keywords

citizen science, public engagement, motivations, research, history

A Ciência Cidadã: Passado, Presente e Futuro do Envolvimento Público na Investigação Científica

Resumo

Numa altura em que as relações entre ciência e sociedade adquirem cada vez mais protagonismo, iniciativas que permitam um maior envolvimento e diálogo entre ambas as partes ganham cada vez mais destaque. Neste contexto tem-se assistido a um enorme crescimento, ao longo da última década, de uma prática conhecida como ciência cidadã que, pelo facto de constituir uma forma de participação pública na investigação científica, potencia o avanço mais rápido do conhecimento científico, contribuindo para uma maior colaboração entre a ciência e a sociedade. Apresenta-se aqui um breve apanhado das principais características da ciência cidadã, de que forma esta prática surge no passado, mobilizando o envolvimento da sociedade daquele tempo, analisando, em particular exemplos relacionados com o registo da biodiversidade, e traçando algum do panorama atual em Portugal. Deixam-se algumas sugestões para o futuro desenvolvimento de ações nesta área, em particular estudos que analisem as motivações para participar na investigação científica, permitindo abrir portas a uma ciência mais aberta e partilhada.

Palavras-chave

ciência cidadã, envolvimento público, motivações, investigação, história

1. Introduction

When we talk about the relationship between science and society, the growing interest in initiatives focused on the engagement of the public in scientific activity has been remarkable over the last decades. That reflects a change from the previous emphasis, mostly on issues of public understanding of science. The concept of open science, for example, is increasingly prominent nowadays, especially in the European landscape. For instance, the European Commission has given great emphasis to the implementation of open science in the European Union framework programme for research and innovation, Horizon 2020 (2014–2020; European Commission, n.d.), promoting the engagement of citizens in science and technology decisions aiming to improve the alignment of the goals, processes and outcomes of research and innovation with the values, needs and expectations of society.

The "citizen science" movement has assumed great prominence over the last 2 decades and is part of the open science scenario.

This work aims to present an overview of citizen science, with a brief description of the past and present in Portugal, highlighting citizen science practices related to biodiversity and addressing some examples of engagement dynamics used over time. It includes suggestions for future studies to understand how society's engagement in this practice can be improved so that science is effectively more open to society.

2. What Is Citizen Science?

There is no single, consistent definition for the concept of citizen science, as it is a practice that takes on multiple aspects. The term emerged in the 1990s through two different epistemological directions: that of Alan Irwin (1995) and Rick Bonney (1996, as cited in Bonney et al., 2009). Irwin (1995) defines citizen science as an approach to support a more democratic and participatory science, developing concepts of science citizenship and stressing the need to open science policy processes to the public. Bonney (1996, as cited in Bonney et al., 2009) describes it mainly as a tool used by professional scientists in which citizen volunteers contribute to science through data collection. Later, in the white paper on citizen science in Europe, the term is defined as "the involvement of the general public in scientific research activities in which they actively contribute to science with their intellectual effort, their knowledge or their tools and resources" (Serrano-Sanz et al., 2014, p. 8).

Citizen science is essentially an approach to answering key research questions through the voluntary engagement of citizens in the various stages of the scientific process, from the research project design (through the definition of research questions) to the dissemination of key findings and conclusions, to the collection, interpretation and discussion of results.

Citizen science projects are conceived in multiple ways, so there is an effort to categorise them. For example, Wiggins and Crowstone (2011) categorised them according to the project objectives, the activity type and technology use. However, most authors

divide project typologies according to the degree of engagement and the type of scientific tasks performed by the volunteers participating in the project (e.g., Bonney et al., 2009; Haklay, 2013). In this type of classification, based on the type of volunteer engagement, projects can be classified according to the following types: *contributory* (usually designed by scientists where the general public contributes data); *collaborative* (usually designed by scientists where members of the public contribute data and help refine the project design, analyse data or disseminate results); and *co-created* (designed jointly by scientists and members of the general public where some of the public are actively involved in most or all steps of the scientific process). In a paper from 2012 (Shirk et al., 2012), two other categories were added: *contractual* (where communities ask scientists to conduct specific scientific research and report the results) and *collegial* (where citizens conduct research that creates scientific knowledge separately from the scientific community).

Citizen science thus takes on several facets, including raising new research questions and co-creating new scientific knowledge. Volunteer participants acquire new knowledge and skills and a deeper understanding of scientific work, which enables new forms of scientific culture. In this collaborative and transdisciplinary scenario, it is thus important to understand how to improve the interactions between science and society to allow more open and participatory research.

3. Engagement in Citizen Science Practices

One of the main challenges in citizen science is understanding what drives public engagement in citizen science and how this engagement can be maintained over time. However, this is not an easy task. Studies such as Raddick et al. (2010) or Rotman et al. (2012), to name but a few examples, identify motivation categories and factors for contributing to a project. Whereas Nov et al. (2014), for example, explore motivation as an underlying factor for both the quantity and quality of contribution in citizen science projects, West et al. (2021) offer an interesting literature review on voluntary participation in citizen science.

Generally, self and more altruistic motives are often identified as important to participants (Kragh, 2016). Motives for their selves may include personal interest in the topic under investigation, for example, interest in chemical structures, biodiversity or the environment; a desire to learn more about the topic; or a desire to discover something new such as, for example, new species or new galaxies. Depending on the type of project and the form of participation, there may be other reasons for participation. For example, participation may provide participants in environmental projects opportunities for entertainment or for spending time in nature. Motivations related to pursuing a professional career, such as volunteering to gain experience to include in the curriculum or the opportunity to collaborate with an institution in which one wishes to work, are rarely mentioned. When they are, they refer to responses from students or young people (Johnson et al., 2014). Many of the participants in citizen science projects have their own motives for getting involved in the projects. However, altruistic motives are, in many cases, more

influential than their own. An important altruistic motive for the participation in citizen science projects is the willingness to contribute to science, a motive unique to citizen science and that distinguishes it from other opportunities for voluntary participation. Other altruistic motives, such as being able to contribute to a cause or the feeling that it is important to help, are also significant for many. Participants in citizen science projects in environment-related areas, such as biodiversity monitoring, are often altruistically motivated to participate because they are concerned about the environment and feel it is important to help conservation efforts. However, have the motives for participating in a citizen science project always been the same throughout the history of this practice?

4. The Pertinence of Studying the Past of Citizen Science

Thanks to the proliferation in recent years of citizen science projects in several countries, this practice is often referred to as recent. However, the engagement of citizens without specialised training in science is far from being a new phenomenon. The history of science provides several examples showing that the first modern scientific data were mostly obtained by amateurs, namely members of the clergy or aristocrats, who had the time and financial means to collect information about the natural world (Silvertown, 2009). In reality, it is important not to lose sight of the recent rise of science as a profession. The term "scientist" is only coined in the first half of the 19th century[1], and only decades later (or, in many countries, throughout the 20th century) is there an effective professionalization of scientific activity (Haklay, 2013; Vetter, 2011). Similarly, the engagement of the non-specialist public in large-scale initiatives to collect scientific data also has a long history. For hundreds of years, groups of people without specific scientific training have made observations and records about the natural world, including collecting information about animal and plant species distribution, meteorological data and observations of astronomical phenomena. Associations or government entities often centralise these records (e.g., Carolino & Simões, 2011; MacGregor, 2018; Roy et al., 2014). Thus, studying the history of citizen science not only helps to understand how this practice has taken different contours over time but also helps to understand how the relationship between science and society has developed and what has been motivating society's engagement in science.

One of the areas where there are most examples of public engagement in science is biodiversity recording. For centuries, countless people have shown motivation and interest in identifying and documenting the occurrence of animals and plants, in other words, in recording biological data. A biological record is a point on a map showing that a particular species or organism was found in that place on a particular date. However, despite this simplicity, making a biological record is an incredibly diverse activity which involves thousands of people worldwide for centuries. There has been a long tradition of amateur naturalists collecting specimens, recording their observations in journals, and

[1] In response to a challenge from the poet S. T. Coleridge, in 1833, William Whewell invented the word "scientist". Previously the terms in use were "natural philosopher" and "man of science".

becoming specialists in specific habitats or taxa since the 17th century (Miller-Rushing et al., 2012). Some surveys point to historical traditions regarding the systematic collection of observations and information by society, including millennial records documenting natural phenomena over time. The Audubon society's Christmas bird count, which began in 1900 and continues to take place annually at hundreds of sites in the United States and Canada, is commonly noted as one of the earliest such initiatives (Dunn et al., 2005). There are, however, other examples. In China, citizens and officials have recorded locust outbreaks for at least 3,500 years (Tian et al., 2011), while in Kyoto, Japan, we find records of cherry trees blossoming over 1,000 years ago (Aono & Kazui, 2008).

While the long history of voluntary engagement in the biological recording is widely acknowledged to have played a critical role in science and decision-making, it is unknown in many countries. Thus, it is worth trying to understand what kind of calls were made for society's participation and, if possible, their motivation to participate.

5. Some Past Examples of Citizen Science in Portugal

Although they do not seem very frequent, there are historical examples of voluntary engagement in the biological record in Portugal. Aristocrats with a fondness for nature observation which, in their spare time, contributed to the biodiversity record (Felismino, 2016), or others who, besides their governance duties, dedicated some of their free time to natural history (Sousa, 1861). However, no thorough study of the history of citizen science in Portugal has ever been conducted, and the history of amateur biodiversity monitoring practices has not been systematically traced. Revealing the history of biological recording in Portugal is like telling the history of citizen science in biodiversity monitoring. It discloses how communities of amateur naturalists were formed and evolved throughout the 19th and 20th centuries to understand when and how the public was called to engage and participate in biodiversity monitoring practices. Telling this story is thus of the utmost importance to help explain why citizen science and non-expert biodiversity monitoring practices are still residual in Portugal compared to other countries. In other words, looking at the examples from the past can help to understand the reason for the still low engagement and motivation to participate in citizen science projects at present and help enhance participation in the future.

In an attempt to reconstruct part of the history of citizen science in Portugal, a study is being developed to examine the network of volunteer collaborators in recording animal biodiversity and how information circulated between collectors, amateur naturalists and specialist naturalists. When surveying the historical archives, particular attention is given to the catalogues and publications held in the National Museum of Natural History and Science, now part of the University of Lisbon. The documentation in that museum provides important data, such as instructions for data collection and information about the collectors of the specimens. Furthermore, it shows what kind of appeals were made to participate in the biological registry and what motivations were behind the participation of some members of the society.

José Vicente Barbosa du Bocage (1823–1907), director, from 1858, of the Museum of Lisbon (the institution that became the current National Museum of Natural History and Science), published, in 1862, *Instrucções Praticas Sobre o Modo de Colligir, Preparar e Remetter Productos Zoologicos Para o Museu de Lisboa* (Practical Instructions on How to Collect, Prepare, and Send Zoological Products to the Museum of Lisbon; Bocage, 1862). With this publication, the museum director appealed to individuals' collaboration to help expand his zoological collections. Bocage (1862) mentions that:

> Portugal is today the least known and explored of all the countries of Europe. Of its Fauna, only very few rare fragments are known. In the richest and most complete museums, in the best collections of private individuals, one scarcely sees one or another specimen collected from our land. Even our old museum was, at this point, one of the least privileged. We believe it is time to end this disgrace, which, more than anything else, denounces our backwardness and obscurantism to foreigners. It is time to study for ourselves what is ours and to collect in the manner prescribed by science the documents that should serve as a basis for the history of natural productions of our country. (p. 8)

The director states that he would have eventually abandoned the project of expanding the museum's collections if he had not expected much help from many of his fellow citizens. Therefore, he addressed his instructions to those who wished to help the museum. It is very interesting how this document addresses the general population and calls for the collaboration of all those interested in collecting zoological specimens, disregarding any previous experience as an amateur naturalist:

> to collect the natural products of the area in which one resides, entertain the idleness of country life with occupations that lighten the hours and elevate the intelligence, study nature, and seek to understand the great work of creation by spelling out some of the pages of its history, one does not need to be a naturalist by profession, nor a scholar graduated from universities and academies. To start, a few indications on how to look for and prepare the objects one wishes to collect suffice; then, the repetition of the excursions and research, the experience of each day, and the trials and observations themselves will develop aptitudes, we might say almost instincts, of a true naturalist. (Bocage, 1862, p. 9)

This excerpt from *Instrucções Praticas Sobre o Modo de Colligir, Preparar e Remetter Productos Zoologicos Para o Museu de Lisboa* (Bocage, 1862) is a testament to what we might call a 19th-century call for everyone to become citizen scientists.

The strategy to encourage the population to participate underlines the notion of recognition outside the same official framework of state officials: "we reckon that other people who visit the overseas territories or live there permanently (...) will not refuse to contribute with whatever donations they can get, and that will bring their names to public recognition" (Bocage, 1862, p. 11).

It also highlights the contribution to the country's progress:

> the galleries of the museums of Europe abound with the donations of men who are strangers to science but who are not indifferent to the prosperity and intellectual advancement of their country. We do not believe that the qualities and feelings that in other eras and under the influence of other ideas have made us great and placed us at the forefront of world civilisation are today the exclusive appanage of other peoples. (Bocage, 1862, p. 11)

It is interesting to note the use of recognition to attract and motivate participation, a technique currently used in citizen science practices. In fact, and although some of the names that contributed specimens remain unknown because it is not possible to find information about who they are, the truth is that the recognition of their contribution is forever associated with the museum's biological records.

The success of the strategy implemented by Bocage can, to some extent, be inferred from a report he published in 1865 (Bocage, 1865). He received specimens from about 24 collaborators from different parts of the country. The region with the most collaborators was Coimbra. These collaborators were studying or teaching at the university and, in some cases, were young people striving for an academic career. The second region with the most contributors was Setúbal, a coastal city traditionally linked to fishing and with an important seaport (Gamito-Marques, 2018). It is worth noting that, except for the collaborators from Coimbra, who were actively pursuing an academic career, those who contributed specimens to the museum did not have a main scientific occupation. It would be worthwhile in the future to delve deeper into the reasons and motivations that led to their participation and engagement.

Besides the documentation analysis mentioned above, old publications are also being analysed. These provide examples of calls made by academics for the population's contribution to science, not only through the biological record but also through wider contributions such as correcting inaccuracies. In the 1896 book on the birds of the Iberian Peninsula (Paulino d'Oliveira, 1896), one of the classic works of Portuguese ornithology, Manuel Paulino d'Oliveira (1837–1899), professor at the University of Coimbra and director of its museum, includes the following passage:

> if hunters take note of any faults or inaccuracies they may find in this work, based on their observations, and use them for their own col[lections] or send to museums the new or r[are] spe[cies] they find, hunting will become more attractive to them, and they will greatly help future ornithologists. (p. 126)

Nowadays, some citizen science projects in Portugal are trying to find ways of involving hunters and fishermen in biodiversity monitoring, so it is worth bringing to light the results of the engagement of these communities in the past so that today's communities feel a greater drive to contribute to scientific development.

6. The Present of Citizen Science in Portugal

As we have seen from the previous examples, citizen science in Portugal is far from being a new practice. However, it still has little projection compared to what happens in other countries. Nevertheless, it has gained more momentum over the last decade.

In the Portuguese case, as in many other national contexts, organising and gathering efforts around the community that already promotes citizen science initiatives is important. It is also essential to create a broader plan to disseminate the potential of citizen science, both for greater and faster progress in scientific research and for a closer relationship between science and society at large. In 2017, a first step was taken with the organisation of the first "Encontro Nacional de Ciência Cidadã" (Portuguese Citizen Science Meeting), promoted by the then Secretary of State for Science, Technology and Higher Education. This first meeting sought to bring together for the first time the communities involved in citizen science initiatives in Portugal to highlight experiences, pathways and examples of actions in this area and launch the debate for the creation of a national strategy for citizen science. The "2.º Encontro Nacional de Ciência Cidadã" (2nd Portuguese Citizen Science Meeting) was held in 2019. It was promoted by several national institutions and aimed at bringing together all involved in citizen science initiatives interested in learning more about this topic from inside and outside academia. It also sought to debate the creation of a citizen science network in Portugal and a national portal for the dissemination and aggregation of projects and initiatives in this area. Although not yet formalized, the Portuguese Citizen Science Network (CC.pt) was created. It meets regularly with all members interested in the subject, inside and outside the academy, and has working groups in operation. In 2021, the CC.pt network promoted the "3.º Encontro Nacional de Ciência Cidadã" (3rd Portuguese Citizen Science Meeting), which motto was "building bridges for a participatory science", and is preparing to launch a platform on which it will be possible to view citizen science projects and initiatives taking place in Portugal.

The network is also developing the mapping of ongoing citizen science initiatives in Portugal. However, in a non-exhaustive survey conducted in 2015 (see more detailed information in Conceição & Luís, 2021) and upgraded in 2019 (Piland et al., 2020), it is possible to see that, in Portugal, citizen science projects follow a global pattern, that is., are mostly *contributive* and in the areas of environment and biodiversity (e.g., *BioDiversity4All*, *Invasoras.pt*, *GelAvista*, *Lixo Marinho*). There are also some examples in health (e.g., *Gripenet*, *MosquitoWeb*) and astronomy (e.g., *Sun4All*, *Caçadores de Asteroides*; see Table 1). Some projects are also emerging in the humanities and social sciences (e.g., *Memória para Todos*, *Histórias de Vida*, *Novos Decisores Ciências*), but in smaller numbers than in the other areas. It should be noted that some of the projects stem from the collaboration with international platforms (e.g., *Biodiversity4All*, *Portugal Aves*, *Gripenet*), and it is also worth mentioning that some projects are particularly aimed at the school public (e.g., *Caçadores de Asteroides*, *MEDEA*, *EduMar*). By allowing the engagement of students in scientific research activities, this type of experience familiarizes them with the typical procedures of science production, contributing, at the same

time, with data for the development of scientific knowledge. It is also worth highlighting the emergence in Portugal, albeit very residual, of citizen science initiatives emanating from civil society or public institutions outside the strictly scientific sphere. An example is the *Histórias de Vida* (Life Stories) project, launched by the Oeiras municipal libraries to collect and record the stories of people in the community born before 1955 and cross-reference them with local history.

Project	Scientific area	Brief description	Website
BioDiversity4All	Biology/ biodiversity	An online biodiversity platform, accessible to all, with citizens' records of plants, animals and fungi submission	http://www.biodiversity4all.org/
Caçadores de asteroides	Astronomy	A project for tracking asteroids, coordinated by the University of Texas, where schools from around 40 countries participate, including Portugal	http://nuclio.org/iasc/iasc-pt/
EduMar	Biology/ environment	A project to raise awareness through citizen science practices of 4th and 5th-grade students for preserving the sea and its resources	https://www.biodiversity4all.org/projects/edumar
GelAvista	Biology	A programme that counts on citizen volunteers to obtain data to monitor the populations of gelatine organisms (such as jellyfish) on the Portuguese coast	http://gelavista.ipma.pt/
Gripenet	Health	Monitors the seasonal influenza epidemic through the internet with the voluntary participation of citizens	http://www.gripenet.pt/
Histórias de vida	History	A challenge from the municipal libraries to rediscover the municipality of Oeiras, giving voice to its senior inhabitants to share with the community their stories and memories	http://historiasdevida.cm-oeiras.pt/
Invasoras.pt	Biology	It aims to alert to the problem of biological invasions, to make invasive plants known at a national level and stimulate the active participation of the public both in mapping these species and in control and dissemination activities	http://invasoras.pt/
Lixo Marinho	Environment	This project emerged from the need to produce statistical data and raise awareness about the problem of marine debris. Participants are asked to count and collect marine debris on their beaches	https://lixomarinho.app/
MEDEA	Physics/health	A project to measure electromagnetic fields in the environment, conducted by students from various secondary, vocational and higher education schools in the country	http://medea.spf.pt/
Memória para Todos	History and cultural heritage	This research project invites all citizens to share their personal and family memories of certain historical moments and processes	http://memoriaparatodos.pt/
MosquitoWEB	Health	A project that invites citizens to participate by taking pictures of mosquitoes or by capturing and sending mosquitoes by mail	http://www.mosquitoweb.pt/
Novos Decisores Ciências	Environment	Original research questions co-created between citizens and researchers. In Portugal, a research project on coastal geology commissioned by a group of residents from the Segundo Torrão neighbourhood, Trafaria, Almada, is under development	https://es-la.facebook.com/pg/Torrao2825/posts/
Sun4All	Astronomy	A project to promote astronomy among non-higher education students using a collection of images of the sun	http://www.mat.uc.pt/sun4all/index.php/pt/

Table 1 *Some citizen science projects in Portugal*

Source. Adapted from Conceição and Luís, 2021

Citizen science projects taking place in Portugal (of which only a few examples have been given here) have been increasing every year as this practice becomes more widely known. However, there is still much to be done in studying the implementation and evolution of citizen science in Portugal.

In a survey conducted in late 2016 among the Portuguese scientific community, which results have already been partly reported by Luís et al. (2018), some researchers' lack of knowledge about citizen science or its potential was confirmed. Although the term is no longer completely unknown to many researchers, most see it as more in line with the movement of public awareness of science than exactly as effective public participation in scientific research. Citizen science has gained more prominence at an international and national level. More and more attempts are being made to envisage the future of citizen science. Thus, it is worth understanding the scientific community's perspectives on this practice and the motivations behind creating this type of project by those developing projects involving civil society's participation. Furthermore, given the potential of this engagement of citizens in scientific research, it is also important to understand the real potential of public engagement these projects allow and what motivates society to get involved.

7. The Future of Citizen Science in Portugal

There is not much literature on the motivations for participation in citizen science projects in Portugal. However, there is a study conducted by Tiago et al. (2017) on the influence of motivational factors on the frequency of participation in citizen science activities. This study was based on the analysis of an online survey of participants in the largest platform for recording biodiversity in Portugal, the *BioDiversity4All* platform. The results suggest that working on topics related to the participants' engagement in citizen science initiatives is fundamental to increasing and maintaining their participation. For initial recruitment, especially in countries with a low culture of participation, such as Portugal, external motivation mechanisms may be necessary to ensure higher levels of participation. In the long term, citizen science projects should foster intrinsic motivations, incorporating relationship experiences, capacity building, positive feedback and adapted participation models into the projects.

Understanding what drives society's voluntary participation in citizen science projects is thus key to encouraging their greater engagement and maintaining these projects' long-term sustainability. Participants have diverse motivations, and people from different demographic groups will have different motivations. Further understanding how motivations differ between groups is therefore important so that the implementation of citizen science actions can improve engagement with the communities with which they work. It requires further research to understand participants' different motivations better, track how motivations change throughout the participation process and improve society's engagement in the scientific process.

8. Final Considerations

Much has changed over time regarding the approximation between science and society, and Portugal is no exception. Citizen science projects, not necessarily a novelty as seen by the examples presented, are one of the most interesting developments in this approximation movement. In particular, they configure an approach based on the more active participation of citizens in scientific practice and, ultimately, in exploring new forms of co-creating scientific knowledge in a shared process between scientists and non-scientists.

In Portugal, the experiences of citizen science are growing. Although they still adopt an essentially contributive model, it is expected that, given its huge potential for society's engagement, they will adopt a more collaborative nature. Furthermore, so this practice can effectively take more collaborative characteristics and involve more members of society in the future, it would be interesting to develop studies to understand better what motivates the participation of non-scientists in science, opening doors to a science that is increasingly open and shared.

Translation: Anabela Delgado

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Science Communication and Citizen Science: Strategies for the Ordinary Citizen

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Abstract

Citizen science (CS) is a paradigm shift in communicating scientific findings to society. CS aims to produce knowledge with society and democratize it through participatory approaches between researchers and citizens. International research entities have been developing strategies for communicating about scientific knowledge and getting closer to the citizen. This study aims to identify the strategies for communicating science to ordinary citizens used by international research entities practicing CS. This exploratory and descriptive study used documentary analysis on the websites of 23 internationally recognized scientific entities with relevant work mostly focused on the health area. The text corpus was organized and submitted to the thematic content analysis technique. The results reveal several strategies for communicating science to citizens, such as the review of information materials by citizens prior to their dissemination; courses and training of citizens on issues related to science and science communication; lectures and presentations in schools or informal settings (e.g., cafés, stores, theater plays, stand-up events); and digital information materials with simplified and user-friendly scientific content. Scientific entities tend to promote CS through innovative strategies to get closer to and engage with ordinary citizens.

Keywords

scientific diffusion, citizen science, scientific literacy

Comunicação de Ciência e Ciência Cidadã: Estratégias Para o Cidadão Comum

Resumo

A ciência cidadã (CC) assume-se como uma mudança de paradigma na comunicação de resultados científicos à sociedade. A CC tem como propósito produzir conhecimento com a sociedade e promover a sua democratização por meio de abordagens participativas entre investigadores e cidadãos comuns. Visando aproximar-se do cidadão comum, entidades de investigação internacionais têm vindo a desenvolver estratégias de comunicação do conhecimento científico. O presente estudo tem por objetivo identificar as estratégias para promover a comunicação de ciência aos cidadãos comuns, implementadas por entidades de investigação internacionais que praticam a CC. Trata-se de um estudo exploratório de natureza descritiva, com recurso à análise documental. Foram analisadas as páginas de internet de 23 entidades científicas internacionais, com idoneidade e trabalho relevante, em sua maioria, voltadas para a área da saúde. O corpus textual foi organizado e submetido à técnica de análise de conteúdo temática. Os resultados revelam diversas estratégias de comunicação de ciência para o cidadão comum, entre as quais se destacam: a revisão de materiais informativos por parte dos cidadãos prévia à sua disseminação; cursos e capacitação dos cidadãos sobre temáticas relacionadas com a ciência e comunicação de ciência; palestras e diálogos em ambientes escolares ou informais (e.g., cafés, lojas, espetáculos de teatro, stand-up); materiais informativos digitais de conteúdo científico simplificado e amigável. Verifica-se uma tendência das entidades científicas para promover a CC, através de estratégias inovadoras que visam a aproximação ao cidadão comum e o seu envolvimento.

Palavras-chave

divulgação científica, ciência cidadã, literacia científica

1. Introduction

Science communication in health has evolved significantly worldwide, despite being a recent discipline (Magalhães et al., 2021). It has emerged due to the growing need to ensure that academic knowledge is a driver for societal behavioral changes. Despite the commitment to science communication, science is usually communicated through traditional approaches based on the transfer of scientific knowledge, neglecting the democratization of knowledge (Jünger & Fähnrich, 2020).

Emerging situations, such as the public health crisis caused by the COVID-19 pandemic, further encourage reflection on the characteristics of this communication process. Therefore, it is paramount to identify the strategies used and the level of citizen involvement in science communication. Researchers and academics should address and discuss the following questions: what scientific information do citizens want to receive; how do they want to receive it; what is the most appropriate format; and what type of language should be used?

Citizen science (CS) is a growing field of research and practice that can be used to overcome the traditional and unidirectional paradigm that has long guided the production and dissemination of knowledge. CS involves engaging citizens throughout the

research cycle and thereby learning about what is truly important to society (Roche et al., 2020; Wu et al., 2019).

By involving citizens in the research process, CS brings researchers and society closer together, benefiting both parties due to this close relationship and collaborative work (Bento et al., 2016; Roche et al., 2020). For researchers, the goal is to develop more relevant research that focuses on the real needs of individuals and more easily responds to the sustainable development goals of the United Nations (United Nations, n.d.). For citizens, it facilitates their collaboration in knowledge coproduction and promotes the exchange of experiences and engagement. These processes increase awareness, literacy, and empowerment to guide decision-making processes in health and the sociopolitical context (Goi & Tan, 2021; Roche et al., 2020).

In health care, although CS is still an underexplored area, renowned institutions such as the National Institute for Health Research, the Research Governance Framework for Health and Social Care, the Research and Development Directorate of the National Health Service, and the National Institutes for Health advocate this good practice. They believe that citizen, patient, family, and caregiver engagement should be a priority area of research requiring further analysis (Ahmed & Palermo, 2010; Hayes et al., 2012; Vale, 2012).

Communication and dissemination of scientific knowledge are crucial steps in the research cycle, and as such, they should follow specific formats and occur in spaces closer to the citizens. Therefore, this study aims to identify the strategies for communicating science to ordinary citizens used by international research entities that practice CS.

2. Method

This exploratory and descriptive study had the following research question: what strategies for communicating science to ordinary citizens are used by international scientific entities that practice CS?

A purposive sample of websites of renowned international scientific entities with relevant work in CS was analyzed. This study included entities that put forward specific actions or initiatives for communicating science to the citizens in their website menus and/or have ongoing or completed research projects based on the CS paradigm.

This study was conducted in December 2021. Data were obtained from the websites of these entities.

Knowing in advance that the ideal sampling technique in this type of study translates the dimensions of the phenomenon, both in quantity and intensity, a sufficiently comprehensive text corpus was identified, which resulted in data saturation (Green & Thorogood, 2018).

The text corpus consisted of the content extracted from these websites. It was then translated into Portuguese by Elaine Santana and validated by Rosa Silva (both authors), organized using Microsoft Excel, and analyzed using the content analysis technique proposed

by Bardin (1977/2016). According to the principles of this technique, content analysis allows exploring the information contained in the messages through systematic procedures, that is, their meanings and significance, revealing what lies behind the analyzed words. By achieving these indicators, content analysis allows the inference of knowledge related to the conditions of production and reception of these messages (Bardin, 1977/2016).

Bardin's (1977/2016) technique for thematic content analysis establishes three chronological phases: (a) pre-analysis, (b) exploration of the material and treatment of the results, and (c) inference and interpretation. In the pre-analysis, the material was organized after skimming the text, which later resulted in formulating objectives and hypotheses that grounded the interpretation. In the second phase, the material was explored and organized into data coded by the registration unit. Finally, in the third and last phase, data were treated based on their similarities and differences, then categorized and regrouped according to their similar characteristics (Bardin, 1977/2016).

Word clouds were built to represent each category using the Tagul Cloud online word cloud generator to facilitate the analysis and presentation of results. This resource helps to better visualize the categories and analyze the content because it identifies the most frequent words, culminating with their graphic representation in a word cloud.

There was no need for ethical review of this study because it did not involve human beings (no contact of any nature was made with those responsible for the websites or individuals who integrated the analyzed strategies), and data were collected exclusively from open-access websites.

3. Results

A total of 23 websites of international scientific entities were analyzed, 16 of which met the inclusion criteria. They present science communication actions or initiatives to the citizens on their websites. Consequently, the eligible text corpus consisted of 12 websites of scientific organizations/associations, two websites of research centers, and two websites of governmental agencies/institutions (Table 1).

ID	Entity	Country	Association/ organization	Research centers	Governmental agency
E1	Comprehensive Clinical Trials Unit — University College London	United Kingdom		X	X
E2	National Institutes for Health Research	United Kingdom			
E3	European Patients' Academy on Therapeutic Innovation	European Union	X		
E4	Imperial College London	England		X	
E5	Voice	United Kingdom	X		
E6	Crohn's and Colitis UK	United Kingdom	X		
E7	European Citizen Science Association	European Union	X		
E8	Vetenskap & Allmänhet	Sweden	X		
E9	Health and Care Research Wales	Wales, United Kingdom	X		
E10	Scientific American/ Springer Nature	United States of America	X		
E11	Scottish Intercollegiate Guidelines Network	Scotland	X		
E12	Value for Health CoLAB	Portugal	X		
E13	Agency for Clinical Research and Biomedical Innovation	Portugal			X
E14	Australian Citizen Science Association	Australia	X		
E15	International Consortium for Health Outcomes Measurement	United States of America	X		
E16	Cochrane Collaboration	United Kingdom	X		

Table 1 *Characterization of the scientific entities per type and country*

Four categories emerged from the analysis: "citizen engagement", "citizen empowerment", "usual and innovative interactions", and "communicating with accessible resources and formats".

The analytical categories are presented below. The category "citizen engagement" highlights science communication strategies that enable ordinary citizens to be engaged and actively participate in the research process.

As shown in the word cloud (Figure 1), the analyzed information indicates that some scientific entities involve the citizen in science communication through groups, such as patient groups. These citizens can be representatives who collaborate in evidence reviews and give their opinion about information materials that will be shared with society.

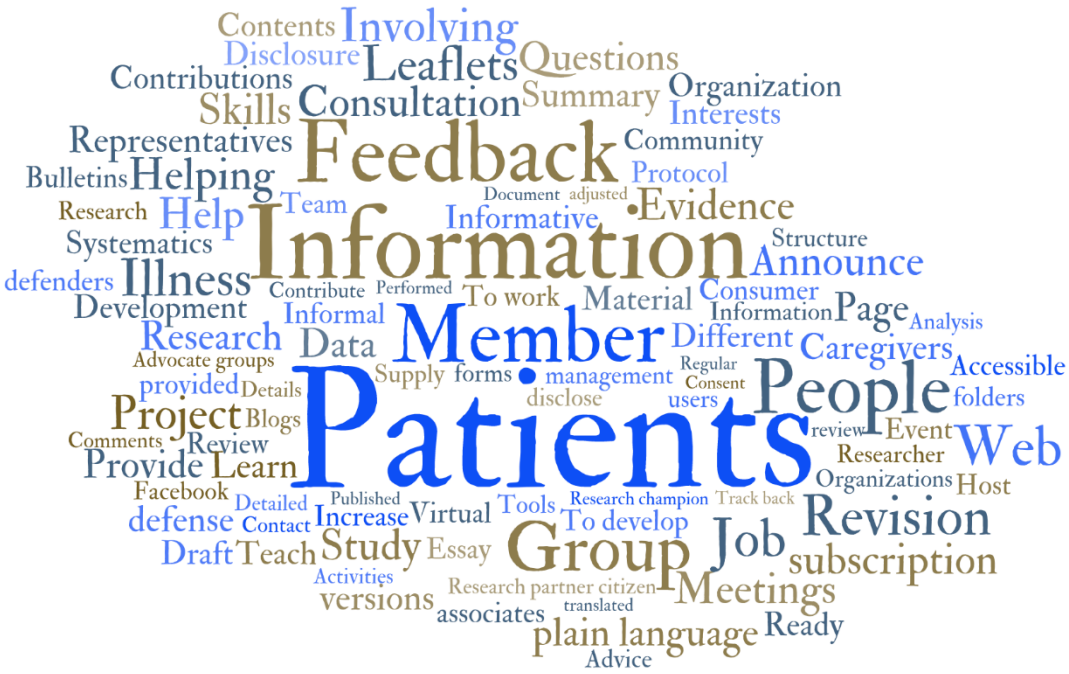

Figure 1 *Citizen engagement*

These strategies can be observed in the excerpts below:

- "patients provide feedback on the information leaflets we design and simplify the scientific language" (E1);
- "Reader Volunteers provide feedback on our information resources, (...) help us to improve our information, making sure it is relevant and easy to understand" (E6);
- "the role of a Research Champion is to be part of a research project, attending meetings, sharing their own views and experiences" (E6);
- "citizens [patients] provide feedback on the draft versions of our sets [sets of informational materials]" (E15);
- "citizen research partners, global teams, and advocacy groups are coproducers of information leaflets" (E15);
- "citizen [patients with Cushing's disease] and patient organizations announced and disseminated information about the studies on Cushing's disease" (E3).

The category "citizen empowerment" represents a strategy used by the entities to empower the ordinary citizen in science communication and increase their literacy

in their topics of interest, transforming them into disseminators and multipliers of this knowledge.

The following excerpts include the strategies identified in this category:

- "mini-course: health technology and medicines safety to foster patient involvement in co-construction and co-validation" (E3);
- "workshop: to encourage citizens to share their opinions to help improve the acceptance of lung function testing" (E4);
- "training platform: raises citizen awareness about the importance of protecting biodiversity by organizing citizen science activities" (E7);
- "a free online resource offering an introduction to health evidence, and how to use it to make informed health choices" (E16);
- "interactive courses in a storytelling format, with readings, videos, audio, questionnaires, including self-assessment processes of the knowledge acquired" (E16);
- "training: Collections of resources that offer the opportunity to develop self-directed online learning through online courses, individual learning modules, videos, slideshows, webinars, international workshops, conferences, scripts, and manuals" (E16).

Figure 2 shows several capacity-building strategies, such as workshops, forums, webinars, modules, courses, and mini-courses in digital format. These strategies work as a guided resource to raise awareness and empower ordinary citizens to communicate science and are illustrated by the highlights in the word cloud.

Figure 2 *Citizen empowerment*

The category "usual and innovative interactions" highlights the strategies that involve both conventional initiatives, such as lectures, meetings, and open classes, and innovative initiatives, such as discussions in non-academic environments (e.g., cafés and city squares) to make the dialogue simpler and closer to the citizen.

Conventional interaction strategies are illustrated in the following excerpts:

- "dialogue between researchers and the public (...) a project connecting Swedish schools with scientists" (E8);

- "lectures and debates: panel with researchers to promote a dynamic conversation" (E8);
- "we have already jointly given a talk (speakers are researchers, experts, but also citizens, in this case, people with cancer) at the Rare Cancer Forum" (E9).

The promotion of debates in non-academic spaces for casual and informal interaction is demonstrated in the following excerpts:

- "sipping science with a science café" (E8);
- "exhibitions: poster displays, outdoor exhibitions, museum exhibitions, traveling exhibitions, film screenings, art exhibitions, photography exhibitions" (E8);
- "shop with researchers: researchers are available to answer questions about the products on sale/display" (E8);
- "visits, tours, and open-house events: bus tours with researchers, city walking tours, excursions, study tour; open-house events or visits to various research facilities such as laboratories, research facilities, Science Centers, zoos, and museums" (E8);
- "Science square: researchers are available to answer questions and talk with visitors. It is an easy way to create opportunities for dialogue" (E8);
- "borrow a scientist: researchers visit schools or workplaces at the request of the participants" (E8).

In this category, the use of artistic language by the entities also stands out as an innovative resource to communicate science to ordinary citizens:

- "theatrical production on the challenges of aging" (E5);
- "demonstrations and theater: Forum theater, an interactive form of theater in which the audience gets the opportunity to change and influence the performance" (E8);
- "comical and poetic performances revolving around the beautiful and fantastic aspects of physics and the universe" (E8);
- "stand-up: an unconventional and attractive format for science communication" (E8).

Figure 3 shows the word cloud that characterizes these strategies. On their websites, the entities revealed how they communicate science and highlighted the need to bring researchers closer to citizens. This approach involves interaction activities, school visits, open classes, meetings, and discussion groups. More casual events included exhibitions, theater performances, museum visits, and science dissemination events in cafés or shops.

Figure 3 *Usual and innovative interactions*

The use of strategies that prioritize making scientific knowledge available in an accessible format is highlighted by the category "communicating with accessible resources and formats".

These strategies focus on providing citizens access to information materials with high-quality scientific content in a friendly language at a click.

This concern can be seen in the following excerpts:

- "openly accessible versions of articles" (E9);
- "lay abstracts to be published on the website (...) about diabetes" (E9);
- "booklets with patient-friendly versions of guidelines that 'translate' recommendations and their rationale from clinical guidelines for health professionals into a more easily understandable and usable format for patients and the public" (E11);
- "publication of plain language texts, opinion articles, and interviews" (E13);
- "plain language summaries: they are created using standard content, structure, and language to ease understanding and translation" (E16);
- "sets of patient-centered outcome measures, including all reference guides, leaflets, 'data dictionaries', and press releases, are available free of charge" (E15).

In order to intensify the communication of science, research centers and their affiliates/partners reaffirm the commitment to make scientific knowledge available and accessible through plain language. Digital platforms (in some cases, collaboration in the design of information materials is possible), social networks (e.g., Facebook, Twitter, and Instagram), and other innovative tools were used to integrate the new characteristics of the science communication process, as can be seen in the following excerpts:

- "digital platform designed to promote health literacy in society" (E12);
- "COVID-19 Collaborative glossary in partnership with several institutions (...). Terminological resource for non-specialists. 'This collaborative glossary comprises the terminology used by official health care agencies, healthcare professionals, (...) allow access to organized terminological information on the disease, in clear, easy-to-understand language'" (E12);
- "educational application to educate citizens about how to manage rainwater in the urban fabric" (E7);
- "interactive website on the developed projects and initiatives: Blog, News, Videos, document Library" (E9);
- "video of the findings: share, in a report and video format, the experiences of the people involved in the study through publication in journals, websites, and social media" (E9);
- "podcasts, videos, multimedia, photo features, and other forms of storytelling" (E10);
- "digital platform to increase environmental awareness" (E14);
- "blogs, targeted emails, audio/visual products, blog posts (video blogs), podcasts, infographics, videos, social media (Twitter, Facebook, Instagram) and Wikipedia" (E16).

Figure 4 shows a representation of the main strategies, demonstrating that the entities share information materials through digital resources, such as videos, websites, blogs, podcasts, and social networks. The entities also ensured that this information and evidence (in the form of summaries, reports, or other information products) meet the criterion of accessibility and use plain language that is close to ordinary citizens.

Figure 4 *Communicating with accessible resources and formats*

4. Discussion

According to the CS paradigm for doing and communicating science, the practices of scientific and non-scientific actors should be readjusted to co-construct innovative research ecosystems (Bento et al., 2016). In the current international scenario, several initiatives have considered the innovative potential of transforming the citizen into a scientific communicator by focusing CS on the real needs of citizens and their social context (Silva et al., 2021).

Citizen engagement allows recognizing citizens' knowledge, interests, and motivations as members and representatives of society, so it is important to build sensitive science communication close to the citizens that leads to better decision-making processes (Besley et al., 2015).

In line with the findings of this study, the involvement of ordinary citizens in science communication has been encouraged through the creation of representative groups (e.g., citizen research partners, advocate groups, research champions) aimed to coproduce the materials in plain language through reviews (i.e., feedback; Campos et al., 2021; South et al., 2016; Ward et al., 2020).

The strategies identified in the "citizen engagement" category demonstrate that the involvement of ordinary citizens in science communication facilitates the process of transferring scientific knowledge to society. This involvement can be developed at different levels of proactivity, designated in the literature as different types of public involvement (Hayes et al., 2012). Concerning the different levels of citizen engagement identified

in the literature on CS, many researchers, mainly in the health area, recognize that citizen engagement can occur based on three types of approaches: (a) consultation, (b) collaboration, and (c) coproduction (Biddle et al., 2021; Hayes et al., 2012; Hickey, 2018).

The consultation approach consists of organizing meetings or consultative groups to gather opinions from citizens (patients [experts], caregivers, or stakeholders) interactively and systematically.

On the other hand, the collaboration approach involves partnerships with citizens, and research champions, advocate groups, or citizen research partners are elected. These citizens will participate in shared decision-making with researchers and be involved in meetings, workshops, working groups, panels, or committees. Finally, the coproduction approach consists of the active participation of citizens as members of the research team in the research's control, direction, and management. In the context of communication, the citizen coproducer can participate as a translator, reviewer, and coauthor of the content that will be shared (Biddle et al., 2021; Hayes et al., 2012; Hickey, 2018).

It is important to clarify that the engagement strategies identified in the analysis of the text corpus fall within these three types of approaches. In this case, the contribution of these citizens, through the adaptation of information materials to a more straightforward and accessible language, takes the form of a consultation approach. Strategies such as coauthoring shared content and identifying citizens' representatives to share their experiences in workshops and meetings are part of coproduction and collaboration approaches.

The premise of science communication within CS is to bring citizens closer to research contexts and academic processes, demonstrating that ordinary people's opinions, experiences, and knowledge have great relevance (Oliveira & Carvalho, 2015). This premise seems to be a priority of the analyzed entities.

According to Campos et al. (2011), besides empowering citizens for concerted participation in science communication, the strategies in the "citizen empowerment" category provide the opportunity for social interaction with other citizens and with the researchers themselves.

Reaffirming the primary goal of science communication, especially in raising health awareness, it is paramount that science communication contributes to and allows engaging and empowering both citizens and the society in which they are inserted (Richter et al., 2019; Schiavo, 2014). Moreover, giving ordinary citizens opportunities for exchanging experiences and acquiring knowledge helps build trusting relationships and value science (Amaral et al., 2017).

The transition movement in scientific production, which tends to be increasingly focused on problem-solving, impels citizens to assume an active collaboration so that the knowledge produced and shared is relevant and applicable in practice (Bento et al., 2016). The answer to the challenge of countering misinformation may lie in restoring society's respect and trust in science. Given the arguments already presented, getting closer to the citizens through the CS paradigm will certainly bring science and society

closer together. Thus, the interaction and dialogue between researchers and citizens is a strategy with great potential used by international entities.

However, as presented by the "usual and innovative interactions" category, despite the growing movement towards openness in the processes of creation and dissemination of scientific knowledge, many researchers and research centers continue to implement interventions focused on informing rather than on communication, interaction, and the development of a trust-based relationship with citizens. This aspect is confirmed by Dudo and Besley (2016) in a study aimed to explore how scientist communicators evaluate five specific communication objectives. The authors concluded that the main priority in science communication is educating the population and fighting misinformation, while the least prioritized aspect is building a trust-based relationship with society (Dudo & Besley, 2016). Therefore, reaffirming the challenge of science to develop innovative forms of communication and promote the trust and interest of society in scientific topics, future initiatives should include several stakeholders, whether they are researchers in natural, social, and health sciences, citizens, or political agents, and diversify the resources and spaces where this sharing of knowledge can occur (Bento et al., 2016).

In this regard, the innovative strategies used in some interventions by the entities analyzed in this study promote the approximation process and add value because they prioritize communication in informal and relaxed environments or environments familiar to citizens. These situations are more likely to arouse interest in exchanging experiences and learning (Amaral et al., 2017; Ward et al., 2020). Moreover, the use of artistic languages, such as theater or comedy, is described in the literature as an innovative resource to communicate and engage citizens in science-related topics (Amaral et al., 2017; Pinto et al., 2015; Riesch, 2015).

Through these creative ways, researchers become more involved in society and better scientific communicators, helping the general public to better understand science-related topics by the general public, especially through the emotions and awareness that theater and laughter provide (Amaral et al., 2017; Bultitude & Sardo, 2012; Richter et al., 2019; Riesch, 2015).

As to provide simple and clear scientific knowledge, the strategies in the "communicating with accessible resources and formats" category are in line with the initiatives in the "citizen engagement" category, demonstrating that the use of a language accessible in several formats brings citizens closer to science-related topics to increase their awareness and literacy is a common concern.

Therefore, given the wide reach of the internet and its contribution to health awareness and promotion, the analyzed entities recognize the importance of introducing digital tools in their communication processes to provide reliable and easily accessible scientific content (Magalhães et al., 2021; Mheidly & Fares, 2020). However, the development of digital resources increases the concern with the quality of what is made available and consumed on social networks. For this reason, it is even more important that science

communication reaches the most diversified settings, namely digital environments, as seen in the strategies identified in this study.

In the era of hyperconnectivity, digital tools are crucial to combat misinformation and the negative influence of distorting mechanisms on shaping public opinion and reducing trust in science (Haklay, 2018).

Pulido et al. (2020) analyzed the tweets published on February 6 and 7, 2020, on the social network Twitter and found that false information was "tweeted" more than science-based evidence, which leads to an important reflection on the responsibility of communicating science in the field of public health.

Science communication within this new paradigm of CS has major potential for improving the quality of access to knowledge and increasing the involvement of ordinary citizens, who will now be included in the development and dissemination of scientific knowledge (Edwards et al., 2018).

Therefore, the results of this study are of practical utility for scientists and science communicators. They promote the recognition of the work of those who already develop this practice and encourage the adoption of similar strategies by those researchers and research units that still have not included these initiatives in their work plans.

Concerning limitations, some entities with recognized work in this area may have been excluded due to the small sample size and the selection strategy. Therefore, interesting data may have been lost.

5. Conclusion

Regarding implications for practice, we conclude that the strategies for citizen engagement in science communication processes were more frequent among the analyzed entities, with the main objective of bringing scientific knowledge closer to the citizen through accessible and attractive formats. We recommend the implementation of initiatives to transform ordinary citizens into team members, promoting their involvement through consultation, collaboration, and coproduction approaches.

However, it should be noted that the information on the websites included in this sample does not allow checking if these strategies are sufficient, relevant, or still incipient or analyzing the meaning attributed to them by citizens or researchers. Therefore, this topic requires further exploration, namely by listing the gaps to be addressed in future studies and assessing the impact of these strategies.

The entities recognize the importance of science reaching the population through different formats, usual strategies, and innovative tools that promote greater interest, understanding, and appreciation of these topics.

Another implemented strategy was citizen empowerment through workshops, courses, and practical meetings to communicate science by translating scientific terms into a more accessible language, sharing experiences, and promoting health literacy.

Innovative ways to communicate science were highlighted, namely strategies of interaction between researchers and citizens in unconventional spaces, such as cafés/pubs, theaters, stores, and city squares, promoting a conversational approach. However, most of these initiatives were implemented by a single entity, which shows that, despite the progress in deconstructing the standardized and citizen-distant model of science communication, it still needs further analysis.

As for the implications for research, we believe there is an urgent need to explore the issues surrounding CS and its impact on the processes of doing and communicating science. The effects of these initiatives must be evaluated and measured to help build knowledge in this area and improve the quality and effectiveness of these initiatives.

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Science and Technology: Youth Perception in the City of Rio de Janeiro

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Abstract

Numerous challenges faced by contemporary democracies are related to circulation, social appropriation, and debate on and use of technoscientific knowledge. As such, the study of science and technology perceptions, as well as attitudes and practices in knowledge appropriation across diverse strata of the population, are today a central theme in both academic and administrative contexts regarding indicator and policy design. In this context, one demographic stands out for its peculiarities: individuals between 18 and 24 years old, born and raised in the presence of the internet in Brazil, arriving at adulthood through a socialization process in which online platforms, along with school and family environments, played a central role. This study adopted a qualitative approach to explore, investigate, and contextualize this demographic's opinions and perceptions of science and technology, conducting five in-depth interviews followed by five group discussions with young residents of Rio de Janeiro city. We collected a rich trove of data from these individuals that presents a positive perspective on science and technology, recognition of its benefits and risks, and connections of related activity to social context, eliciting reflections and potential for establishing dialogue and communication.

Keywords

science communication, youth, young people, science and technology, science and society

Ciência e Tecnologia: Percepções de Jovens da Cidade do Rio de Janeiro

Resumo

Muitos dos desafios das democracias contemporâneas estão ligados à circulação, à apropriação social, à discussão e ao uso do conhecimento tecnocientífico. Nesse sentido, estudar

percepções sobre a ciência e a tecnologia, atitudes e práticas de apropriação do conhecimento de diversos públicos é hoje um tema central tanto no contexto acadêmico como para gestores, para a construção de indicadores de avaliação e criação de políticas. Nesse contexto, um público se destaca pelas suas particularidades: os jovens com idade entre 18 e 24 anos, que nasceram e cresceram juntos com a internet no Brasil, chegando à vida adulta a partir de uma socialização em que não tiveram papel central apenas a escola e a família, mas também os fluxos de informação e as práticas de sociabilidade em redes online. Com o objetivo de explorar, aprofundar e contextualizar opiniões e percepções destes jovens sobre ciência e tecnologia, realizamos neste estudo, de caráter qualitativo, cinco entrevistas em profundidade, seguidas de cinco grupos de discussão com jovens residentes da cidade do Rio de Janeiro. Coletamos um rico corpus junto a esses jovens que apresentaram uma visão positiva da ciência e tecnologia, reconhecendo seus benefícios e riscos, vinculando a atuação da área ao contexto social e trazendo-nos reflexões e possibilidades para estabelecer diálogos e processos comunicacionais.

Palavras-chave

divulgação científica, juventude, jovens, ciência e tecnologia, ciência e sociedade

1. Introduction

Complex scientific issues are currently in constant debate in the public sphere, and understanding these debates should be possible for all members of society (Brossard & Lewenstein, 2009). The relationship of the scientific community with the lay public primarily manifests through public science communication initiatives composed of individuals involved in creating and producing scientific knowledge. Aside from its influential utility in quotidian decision-making and the strengthening of democracy, the diffusion of scientific culture also carries aesthetic, intellectual, and moral connotations (Castelfranchi, 2010).

According to Castelfranchi et al. (2016), surveys[1] of public perception and scientific culture indicators aid in improving science communication and dissemination practices, as well as the social appropriation of science. In this context, the study of diverse populations, with their peculiar characteristics and repertoires, contributes to the consolidation of a body of knowledge, establishing formats for public science and technology (S&T) communication that are better tailored to each of these demographics. Such studies have been performed in numerous countries (Dudo & Besley, 2016) with the objectives of understanding scientists' public engagement and their challenges and priorities in science communication, contributing to the formulation of indicators for the monitoring of S&T social appropriation practices (Daza-Caicedo et al., 2017).

In Brazil, perception studies were most notably carried out on a national level in the years 1986, 2006, 2010, 2015, and 2019. The most recent survey, performed by the Center for Administrative and Strategic Studies (Centro de Gestão e Estudos Estratégicos, 2019), confirms what other studies had already indicated: that the average Brazilian is

[1] The term "survey" is adopted in Brazil for quantitative opinion research, while the term "inquiry" is not usual, and the term "poll" is preferred when it comes to research without a representative sample, or not based on scientific methodology.

interested in S&T subjects, recognizes the importance and benefits of scientific research, and lacks information regarding science and scientists, as well as confirming extremely unequal levels of access to scientific knowledge.

The first step of this study was identifying studies/surveys that made at least partial data available on individuals between 18–24 years of age and that did not focus on formal, scholastic science education or restrict participants to currently enrolled students. The following were identified: *Science in My Future* (Haste, 2004), *Percepção Pública da Ciência e Tecnologia no Brasil* (Public Perception of Science and Technology in Brazil; Ministério da Ciência e Tecnologia, 2006), "Percepção Pública da Ciência e da Tecnologia no Estado de São Paulo" (Public Perception of Science and Technology in the State of São Paulo; Vogt, 2011), *Young People and Science* (European Commission, 2008), "Ciencia y Tecnología: ¿En qué Piensan los Jóvenes 2.0?" (Science and Technology: What Do Young People Think 2.0?; González, 2011), *Os Mineiros e a Ciência: Primeira Pesquisa do Estado de Minas Gerais Sobre Percepção Pública da Ciência e Tecnologia* (Citizens of Minas Gerais and Science: The First State Level Study in Minas Gerais on Public Perceptions of Science and Technology; Castelfranchi et al., 2016), and *A Ciência e a Tecnologia no Olhar dos Brasileiros: Percepção Pública da C&T no Brasil – 2015* (Science and Technology in the Eyes of Brazilians: Public S&T Perceptions in Brazil – 2015; Centro de Gestão e Estudos Estratégicos, 2017). Upon identifying the lack of studies focused on young people at a national level, the National Institute of Science and Technology and Science and Technology Public Communication (INCT-CPCT) performed the first study of this kind that focused on young Brazilians: *O que os Jovens Brasileiros Pensam da Ciência e Tecnologia?* (What Do Young Brazilians Think About Science and Technology?; Massarani et al., 2021). The qualitative results presented in this article are part of one of the phases of this project.

The concept of youth varies in its definition throughout history and is molded to social, economic, and cultural contexts (Abramovay & Castro, 2015; Cassab, 2011). With regard to the design of public policy and empirical studies, many institutions and national and international organizations have established socio-demographic criteria for the study of youth. The United Nations Organization for Education, Science, and Technology (Organização das Nações Unidas para a Educação, Ciência e Tecnologia, 2004), following the United Nations guidelines defined at the 1985 General Assembly, assumes an age range of 15 to 24 years, flexible at both extremes and considering contextual specificities.

Brazilian youths who, in 2018, were between 18 and 24 years old (this study's target demographic) present relevant and peculiar characteristics made possible by the advances in science and information technology. These individuals were born and raised in the presence of the internet in Brazil. Their language, tone, and forms of communication are influenced by various online socialization processes. They typically intensely interact with and appropriate the information — and disinformation — present on the internet ecosystem, experiencing ease in finding, editing, publishing, sharing, and discussing diverse subjects.

Castells (1996/1999) has previously indicated that humanity is engaged in a network communication system that permeates society, establishing a universal language

that promotes global societal integration that simultaneously incentivizes the potential for personalization and generates spontaneous communications with various goals and motives for specific individuals' participation. According to Castells (1996/1999), "interactive computer-based networks are growing exponentially, creating new forms and channels of communication, molding life and, at the same time, being molded by it" (p. 40).

According to the *Pesquisa Brasileira de Mídia 2016: Hábitos de Consumo de Mídia Pela População Brasileira* (Brazilian Media Research 2016: Media Consumption Habits in the Brazilian Population; Brasil, 2016), carried out in 2016 among young people between the ages of 18 and 24 years old, the internet is the primary informative medium for subjects related to Brazil (50%), followed by television, which, though in decline, continues to be relevant (44%), radio (3%) and print news (2%). Social networks cannot be excluded from this conversation, as they are strongly present in the daily routines of individuals in this age range. In 2019, the Fundação Telefônica (2019) published a study titled *Juventudes e Conexões* (Youth and Connections), revealing that 97% of young people between the ages of 15 and 29 years old that had used the internet in the previous 3 months had accessed at least one social network an average of 5.5 times per week, with 80% creating/posting content on these networks at an average frequency of three times per week.

In July 2018, the Facebook group released its first quarter performance report indicating that the Facebook platform had 127,000,000 active users in Brazil (Valente, 2018). The *Mídia Dados Brasil 2018* (Brazil Media Data 2018; Grupo de Mídia São Paulo, 2018)[2] publication discusses the importance of the transit of content across different platforms:

> one-third of young people post what they watch on TV to social networks. They are impacted by this and search for more information on the internet. That is to say, these conversations continue and circulate between platforms, demonstrating the necessity of understanding this context. (p. 45)

Themes involving S&T are present in this ecosystem of information access and sharing, provoking reflections on the necessity of the construction or consolidation of orientations and connections between public communication apparatuses and young people, taking their repertoire and an understanding of the changes brought about by the development of information and communication technologies into consideration.

This study explores young people's perception of S&T in the city of Rio de Janeiro, the cultural diffusion of technoscientific themes in these young people's priorities, and the sources of information that they use to inform themselves on such subjects, as well as possible connection points between these young people and public science communication.

2. Methodology

This article is the result of a study incorporated into a larger project carried out by the INCT-CPCT with support from the National Council for Scientific and Technological

[2] *Mídia Dados Brasil* (Brazil Media Data), an annual Brazilian media industry publication made available by the Grupo de Mídia São Paulo.

Development, and the Carlos Chagas Filho Foundation for Supporting Research in the State of Rio de Janeiro. It can be characterized as an interdisciplinary and interinstitutional study with national scope and the objectives of exploring, identifying, and establishing — using qualitative and quantitative techniques — what young Brazilians think about S&T (Massarani et al., 2021). This study was approved by the Ethics Committee of the Joaquim Venâncio Polytechnic School of Health/Fiocruz/RJ (Ethics Certificate CAAE 86632218.2.1001.5241/report -2.808.981).

In the stage presented in this article of this larger study, the authors carried out a qualitative research project intending to explore young people's (ages 18–24) methods of scientific cultural appropriation, as well as the perceptions and representations of S&T themes, through in-depth interviews and discussion groups held between October 25th and December 19th, 2018, in Rio de Janeiro city.

This qualitative approach complemented the body of numerical data collected during the quantitative phase of the project. That, according to Minayo and Sanches (1993), contributes to the "exploration of the complexity of the phenomena, facts, and specific processes present in groups that are more or less delimited in their range and capacity to be 'intensely investigated'" (p. 247). Gaskell (2000/2002) also suggests that "the deeper understanding offered by qualitative interviews can provide valuable contextual information that aids in the understanding of specific findings" (pp. 65–66), though it is clearly an approach that does not endeavor to generalize its results to populations beyond the groups that were studied.

2.1. The City of Rio de Janeiro

In 2018, according to the census estimates published by the Brazilian Institute of Geography and Statistics (Instituto Brasileiro de Geografia e Estatística, n.d.), the city of Rio de Janeiro was inhabited by approximately 6,700,000 people, with a population density of 5,300 residents per square kilometer, a labor force participation rate of 40.6%, and 15 to 29-year-olds representing 23.29% of the population.

This exploratory study investigated residents of the north side and south side areas of Rio de Janeiro City aged between 18 and 24; the west side area (the third of the city's three major regions) was not included. The choice to study the north and south sides was made due to their socioeconomic and cultural differences. The north side of Rio de Janeiro is the most densely populated region of the city, containing 87 districts and 42% of the city's population. The downtown/south side area contains 39 districts and is the least densely populated of the city's three geographic regions. Downtown/south side household income was estimated in July of 2010 to be triple that of the north side. Another striking difference between the two regions is that 54% of the city's formal employment is located in the downtown/south side area. Individuals between 15 and 29 years of age account for 22% of the downtown/south side population and 25% of the north side population (Serviço Brasileiro de Apoio às Micro e Pequenas Empresas, 2015).

It is important to highlight that, concerning the 2000 human development index report[3], eight of the 10 highest scoring districts in Rio de Janeiro City were located in the south side, and seven of the 10 lowest scoring districts were located in the north side (Prefeitura da Cidade do Rio de Janeiro, 2019).

Data collection procedures for this study involved 20 young residents of the north and south sides of Rio de Janeiro, with five of them participating in both activities (in-depth interviews and discussion groups) and the other 15 participating only in discussion groups, for a total of five individual, in-depth interviews and five discussion groups, each one of which was participated in by the interviewed individual and friends invited at their discretion. The selection of in-depth interview subjects was initially guided by recommendations of social workers and residents of the areas studied, modified regarding the socioeconomic differences of the individual's place of residence (north and south sides) as well as their and their parents' levels of education, seeking to establish a diversity of viewpoints, cultural capital, and forms of access to and use of technology and information, as well as differences in socialization.

The five selected individuals invited two to four friends each from their social circle to participate in the discussion groups that fit the criteria of being 18–24 years old, owners of cell phones with internet connectivity (Wi-Fi or network provider plan and/or access to computers, laptops, or tablets), and residents of Rio de Janeiro City, with at least one member of each sex. The discussion groups' compositions were developed using the "snowball" technique.

The choice to study peer-groups, the familiarity of which, according to Gaskell (2000/2002), "at times... is an advantage" (p. 82), provided great value given the characteristics of this demographic and the theme being explored. The discussion groups used the *Nesse Dia das Mães, Vamos Protegê-las* (On This Mother's Day, Let's Protect Them) video to stimulate discussion, posted to youtube by Brazilian influencer Jout Jout Prazer (2018)[4]. In that video, she discourses about the risks that mothers are exposed to through fake news, Facebook check-ins, and sharing who they are with and what they are doing, provoking reflections on fake news and S&T. Moreover, the following nine statements from the national-level survey were used as discussion material (Massarani et al., 2021), covering current themes and controversies in S&T and structured regarding the benefits, risks, and relationships of public policy and citizenship with S&T as follows.

Risks of science and technology:

- Science and technology are responsible for the majority of current environmental problems.
- Science should concern itself with understanding the natural world and not try to change it.
- Science and technology do more harm than good to humanity.

[3] Human development index — a unit of measurement used to determine the degree of development of a given society in the areas of education, health, and income. It was created by Mahbub ul Haq, with the collaboration of Indian economist Amartya Sen, winner of the Nobel Prize in Economics in 1998, and has been adopted by the United Nations Development Programme.

[4] Jout Jout: Julia Tolezano is a Brazilian vlogger, writer, and journalist. She is known for her YouTube channel, *Jout Jout Prazer*, directed toward young people, which currently has over 2,000,000 subscribers. In 2016, the Companhia das Letras (a major Brazilian publishing house) published her first book: *Tá Todo Mundo Mal* (Everybody's Down), which became a national bestseller.

Benefits of science and technology:

- Science and technology will help eliminate poverty and hunger in the world.
- Science and technology are making our lives more comfortable.
- Science is the only trustworthy source of knowledge about the world. Explore: do others exist? If so, what are they?

Science and technology, public policy, and citizenship:

- The people's voice should be heard on big decisions in the areas of science and technology.
- As all governments' resources are limited, and spending more on one thing means spending less on others, the government should increase or at least maintain its investments in scientific and technological investigations over the next few years.
- If science didn't exist, my day would look very different. Explore: how? Why? Would it be better? Would it be worse?

Techniques used in the analysis of the collected material include interpretive textual analysis and thematic analysis based on transcriptions of the in-depth interviews and discussion groups, as the results obtained from the two phases were convergent and treated as a single "body of data", using the three following analytical dimensions as references: attitudes about S&T (exploring, for example, how this demographic expressed their perceptions about what science and technology are, the roles that they play in contemporary society, their risks, benefits, forms of social control, etc.); interest in S&T and access to scientific information and culture (searching for where and how this demographic is impacted by S&T themes and information, the role of the internet as a research resource, the role of social media as a discussion forum and propagator of information, and the dynamics involved in the sharing and content of S&T fake news); and, lastly, forms of social S&T appropriation and their impacts on day-to-day life, as well as potential future results expected from S&T.

These dimensions were enriched with sub-themes that emerged during the participants' mutual interactions.

3. Results and Discussion

3.1. Perceptions of Science and Technology

In a period in which the media seems to confuse and/or conflate S&T more and more frequently, the young residents of Rio de Janeiro interviewed in this study recognized a deep relationship between the production of knowledge and technological development, though they also believed that significant differences exist between science and technology. For many of those interviewed, science was perceived as a producer of questions, knowledge, and perspectives on the world. It was defined by them with the terms "base", "knowledge", "research", "study", and "foundation", and comprises all knowledge areas: the exact sciences, the humanities, and life itself. The conversations showed that, for these young people, scientific discoveries do not necessarily have to

have a direct or immediate application, allowing instead for nuanced perceptions of the world, nature, the human body, new lifestyle conditions, innovation, and development. Many described it as a common good, a body of knowledge assimilated by society over time[5]. "I think it's also the basis of evolution, really, isn't it?! I think it's the basis!" (Group 3, participant 4, male, 24 years old, south side). "Explanation! It's... study. Basically, the studying part itself (...) maybe a phenomenon that occurs" (Group 4, participant 4, female, 18 years old, north side).

The interviewees demonstrated strong associations of technology with innovation, gadgets, devices, computing, communication apparatuses (the internet, computers, cell phones, and mobility), and immediate applications present in day-to-day life, leisure, transportation, and communication. They, in synthesis, understood technology as integrally tied to the development of products with immediate applications and the objective of generating profit: "it comes from technical really, technology! It can be many things. But the really recent things come to mind: computers, video games, things like that" (Group 4, participant 1, male, 20 years old, north side). "It's connected to companies' production processes" (Group 5, participant 2, male, 20 years old, north side).

The interviewees demonstrated a predominately positive view of S&T, understood by them as inherent parts of what it means to be human, present "since the time of cavemen", representing a competitive edge and, when combined, fostering innovation, progress, and evolution. "Like a guy who loses an arm. They put on a new arm and, with his mind, the guy can move his hand? (...) The progress of science! An insane piece of technology!" (Group 2, participant 3, male, 21 years, north side). "Development, right!? You can create a... a city, sort of, with all these wires and electricity in houses, convenience, comfort, you can have a whole bunch of people living in a small space" (Group 3, participant 4, male, 24 years old, south side).

Such optimistic statements are coherent with results from national and international surveys that confirm a generally very positive view of S&T by young people both in Brazil and in the majority of Western countries (Castelfranchi et al., 2016; Centro de Gestão e Estudos Estratégicos, 2017, 2019; European Commission, 2008; González, 2011; Haste, 2004; Ministério da Ciência e Tecnologia, 2006; Vogt, 2011). A significant portion of the quantitative studies on the subject, as well as the interviews and ethnographies, confirm that young people have a generally positive image of S&T, recognizing its benefits, especially those related to improvements to the quality of life and the convenience that they offer, though they are aware of the risks involved.

The repertoire of S&T themes and subjects of interest mentioned by the interviewees is rich and diverse, comprising new discoveries, scientific findings and experiments, innovation, humanitarian and social issues, psychology, politics, health, education, environmental issues, applied technology and equipment widely used in day-to-day life (such as cars, gadgets, high tech apparatuses, and information technology resources).

[5] The statements made by study participants are faithfully reproduced throughout this publication, with no alterations to colloquial expressions, jargon, slang, or syntax errors.

The interviewees demonstrated a relatively articulate perception of S&T and the economic, political, and social implications of technoscience. It is seen as part of a social context, with its own directions and objectives depending not only on endogenous forces but also on cultural, political, and economic influences.

> Who's going to invest? No one is going to invest because it won't turn a profit! Right? No! Great, hunger in Africa, in the Northeast... Man! There's a load of studies... to collect water in the Northeast that I saw (...), but no one invests any money because they'd be helping a population that won't amount to anything, man! (Group 2, participant 3, male, 21 years old, north side)

3.2. Risks and Benefits of Science and Technology: A Politicized Perspective

An important result emerged from the discussion groups concerning the benefits and ills associated with scientific and technological development. In numerous instances, clear concern was portrayed by young people from different socioeconomic strata as to how S&T may reproduce or accentuate social inequalities and power dynamics: the benefits of technoscientific development tend to be concentrated on and controlled by the rich, while the risks and damages tend to be more serious for those with fewer resources: "the harm is in the poor communities! Now, the benefits? Nowhere to be found" (Group 5, participant 3, female, 22 years old, north side). "Like, science is, sort of... as technology improves, more expensive. So, since it's more expensive, there are fewer people buying... Ah, someone who can't afford, for example, a person who can't pay for an operation" (Group 2, participant 2, male, 18 years old, north side).

The perspective holding that the benefits associated with S&T development are greater than the costs and risks was expressed in numerous instances by many of the young participants, corroborating results from quantitative national and international investigations. In the poll carried out by the INCT-CPCT (Massarani et al., 2021), for example, the majority of young people interviewed stated that they believed that science brought significant benefits to humanity (69%) and only 16% believed that it presented significant risks. International studies also demonstrate that, for young people, science delivers more benefits than it does risks to humanity (European Commission, 2008; González, 2011; Haste, 2004).

When evaluating the risks and benefits of S&T, identifying those responsible for the damages caused by S&T, evaluating the potential of S&T applications to resolve social issues, or discussing whether greater investment in research is necessary, the participants articulately represented their points of view. Politics, economics, and citizens themselves and their behavior appear in the participants' statements as references for understanding how the area functions.

These young people recognize the benefits and risks of S&T. However, "weighing the scale" is considered a difficult task. They understand that what matters is who uses and appropriates S&T and for what purpose. The preeminent benefits mentioned by these young

people are improvements in quality of life, cures for diseases, "fixing past mistakes", building new perspectives on humanity and nature, convenience in day-to-day activities and communication, solutions to routine problems, transportation, and ample access to information. On the other hand, associated risks include destruction, war, weapons of mass destruction, and also consumerism itself, and the excessive exploitation of natural resources: "it's just that we've come to a moment, a point, where we are damaging everything we live with" (Group 4, participant 2, male, 9 years old, north side). "Like, I don't know, too much technological and scientific development in the sense of wrecking the planet, you know what I mean? Wrecking, I don't know... polluting too much, destroying nature and destroying ourselves, you know?" (Group 1, participant 1, female, 18 years old, south side).

The responsibility for the damages caused by S&T is also attributed to the actions of the scientists and technologists themselves, but in many cases, these young people demonstrated that they were not naive: they extended this responsibility to other areas. Politics, for example, is seen by the participants in a controversial way: many of them stated that it does not prioritize projects that would yield returns for society but rather those that serve the interests of the politicians themselves and their companies. The companies, in turn, due to the nature of their activities, prioritize profits without considering the importance of preserving the environment or the well-being of the population, which can lead to the exacerbation of social inequality and environmental destruction. Lastly, citizens that are not willing to change their habits or "give up" the benefits of S&T are also considered responsible: "I think that there are a lot of politicians out there... a lot, a lot, a lot" (Group 1, participant 1, female, 18 years old, south side). "If you look more from the industry side, it's, like, all a façade" (Group 4, participant 1, male, 20 years old, north side). "Not giving up the experience, not letting go... I didn't, say, give up my comfort, my house, driving my car" (Group 4, participant 4, female, 18 years old, north side).

Another important implication of the extensive and contextualized perspective of these young residents of Rio de Janeiro is the application of S&T to urgent social challenges. They believe that the technology already exists to attenuate problems such as hunger, disease, sustainable means of production, security, and mobility, among others, though they understand that this technology also depends on the interests of politicians and social context: "I think it's more a question of changing how we think about human beings and not simply creating technology. Because we have a lot of different technology, and this doesn't eradicate hunger" (Group 3, participant 4, male, 24 years old, south side). "It's weird! Just that, like, so many studies on cancer and AIDS [acquired immunodeficiency syndrome], and it's not there... that they don't discover! It's incredible" (Group 2, participant 2, male, 18 years old, north side).

The statements of these young interviewees are aligned with Beck (1986/2011), who indicates that risk factors resulting from the collateral effects of reflexive modernity are industrially produced, globally externalized, legally individualized, scientifically legitimized, and politically minimized. Society at large is exposed to these risks. However,

their capability to confront them or protect themselves varies according to their differing socioeconomic and cultural statuses, accentuating the contradictions of capitalism.

Lastly, as a final, previously indicated implication, there is support for greater investment in the area. The results of the national study carried out by the INCT-CPCT (Massarani et al., 2021) reveal that 60% of participants support increased investment in the area, despite being aware that investment in one area signifies cuts from another, and 34% stated that investments should not be reduced. The discussion groups, however, showed interesting declines in this general support for S&T investment. For the participants of this study, such investment must occur but must also prioritize the areas of S&T that are oriented towards solving the population's most pressing problems. These young people confronted the dilemma of "where can you take the money from?", uncomfortable with the possibility of transferring resources to S&T from other areas such as education, health, and security. For them, the solution lies in better management of public resources: "I think that it depends on research like this! I think that... the government is investing in some studies or others like this; I think it's worth it! But also... man! We're behind on health, education, security" (Group 2, participant 2, male, 18 years old, north side). "But that's the thing! If we're going to keep it or not keep it... the question is: is what is being spent being spent well?" (Group 4, participant 1, male, 20 years old, north side).

Taking this critical and contextualized perspective as a whole, these young people demonstrated a desire for a humanized S&T, oriented towards the common good, that makes more significant efforts towards collaborating in the reduction of social inequalities, as well as democratization and access both to the dissemination of information and to knowledge, such as in the right to enjoy the benefits of achieved results: "I think that science and technology today should have to reach the whole world as a big challenge and a big objective" (Group 1, participant 1, female, 18 years old, south side). "Ah! A way of eliminating inequality, social and (...) because we think of rich countries more in terms of development, in terms of health, it's unstable" (Group 3, participant 3, male, 18 years old, south side). "The proposal that I have, like, the main one, is about more big projects and more teaching methodologies so that citizens, on a global level, grow up more human" (Group 5, participant 2, male, 20 years old, north side).

The participants also demanded that efforts be made towards the resolution of problems in their daily lives, such as mobility, transportation, cures for diseases, drug addictions, and developing new forms of education that better facilitate learning, as well as searching for sustainable alternatives that pay careful consideration to the environment. Their expectations indicate a demand for social outreach and appropriation, along with the democratization of knowledge and its applications in daily life, for, as they stated, some problems could be solved with tools that, though they already exist, are not widely accessible.

These young people demonstrated perceptions and arguments with little variation based on differences in cultural capital when placed into a discussion group that allowed for more time for reflection and elaboration. The most significant polarization was in the possible appropriation of and effective access to the results, concepts, and processes of S&T, which reflects the social inequality resulting from their socioeconomic context.

3.3. The Science and Technology Information Ecosystem

During the activities performed in this study, a remarkable characteristic emerged that profoundly differentiates the current era from those that came before and especially these digital native research subjects from other cohorts: the idea that information (or disinformation) circulates primarily in streams and fragments and is not searched for, found, or received from official sources. Instead, the participants "were found" by content appearing in their streams, and S&T was part of this scenario: "for example, the YouTube tool that sometimes appears, right?! That's what I'm talking about, elbowing in. But, a lot of the time, I'm not looking for it, but it comes to me" (Group 3, participant 2, male, 24 years old, South Side). "Sometimes, in a conversation with someone... an article about a certain subject, it comes up... what's it called... ah! The person recommends it to you! There's a recommendation" (Group 3, participant 3, male, 18 years old, south side).

The young participants recognized that new communication and information technologies facilitated communication between people, day-to-day tasks, transport, and in-person events, streamlined school work, and offered access to information. On the other hand, they also recognized the discomforts, pressures, and anguish brought on by these technologies: impacts on personal relationships, in-person contact being neglected, considered empty, and having its value questioned, harassment, bullying, unrealistic images of others, celebrities that become successful effortlessly, an excess of stimulation that compromises self-esteem, a sensation of failure, and difficulty in concentrating on important tasks. They also complain of difficulty ascertaining the veracity of circulating information, be it on mainstream media outlets or the internet, and are aware that they are impacted by an avalanche of fake news. Even the strategies to identify fake news, which the participants were aware of, were not considered sufficient to guarantee access to reliable sources of information: "the sources that I get my information from are generally those that I consider trustworthy. But that doesn't mean that they're 100% trustworthy" (Group 3, participant 2, male, 24 years old, south side). "A good journalist... a lot of good things, that can alert people, but, since this fake news atmosphere, this atmosphere of mistrust, exists, people don't believe them" (Group 4, participant 1, male, 20 years old, north side).

One aspect that emerged from the discussions was the perception some participants held of their coexistence with two sets of information that are superimposed on and confused for one another. The first set, which they consider easy to access, is made up of images, people from their daily life, or "celebrities" that can persuade them to adopt perceptions that don't correspond with reality, including echo chambers marked by disinformation (fake news) and untrustworthy sources. The second set, considered more difficult to access, comprises relationships, representations, and shared experiences (online or not) that correspond to "real life" and accurate information. The participants identified difficulty ascertaining the veracity of the information circulating both on major media outlets and on the internet, leading to the question, "who and what should I believe in?". Their sensation is one of being "found" insistently in their information streams by the first set of information and struggling to distinguish it from the second set or access the second set effectively. According to the participants, S&T information is embedded into

and transits this superimposition or coexistence of the two sets, indicating that engaging in conversation on S&T themes requires trustworthy and prepared interlocutors.

It is worth emphasizing that the young residents of Rio de Janeiro participating in this study believed that S&T, being a technical area dominated exclusively by experts, have reduced appeal for the dissemination of fake news, stating that they experienced difficulty in identifying fake news on the subject due to the specific knowledge necessary to make such judgments. They highlighted a greater prevalence of S&T fake news in the health sciences due to their broader appeal (diets, miracle cures, etc.). Some participants had previously identified fraudulent research papers and articles published by sources considered to be reliable and affirmed that differing results from experiments on the same theme (climate and diets, among others) generate doubt and insecurity. "Losing weight is a bizarre stimulus now too, isn't it?... Maybe it's not even the fake news, but maybe the way doctors have researched that whole deal like that" (Group 1, participant 2, male, 19 years old, south side).

> Yes! It happens. I remember the example of my professor who received a Chinese scientific article that said they changed the pH of a stem cell. Then, they replicated it in the laboratory and saw that it was a lie. But, until then, a lot of people, even from the scientific community, believed that. (Group 3, participant 2, male, 24 years old, south side)

3.4. Methods of appropriating S&T information

The subjects expressed that contact with S&T themes was made by "being found" by content on the subject during casual reading, "word of mouth", news on social media, television, or the internet, or even at school (considered by them to be an important reference in terms of access to information and knowledge), and in conversations with family members or among friends (online groups, email, and/or in person). If a subject piqued their interest, they would begin the process of searching for more detailed information, with the internet being their primary means due to its various available tools. The web offers a "web of connections" that is activated through its many links and search alternatives, complicating these young people's attempts to identify a single source or specific sources: "I think that the subject searches for me. I end up seeing it like that. It comes to me, you know?" (Group 5, participant 3, female, 22 years old, north side).

In this context, the participants in this study struggled to identify the channels through which specific pieces of S&T information were carried to them, rarely being able to cite their sources spontaneously. Few connection points between young people and scientific information were offline, and social networks stood out as central platforms. Internet S&T information sources cited by the participants included simply "the internet", without further specification, an "online portal", "online articles, "online magazines", Facebook, "scientific pages on Facebook", Linkedin, YouTube, TED Talks/TEDx, the Fiocruz site, and emails and WhatsApp messages received from parents. Offline, cited sources included school and schoolwork, print media, TV news, and word-of-mouth communications.

The difficulty that the participants had in identifying their sources is coherent with studies that indicate that content diversity, the increase in the number of distributing channels, and the possibility of sharing through the internet make it difficult to determine the origin of unregulated channel-crossing content, blurring the borders between different types of media platforms (*Grupo de Mídia São Paulo*, 2018; Music Television Brasil, 2010).

3.5. How to Discuss Science and Technology With Young People

The previously analyzed discussions provide guidelines for dialogue with young people on S&T. First of all, according to them, credibility must be established: constructing relationships built on trust is fundamental in an environment with so much disinformation and difficulty in identifying verifiable content. S&T information is inserted into and transits the superimposition or coexistence of the two sets of information mentioned above. Furthermore, for the participants of this study, discussing such themes requires that the interlocutors be both trustworthy and well-prepared. In the national poll carried out by the INCT-CPCT in 2019 (Massarani et al., 2021), for example, young people most often cited teachers (50%), doctors (37.2%), and university or public research institute scientists (36.7%; omitted to ensure anonymity) when asked to list what they considered to be the most reliable sources of information.

Aside from being specialized, trustworthy interlocutors with an educational background in the area, the participants emphasized that those who wish to engage in science communication must keep up with the trends and changes among young people in the area and the types of information to which they have access. Lastly, the extensive and critical repertoire of S&T themes that such communicators possess must be taken into consideration, using a tone and aesthetic coherent with the form in which they communicate and interact with their audience: "I think that, after you establish credibility... it's easier to think about this in terms of the internet, it'd be your page" (Group 3, participant 3, male, 18 years old, south side). "Ah! Depending on the subject, it'd be you spreading information, wouldn't it?! It'd have to be on all the platforms we use" (Group 5, participant 3, female, 22 years old, north side). "The way you talk! That's it! I think it helps! Since young people have their own language among themselves" (Group 5, participant 2, male, 20 years old, north side).

It is worth restating here that sharing, interaction, and exchange mechanisms for S&T information (which can be commonly observed in diverse subject areas and conversations) are selective, restrictive, and, as the participants stated, a "melting pot" of friends, family, social network groups of like-minded peers, and specific contexts (tutoring or school, for example). When they take place, these mechanisms must be relevant to the target audience, presenting a great challenge for S&T communication with young people: "how do you get into these bubbles?". Aside from this, the participants also indicated to the authors that there are no guarantees when it comes to the "success" of shared content: "There's no real way to force it through! (...) Some things go viral, some things don't. That's basically it!" (Group 1, participant 1, female, 18 years old, south side).

Regarding media platforms, despite emphasizing the limitations and dangers of information circulating on the internet, the participants indicated that the web and its tools, including tools that must be paid for, as potential "meeting places" for young people and S&T. However, they also did not discard in-person events, such as expositions, demonstrations, public talks, or personal conversations as opportunities for the construction of credible conversations on S&T (Figure 1).

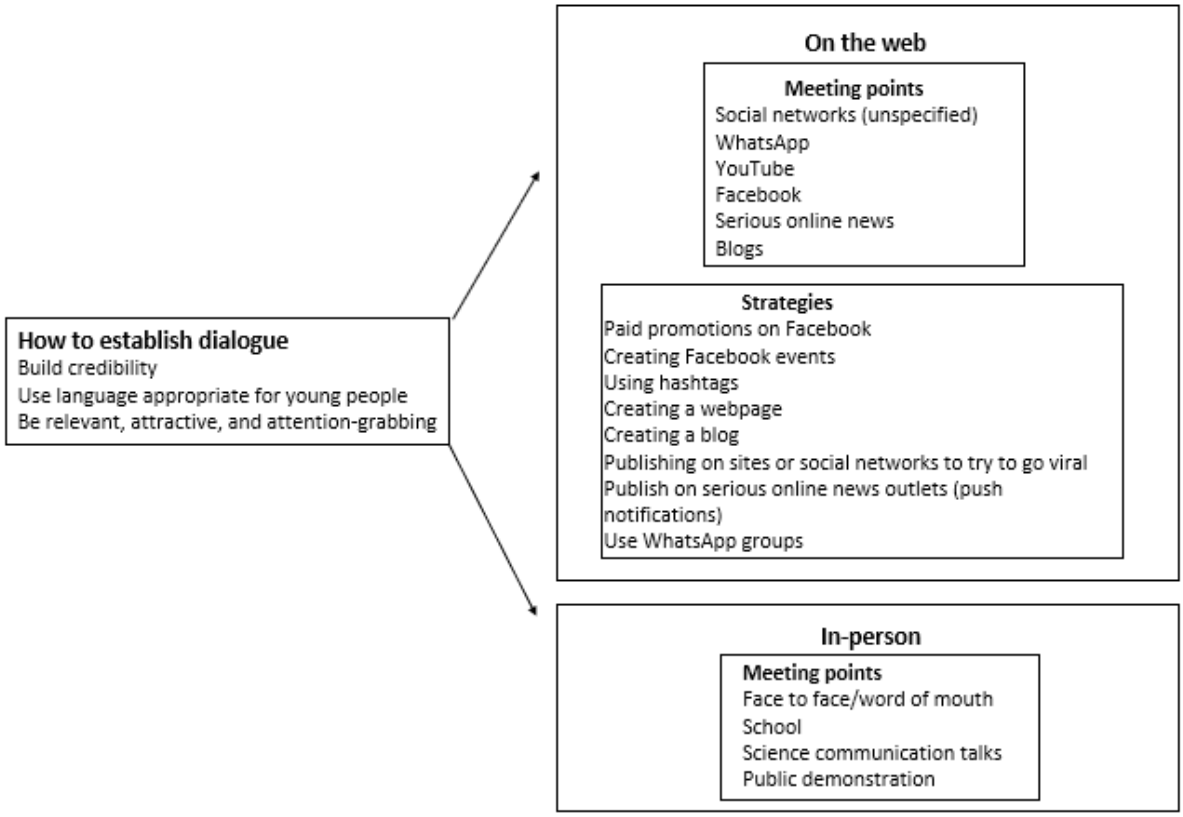

Figure 1 *How and where to engage young people in dialogue on science and technology, per themes explored in interviews*

4. Final Considerations

The empirical research developed from the in-depth interviews and discussion groups with young residents of Rio de Janeiro elicited reflections on the relationship between young people and S&T, as well as indicators and possibilities for establishing dialogue and communication processes with them. The engagement of these young participants in the activities employed was intense and rich, demonstrating their desire to participate in detailed and elaborate discussions on the theme.

Establishing points of connection for S&T themes requires a prior understanding of the perceptions and complex repertoire already incorporated by young people into interactions with these themes. These young people have a positive perspective on S&T, recognizing both its risks and benefits, opening an important window of opportunity for science communication.

This contextualized and relatively critical perspective on S&T has direct implications on the perceptions of these young people on its risks and benefits, which, according to the participants, depend on the purposes, how, and by whom it is used; support for investments is positive. However, it should be oriented towards areas that yield tangible results for the population; the responsibility for damages caused by activities in the area is shared by the government, the companies involved, citizens, and S&T itself; lastly, the application of S&T in the solving of social challenges depends less on development of new technology and more on choices related to political, economic, and social contexts.

Another subject that emerged from the discussion groups is related to these young people's exposure to various areas of uncertainty, marked by information and personal relationships that coexist and are interconnected. Technology and communication apparatuses are seen as welcome and indispensable, though they frequently provoke concerns both in personal relationships and informational searches, expressed well by the question "who and what can I trust?". S&T communication and information are embedded into this context, and the young participants in this study stated that they were frequently impacted by subjects related to the area even without searching for them, with content often arriving to them through unidentified and unsought sources, making the credibility of the communicator of utmost importance. According to the participants, this credibility goes beyond academic preparation and must be constructed, renewed, and strengthened based on attentive listening to the comments and needs of the audience. That supports the relevance of periodical perception studies in the field and, more broadly, the concept that S&T information, in such a dynamic and volatile communication environment, is not necessarily searched for, often making its way to these young people randomly.

Despite their awareness of the challenges presented by information and communication technologies, the participants considered the internet, as a whole, to be the preeminent forum for S&T dialogue, as S&T information appears frequently and prevalently in their streams, competing in an adverse environment where information from both reliable sources and unestablished sources circulate. They also emphasized the importance of in-person activities at school, talks, and expositions, considered important due to their credibility and informational character.

It can be affirmed that the establishment of communication processes with this demographic demands the constant search for points of discussion and connections to their information streams in a complex information ecosystem; credibility built by well-prepared interlocutors, considering young people's repertoires seriously and in-depth; and the utilization of language and aesthetics that appeal to this demographic. The interviewed youths described a complex perspective, indicating the importance of public S&T communication that is not alienated from its social context and can make connections between the information discussed and citizens' daily lives. We as a society face a complex task with no guarantees, necessary and urgent, that is combined with the challenge that young people present us in demanding a more humanistic perspective, more effective democratization of knowledge, and expanded access to benefits generated by the area that, according to them, should be directed towards the resolution of wider social issues.

It should be noted that this study did not aim to formulate results for young Brazilians in general but rather to complement and facilitate the interpretation of the data from the survey mentioned above (which is representative of the young Brazilian population as a whole). This specific geographical area, the qualitative analysis employed, and the choice to focus on discussion groups allowed, in contrast, for a deeper understanding of the reasoning, perspectives, and demands demonstrated by these young people (though not their relative weights). It also helped interpret the quantitative surveys' results, which demonstrate precisely how young people responded to the selected questions but not the motivations behind their answers or the rhetorical resources and representations with which they would support their answers. The authors believe these results clearly indicate the necessity for the completion of larger-scale studies periodically, as well as the necessity of integrating and triangulating qualitative, quantitative, and mixed approaches. Segmentation, cluster analysis, big data text analyses, and interactions with ethnographic studies, for example, can provide a more fine-tuned understanding of these phenomena and allow for more efficient communication with the diverse youth populations, that engage with S&T themes at different levels of intensity.

Translation: Jonathan Edwin Baracho Trindade Hill

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Participation, Citizenship, and Science: The *Ask the Scientists* Experience at the School Agency of the Federal University of Paraná

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Abstract

Public scientific communication in universities aims to encourage dialogue between scientists and society. By involving citizens in debates about its teaching, research, and extension actions, the university facilitates the exchange of knowledge with the community. In this paper, we discuss how this relationship is established through the project *Pergunte aos Cientistas* (Ask the Scientists), in which the population could clarify doubts about COVID-19 with researchers from different fields of knowledge. We, the authors of this article, are part of the Agência Escola (School Agency), an initiative for public communication and scientific dissemination of the Federal University of Paraná, the oldest educational institution in Brazil. Through descriptive analysis, we identify the public participating in this project and reflect on the relationships between society and scientists. To do so, we employ the concepts of open science (Recomendação da UNESCO Sobre Ciência Aberta, 2021), scientific dissemination (Caldas, 2010; Granado & Malheiro, 2015), and public communication of science (Bucchi, 2008; Manso, 2015). The studies on public formation (Dewey, 1946; Henriques, 2018) were essential to understanding how the participation of the publics in *Pergunte aos Cientistas* develops. The initiative has demonstrated the importance of citizens being active and aware of their surroundings. The exchange between scientists and society is beneficial for both parties: the former can map the population's doubts and needs, enabling the development of research based on social demands, while the latter discovers that it also has a space to show and expand its knowledge along with an academic community that has its doors open to society.

Keywords

science popularization, open science, public

Participação, Cidadania e Ciência: A Experiência do Pergunte aos Cientistas da Agência Escola Universidade Federal do Paraná

Resumo

A comunicação pública da ciência na universidade tem o propósito de incentivar o diálogo entre a sociedade e seus cientistas. Ao envolver o cidadão nos debates sobre suas ações de ensino, pesquisa e extensão, a universidade possibilita a troca de conhecimentos com a comunidade. Aqui discutimos como essa relação é estabelecida por meio do projeto *Pergunte aos Cientistas*, no qual a população pôde esclarecer dúvidas sobre a COVID-19 com pesquisadores de diferentes áreas do conhecimento. Nós, autoras deste artigo, fazemos parte da Agência Escola de Comunicação Pública e Divulgação Científica da Universidade Federal do Paraná, que se apresenta como a instituição de ensino mais antiga do Brasil. Por meio da análise descritiva, identificamos os públicos que participaram nessa ação e refletimos sobre a aproximação entre a sociedade e os cientistas. Para tanto, acionamos os conceitos de ciência aberta (Recomendação da UNESCO Sobre Ciência Aberta, 2021), divulgação científica (Caldas, 2010; Granado & Malheiro, 2015) e comunicação pública da ciência (Bucchi, 2008; Manso, 2015). Os estudos de formação de públicos (Dewey, 1946; Henriques, 2018) foram fundamentais para compreender como se dá a participação dos públicos no *Pergunte aos Cientistas*. A iniciativa tem demonstrado a importância de um cidadão ativo e ciente do seu entorno. Nesta troca de comunicação entre cientistas e a sociedade, ambos são beneficiados. Os cientistas conseguem mapear dúvidas e necessidades da população, possibilitando o desenvolvimento de pesquisas a partir das demandas sociais. Por sua vez, a sociedade descobre que também tem espaço para mostrar os seus saberes e adquirir mais conhecimento com uma universidade que abre as portas para a sua comunidade.

Palavras-chave

divulgação científica, ciência aberta, públicos

1. The Scenario Science Faces

The evolutionary process of science has been riddled with barriers and several mobilizations for its discredit (Rosa, 2012), which persist in the 21st century, given the scientific discoveries' power to question established powers. Therefore, the political, economic, social, and cultural context cannot be dissociated from scientific thought. In this sense, we seek to understand the communicational process of science in contemporaneity, observing decision-making made for and with the public.

Previous studies (Caldas, 2010; Costa et al., 2010) on scientific dissemination inspired us to reflect on this topic, bringing to light the current scenario of digital social network platforms, where false information can spread much faster than a virus. Citizens connected to the internet have a voice and can comment on the news and/or produce content. Appropriation of news content on digital social media shows that the production of meaning in groups, such as antivaccine pages on Facebook, is always associated with their cause. Put another way, these pages share, criticize, and even distort information to try to prove that vaccines cause harm (Almeida, 2019).

If, on the one hand, the denial of science can be more intense during a certain period because of the societal context, on the other hand, it increases the interest of scientists to publicize the results found to debate them with their peers and society. By making this decision, scientists try to discuss their findings with different audiences. They know that this approach to the pluralism of ideas can lead them to face many challenges, but these challenges are important for advancing science and developing citizenship. We understand that in science, as Cássio Hissa (2013) highlighted, "the ways of doing are not only articulated to the way of thinking but, above all, to the ways of being - and of being in the world - of the one who researches" (p. 128). Researching also means sharing and engaging in dialogue so that scientific thinking can nourish itself, as Rosa (2012) points out, from universal wisdom.

In this article, starting from our question (how can the public communication of science contribute to the scientific dissemination of a university closer to society?), we discuss concepts of open science, citizen science, and scientific dissemination. Then, we reflect on the public communication of science. Studies on public formation are also explored to examine this project.

From a concrete action, our goal is to analyze how public communication can contribute to the democratization of science by understanding the formation of the publics. The content of the project *Pergunte aos Cientistas* (Ask the Scientists), which is part of the scientific dissemination actions at the Agência Escola (School Agency) of the Federal University of Paraná (UFPR), was analyzed through a process of descriptive analysis to verify how this relationship between scientists and the population that participates, questions and criticizes occurs. According to Gil (2008), descriptive analysis allows the "use of standardized data collection techniques" (p. 28). Using this method, we could point out the characteristics of the participating audiences, such as gender, age, level of education, and city. Beyond identification, we sought to study how the participation of different groups (scientists, journalists, and society) takes place. That made it possible to understand this researched universe's anxieties, difficulties, and concerns. In total, there were 153 questions the public asked, and the scientists answered in 2020. The scholarship recipients and one of the journalists from the Agência Escola were the mediators in this process that brought the groups closer. From this survey, which gathered information about the public's profile, we crossed the data with the experiences lived during the project and analyzed it in the light of studies on public communication of science and the formation of the publics.

2. Open Science and Scientific Dissemination

Contemporary discussions about knowledge production are directly associated with the scientific community's concern with free access to information. With the expansion of digital social networks, this concern is gaining strength to expand access to data and information from academic research and, consequently, disseminate them to peers and the general public. In this context, the *FOSTER* project (*Facilitate Open Science Training*

for European Research) — a consortium formed by researchers from several European institutions — defines open science as transparent and collaborative (Bezjak et al., 2018). This model is challenged by the reflections brought by the sociologist of science Karin Knorr-Cetina (1999). Science should involve social life not only through its products but also through its structures and procedures (Knorr-Cetina, 1999, pp. 377–378).

The *Manual de Formação em Ciência Aberta* (Open Science Training Manual; Bezjak et al., 2018), initiated in the year 2018 at the German National Library of Science and Technology in Hannover, highlights that the "advocacy and promotion of Open Science in all its areas seeks to ensure that people, particularly the most vulnerable, are able to be heard on issues that are important to them" (Chapter 2.11). The authors also state that open science seeks to give the public a voice and considers their views when making any decision about their lives.

Among the dimensions of the process of doing science openly presented by the *FOSTER* project, some advantages are directly associated with science dissemination and science popularization, namely: (a) increased visibility and recognition of researchers and institutions; (b) promotion of scientific, social responsibility and social appropriation of knowledge; (c) transparency and knowledge of the scientific process; and (d) democratization of access to scientific knowledge (Bezjak et al., 2018).

The United Nations Educational, Scientific and Cultural Organization (Unesco) has published, in 2022, a series of recommendations for the development of open science with the purpose of "providing an international framework for open science policy and practice" (Recomendação da UNESCO Sobre Ciência Aberta, 2021, p. 6), considering several issues, such as regional differences and the challenges of all open science actors in different countries. In that document, open science is presented as an inclusive construct with several practices and movements to increase scientific collaborations and information sharing to benefit society and science itself. Regarding the involvement of social actors, there is a recommendation to encourage voluntary participation in building scientific knowledge through citizen science developed with appropriate methods to ensure benefits to all.

In this article, the proposed relationship between open science and communication is associated with its social dimension, where the process is centered on the citizen as an active informational subject. Hence the need to look at this phenomenon from the perspective of public communication.

We try to add our efforts to those of researchers who investigate this theme, such as Costa et al. (2010) and Manso (2015), and to defend open science. In an attempt to clarify the movements that occur in open science, Fecher and Friesike (2014, p. 20) have listed five schools of thought: (a) democratic, (b) pragmatic, (c) infrastructural, (d) public, and (e) metric. In the first, the democratic school, citizens, scientists, and politicians participate. In the second, the pragmatic school, scientists work together for more efficient results. In the third, the infrastructure school, scientists benefit from developing technological platforms that share knowledge. In the fourth, the public school, both scientists and citizens are involved. The fifth, the metrics school, is related to policies for

developing metrics that measure scientific impact. They all involve differentiated publics and require specific communication strategies, besides deserving in-depth studies of these relationships.

In this study, we selected the schools of thought that have citizen participation: (a) public school and (b) democratic school. In the public school, both citizens and scientists participate in the research process, resulting in clearer scientific communication that broadens its scope and facilitates dialogue. In the democratic school, access to knowledge is a fundamental human right, for it is through knowledge that human, social, cultural, and cognitive evolution occurs. This social inclusion in science and technology has also been encouraged for a long time in Brazil. Ildeu de Castro Moreira (2006), who was president of the Brazilian Society for the Advancement of Science, defends the need for every Brazilian to "acquire basic science knowledge" (p. 11). For the scientist, only in this way can citizens understand their surroundings and gain more opportunities to work and actively participate in the process and understanding of research. Thus, it is necessary to study the relationships established between citizens and scientists in an attempt to bring these publics closer together.

Antonio Granado and José Malheiros (2015) present several definitions of concepts about scientific culture. Here we highlight four: science outreach, science communication, public understanding of science, and public engagement in science and technology. These concepts are important for discussing the public communication of science. For the authors, "the *dissemination* [emphasis added], vulgarization or popularization of science consists of the *diffusion* [emphasis added] of knowledge of science (...) and, in particular, of the fruits of research produced at present, throughout the population" (Granado & Malheiros, 2015, p. 15). As they point out, one of the purposes of the activities carried out under this designation is to bring science closer to society. Science communication seeks to communicate scientific knowledge, such as research results, to diverse audiences. Public understanding of science can be associated with how the publics appropriate science through outreach. Granado and Malheiros (2015, p. 17) criticize the information deficit model because the scientist is seen as the keeper of knowledge, and it is considered that the public has difficulty understanding science, so one-way communication is forced. *Public engagement in science and technology* emerged in the United Kingdom in 2000 to combat the trust crisis that science was facing at the time. In this concept, the emphasis of communication is "in a relationship between equal citizens, whose knowledge and will have equal dignity, whose opinions must all be respected, and in a true dialogue between experts and lay people" (Granado & Malheiros, 2015, p. 17). The authors point out that this model "considers the need to involve the whole of society in discussions in decisions that affect its life" (Granado & Malheiros, 2015, p. 17). Democratically, citizens are mobilized to build knowledge with scientists.

3. Public Communication of Science and Democratic Participation

Public communication of science has been widely advocated in Brazil because it encourages democratic debate between scientists and society. In this sense, communicating is, in fact, sharing knowledge for the development of science and the population's welfare. And for this, communication cannot be unidirectional. However, as Brandão (2007) points out, the concept of public communication differs depending on the country, the author, and the context. The author notes at least five ways of defining public communication: (a) public communication identified as organizational communication, (b) public communication identified as scientific communication, (c) public communication identified with the state and/or government communication, (d) public communication identified with political communication, and (e) public communication identified as communication strategies of organized civil society.

Bucchi (2008) argues that the history of public communication of science is relatively new when compared to the long tradition of communicating science to the public. For a long time, argues the author, science communication had a patronizing tone when the media shared a news story they thought was of public interest. He also criticizes the deficit model, explaining that disbelief in science cannot be reduced to an information gap between experts and the public. However, he does not dismiss it in the process of science communication, which has many stages that are not mutually exclusive. For Bucchi (2008), lay knowledge should be valued in a continuous public science communication model. The exchange between scientists and the population affects both. Although their knowledge differs, neither can be considered more important than the other. The author further warns that public communication of science "cannot be seen only in the context of expert/citizen interactions, but also in the broader context of science in society" (Bucchi, 2008, p. 68).

As already mentioned, the concept of public communication of science is directly associated with the process of scientific openness and dialogues from the perspective of an active citizen who assumes the centrality of this process and benefits from it. Another important aspect is to adopt the premise that science, like language, is public (Knorr-Cetina, 1999). Thus, communicating to one's peers is only one aspect of the circulation of knowledge, and communicating to a lay audience is not only a process of dissemination but also of popularization of scientific knowledge. In this perspective, it becomes relevant to challenge a hierarchical trend in which scientists are considered to be those who possess knowledge, and the public, those who lack it. The idea is to enhance processes in which the public interacts with knowledge and re-signifies it according to its cultural, social, and personal aspects. Thus, dialogical relations are established where lay experience, common sense, and everyday life can be equivalent to specialized scientific knowledge, providing public participation. A society needs independent individuals to be independent, and this process takes place, to some extent, in the ability to understand how science works and how it is directly inserted into one's daily life. According to Bauman (2000/2001), the power of the subjects to influence the conditions of their own existence, to give meaning to the "common good", makes social institutions adapt to this meaning, that is, a process of collective construction of citizenship.

Another author who presents a critical perspective on the process of communicating science is Castelfranchi (2008). For the author, a model that values expert knowledge tends to maintain the dominance of experts over non-specialists, ignoring the cognitive and participatory capacity of a type of public that, most of the time, is unaware of science and technology due to the inefficiency of the educational process.

Manso (2015) defines the public communication of science as the space of opportunities for dialogues that brings "to the center of the debates the figure of the so-called citizen (not specialized in science), stimulating the plurality of knowledge and cultures" (p. 2). The positioning of the citizen assuming scientific protagonism, as Manso (2015) highlights, "is something challenging, including in the epistemological sense, of what this citizen with scientific-social (and political) capacity and responsibility will be in contemporary times" (p. 2). These points converge with the concern of Heloiza Matos (2011) in extending scientific knowledge to communicative exchanges: "public communication should be thought of as a political process of interaction in which expression, interpretation, and dialogue prevail" (p. 45). Jaramillo López (2011) understands it as a process that counts on the participation of collective subjects (civil society actors) that, even while expressing themselves individually, seek the construction of what is public in a democratic way.

We base this article on the authors mentioned above to argue that public communication of science presupposes participation, that is, a democratic model, egalitarian among the actors, with emphasis on dialogue, and that recognizes the multiple types of knowledge and the multiple types of reception. In this sense, we understand the need to know our audiences in greater depth. Burns et al. (2003) defend the importance of considering the publics according to their needs, interests, attitudes, and knowledge levels. To this end, they divide the public involved in science communication as scientists, mediators, decision-makers, the general public, the attentive public, and the interested public. In this paper, we focus on the following publics: scientists, mediators (journalists and scholars), attentive public (part of the population that seeks information about science and technology), and interested public (composed of people who are interested but not necessarily well informed about science and technology). The typology of Burns et al. (2003) shows many implications of these established relationships in science communication.

This article does not exhaust all the possibilities of these relationships but seeks to demonstrate how an action mediated by communicators has impacted scientific dissemination by bringing scientists and society closer together.

4. The Agência Escola of Public Communication of the Federal University of Paraná

From the perspective of public communication of science, the UFPR started, in 2018, a technical-scientific project aimed at scientific dissemination. The initiative is called "Agência Escola de Comunicação Pública e Divulgação Científica UFPR" (School

Agency of Public Communication and Scientific Dissemination UFPR) and aims to foster the visibility of the production of science developed and stimulated, in/by the university. The project comprises 21 undergraduate scholarship holders, six graduate scholarship holders, eight scholarship professors (one of them being the coordinator), and 13 professionals hired under the Brazilian labor laws standard.

The operation of the Agência Escola is based on three axes: training, experimentation, and technological innovation. Their integration structures the involvement of undergraduate scholarship students from the courses of visual arts, graphic design, music, advertising and propaganda, journalism, public relations, institutional communication, and information management, and from post-graduate (Master's and PhD level) communication and design. Besides experiencing the productive routines of different fronts in the field of communication and working in an interdisciplinary dynamic, the students broaden their vision of what science is and its importance in people's daily lives, as well as the several specificities of knowledge production. They also develop critical capacity in an environment favorable to expressing creativity and innovation, serving as a space for experimentation and creating new languages and formats.

The set of communication actions of the Agência Escola aims mainly to expand the access of scientific knowledge to society, leaving the university's walls and strengthening the dialogue between scientists, the population, and the press. One of these actions is *Pergunte aos Cientistas*, which aims to bring citizens closer to researchers and the science produced at the UFPR, motivating citizens to send questions about topics related to their daily lives that can be clarified by scientific knowledge.

Launched in March 2020 against the backdrop of the pandemic caused by COVID-19 and false news circulating on digital social networks, *Pergunte aos Cientistas* bridges the gap between the public, scientists, and journalists. The action, which collaborates to democratize access to knowledge production and show the impact of science on people's lives, is put into practice by following these steps: (a) the community sends questions to the means of communication of the Agência Escola (digital social networks and email); (b) the questions are gathered and forwarded to a group of UFPR scientists, (c) who answer all the questions and (d) forward the answers to the journalism team of the Agência Escola; (e) the answers are then organized and provide the basis for a report written in accessible language, (f) published on the website of the Agência Escola and on the university's news portal (in addition to being suggested to the press for reporting); (g) the report is circulated on the Agência Escola and UFPR's digital social networks; and is (h) forwarded directly to all the people who sent their questions.

The multidisciplinary team from the Agência Escola mediates between the publics (society, scientists, and journalists from the press), seeking to present the scientific answers through its journalistic actions in accessible language. The packaging of the content into a news format also seeks the capillarization of the subject to reach other people in society who may be interested in the theme, with questions from the community itself answered by scientists who study the subject. This process seeks, thus, the democratization of scientific knowledge and the participation of citizens in scientific dissemination, a proposal that articulates and dialogues with the concepts and authors discussed in this article.

4.1. Audience Participation in *Pergunte aos Cientistas*

To answer the question of our article, it is also pertinent to approach the discussion about the formation and affectation of the publics from John Dewey's (1946) theoretical basis and its dynamics with the Agência Escola. For this, the analysis is organized to understand how the publics are affected, trained, and move in the "Agência Escola de Comunicação Pública e Divulgação Científica UFPR" *Pergunte aos Cientistas* initiative.

In this context, *Pergunte aos Cientistas* offers different potentialities seen through the lens of public communication of science. Among them is the reach of the action, with the participation of people from several cities in the five Brazilian regions (North, Northeast, Midwest, Southeast, and South). The repercussion in the press amplifies this reach to an even greater number of individuals, as shown in Table 1.

Information	Data
Questions received	153
Questions answered	153
Participants	136
Age	18 to 80 years old, most between 21 and 60
Countries	Brazil, Portugal, the United Kingdom and Paraguay
Cities	53
Brazilian states	12
Brazilian regions	North, Northeast, Midwest, Southeast and South
Profissions	54
Reports produced and published on the Agência Escola website and Portal Federal University of Paraná	10
Total report views	292,055
Press releases	25 news items on three TV stations, three radio stations and 11 websites/newspapers
Scientists who answered questions	23
Subjects of the questions	Several aspects of prevention and contamination from COVID-19, such as the use of masks, hand sanitizer, the practice of physical activities, cleaning of packages and food, going to the market, tests and vaccines and risk groups, among others

Table 1 *Public data from the project* Pergunte aos Cientistas

In this reasoning, Dewey (1946) defends the view that the human being is not a passive spectator but an active participant through the very activity of communication. Moreover, as we highlighted earlier, this perspective is shared in open science.

This movement can be perceived from *Pergunte aos Cientistas*. The population faces countless difficulties, insecurities, and problems caused by the pandemic. Affected by the same event, they try to act to clarify their doubts so that they can feel safer and/or know how to face this circumstance.

In the initiative, people of different age groups, professions, and geographic locations, as shown in Table 1, move and actively participate by sending questions to receive answers that can guide decisions and attitudes in everyday life. These questions may interest other people with similar doubts, which can be observed by the number of views of the reports produced: almost 300,000, as well as press coverage with different scopes. In informal conversations during the mediation with the journalism team of the Agência Escola and press interviews, the scientists who answered questions from society commented that some of the questions led to new investigations and may become the subject of new studies.

We reviewed several authors to understand the formation of the publics at the Agência Escola. Fábio França (2008) presents the concept of the public from the perspective of Dewey and Blumer, as shown in Table 2.

Dewey	Blumer
A group of people faces a similar issue	A group of people who are involved in a matter
They acknowledge the problem	They are divided on the matter
They organize to act on the problem	They discuss the problem

Table 2 *Definitions of public formation*

Source. Adapted from Fábio França, 2008

There are similarities between the authors, and both contribute greatly to understanding the formation of the publics. For Dewey (1946), ideas are important when they serve as a tool for solving real problems. The scientist also defended the relationship between theory and practice and encouraged sharing ideas for developing knowledge, as previously mentioned. In this sense, open science also seeks the collaboration of all involved publics to solve a problem. The biggest obstacle, however, is to unite these publics in an egalitarian way. Hebert Blumer (as cited in V. V. França, 2018), from symbolic interactionism, observed that people act in the world based on the meaning things have for them and that these meanings come from social interaction. For him, in these interactions, the meanings produced are acted upon by the individual himself.

The questions forwarded by people to *Pergunte aos Cientistas*, associated with the answers given by researchers, are consumed as information of public interest. That

shows that the affectation process is not individual but a collective construction. That can be seen in the total number of views of the 10 stories produced in 2020 and published on the Agência Escola UFPR and Portal UFPR websites, which reached 292,055 views that year. The three most read articles include in their titles topics of public interest for prevention care during the pandemic: "Cientistas Orientam Sobre Efeitos Colaterais e Uso Correto de Álcool em Respostas Para Dúvidas da Sociedade" (Scientists' Guide on Side Effects and Correct Use of Hand Sanitizer in Answers to Doubts of Society), in which the cover image is hand sanitizer being applied on hands, with 87,431 views; "'É Verdade que Todos Vão Pegar Coronavírus?': Cientistas da UFPR Respondem Novas Perguntas da Sociedade" (Is It True That Everyone Will Catch The Coronavirus? UFPR Scientists Answer New Questions from Society), with 76,122 views; and "Ida ao Mercado, Caminhada e Imunidade: Cientistas da UFPR Respondem Novas Perguntas da Sociedade Sobre Coronavírus" (Going to the Market, Hiking and Immunity: UFPR Scientists Answer New Questions From Society About Coronavirus), with 38,112 views. Although the reach is large — which proves the public's interest — we are interested in future studies that can deepen the production of this public's meanings and encourage the participation of society in various actions of the Agência Escola.

Henriques (2018) points out that one of the possible ways to explain the process of affecting the publics is by the problematization of a situation because it depends on the perception and recognition of indirect consequences that require attention, the promotion of a sense of impact and the creation of a generalized view of the consequences. When the consequences of a problem reach beyond the individual directly involved, we enter the public dimension, "making people and groups have to deal with them, denouncing the problem and calling for action" (Henriques, 2018, p. 163). In *Pergunte aos Cientistas*, we notice this movement of calling people to action from, for instance, a question about vaccines sent by a young woman who wanted to convince her mother to vaccinate against COVID-19. Soon after the scientists' answer to her question was released, the young woman got in touch to say that her mother had ended up taking the vaccine.

The serious damage faced by society generates a symbolic bond between people who look to science, the public university, and scientists for support in clarifying their doubts. "Publics are first — and foremost — a form of sociability. That is, they define a specific pattern of interdependent social relations, through which individuals establish a certain kind of connections" (Esteves, 2018, p. 143). Henriques (2018) also states that publics are forms of sociability formed in networks of social relations and information flows. For the author, the "conditions of cohesion are not only physical but also (and mainly) symbolic" (Henriques, 2018, p. 162).

That occurs because the impact is collective, for it extends beyond the set of individuals. However, "the collective unit that goes by the name of public does not override or erase the individual subjects that constitute it; quite the contrary, it depends on them and even needs to stimulate their affirmation" (Esteves, 2018, p. 150).

Moreover, the same person can be part of different publics simultaneously or at different times, alternating according to the changes in their perceptions of what affects them.

> While certain groups may create a somewhat more stabilized identification, it does not mean, from the point of view of the action, that they will always have the same members and the same bond between and among them with certain opinions and positions. (Henriques, 2018, p. 166)

In open science, for example, we can observe that scientists play several roles in this dialogue with society, for they also need to listen to their peers and citizens for the development of their research — in interviews for RPC TV, affiliate of Rede Globo in Paraná, one of the UFPR researchers who answers the population's questions stated that society's own questions can generate research questions. For citizens to participate in open science, however, it is necessary to show that their involvement is important for developing society's knowledge.

Henriques' (2018) conceptualization is perceived in the variety of public profiles sending their questions to the project. It is observed by the participants' age range, from 18 to 80 years old, with a similar concentration, 20 to 30 people, in the age ranges from 21 to 30, 31 to 40, 41 to 50, and 51 to 60. In addition, the different profiles can be seen in the areas of activity of the participant population, listed in 54 professions from the data submitted with the questions. The occupations that appeared most often were students, teachers and retired individuals. However, the variety is evident in the 54 cited overall: domestic worker, civilian fireman, health agent, driver, administrative assistant, mechanics technician, insurance broker, salesperson, doctor, nurse, military, lawyer, biochemist, psychologist, systems analyst, entrepreneur, environmental engineer, among others.

The people who send their questions to *Pergunte aos Cientistas* also appear as a group in the published reports with their names and questions related to other similar or diverse questions within the theme of the pandemic asked by people from different geographical locations.

The discussion between public and private is also pertinent in the interaction with organizations. "These interactions both take place in a dimension of private transactions and in a public dimension, and it is in this second dimension that these people and groups take for organizations a less or more defined collective form" (Henriques, 2018, p. 161). From this angle, this article's object of analysis can be observed from the idea of the dual formation of publics. Henriques (2018) explains that this logic highlights the communicative dynamics between these two actors (organization and public) and that, through it, the modes of relationship and the creation of conditions of existence of various groupings as publics are built.

The dynamic of the dual path of formation understands that the public not only takes shape for organizations but is also formed by them. That is, the "public simultaneously *constitutes itself and is constituted* [emphasis added] — which is to say that it is formed in the interaction itself, in its own movement" (Henriques, 2018, p. 165). We perceived the double path of formation with participants who started to follow and actively interact with Agência Escola's communication channels (digital social networks and email). This is the case of the educational advisor Eliane Américo, 38, from the city of

Valparaíso, in the state of Goiás, who also sent questions to more than one of the reports produced involving different themes, such as the use of masks, sanitization of fruits and vegetables, and care for risk groups.

Dewey (1946), at the beginning of the last century, understood the importance of communication and its constant movement for the formation of the public, which, for him, are not mere spectators but reflective subjects that produce and share meanings. In this perspective, the publics are formed through communicational dynamics.

Moreover, Dewey (1946) relates the reflexive potential of communication and the publics to the role of education. In this relationship, we also visualize the competence of connection with the project *Pergunte aos Cientistas* analyzed in this article. The author points out that education can liberate new potentialities, "capable of all kinds of permutations and combinations, which would then modify phenomena, while this modification would, in turn, affect human nature and its educational transformation in a continuous and endless procession" (Dewey, 1946, p. 199).

In this sense, education in the analyzed object lies in the actions of the public, such as seeking scientific information, sharing it among their groups and adapting their behaviors to face the pandemic based on the answers received with scientific knowledge, like using masks and hand sanitizer, social distancing and isolation, hygiene of products and food, and going to the market with preventive care. For example, the union leader Giancarlo Tozo, 43, from Cascavel, Paraná, asked about the safe way to distribute food to the people most affected by the pandemic.

In Dewey's words, "we have the physical tools of communication as never before. (...) Without such communication, the public will remain shadowy and formless, searching spasmodically for itself, but grasping and holding its shadow rather than its substance" (Dewey, 1927/2012, as cited in Calhoun, 2017, p. 39). The author adds that "signs and symbols, language, are the means of communication by which a fraternally shared experience is initiated and maintained" within publics (Dewey, 1991/2012, as cited in Esteves, 2018, p. 148). The fraternally shared experience through communication conceptualized by the authors is also observed in *Pergunte aos Cientistas* from the process of receiving the questions and producing the content to the dissemination to the press. The Rede Massa SBT, for example, publicized the action in its channels by interviewing one of the UFPR scientists who answered the questions, opening the media's own space for the community to send their questions about the pandemic.

The discussion outlined here demonstrates that a public, faced with a situation that affects it, sets itself in motion to act collectively, generating visibility and the possibility of generalization of interest. "It is the condition of manifesting and acting in public that will somehow enable this public, although already existing as a potency, to actually present itself as a public and begin to produce, thereby, its effects" (Henriques, 2018, p. 170).

We understand that transparently showing the operation of communicational processes is important in encouraging public participation. The public, as Henriques (2018) highlights, "always tends to show itself as representative of some opinion or some will that extrapolates it" (pp. 166–167). Moreover, the author continues, the public desires

"the greatest possible expansion of this representation, otherwise it loses its very raison d'être" (Henriques, 2018, pp. 166–167).

5. Considerations

In this article, we sought to show how public communication can contribute to the process of democratization of science through a concrete action of the Agência Escola of the UFPR, which consists of students, teachers and other professionals from different areas. Attracting citizens to discuss science has been challenging for the project team and its partners.

The public's participation in *Pergunte aos Cientistas* is still limited when we reflect on the potential of open science and public communication of science. However, the action contributes to knowing the needs of the public of the Agência Escola, as well as their location, experienced contexts, attitudes and interests, as Burns et al. (2003) recommended. The questions sent to the scientists were catalogued, aiming to know the Agência Escola's publics. Although we have not analyzed the content of the questions nor the answers of the scientists in this paper, the themes addressed signal the interests of a population that sought not only solutions to their problems but also questioned public health decisions. The public's participation also made it possible to plan other editions of *Pergunte aos Cientistas* with other themes beyond COVID-19, such as mental health, natural disasters, politics and democracy. In this sense, by opening up space to listen to the needs of Agência Escola's public, we also seek to contribute, through public communication of science, to awaken the public's interest in dealing with themes of their daily lives in science dissemination.

The approach to the publics of the Agência Escola also involved scientists and communication mediators (advisors, journalists and scholarship holders). For these groups, this activity also brought a new experience that resulted in more knowledge about the community and the public communication of science. We do not rule out direct contact between scientists and the population, but the dynamic adopted in *Pergunte aos Cientistas*, which has the mediation of communicators, allowed the involvement of researchers with a very extensive work routine. The communication between scientists, mediators and the public also allowed the direct exchange of knowledge. The scientists offered more subsidies to the mediators when answering questions from the public. Moreover, they also had a better understanding of the role of communicators in science dissemination and the importance of public communication of science to meet the population's needs. The mediation of communicators also made it possible to package the content in an accessible language in different formats and media, in which diverse audiences circulate and move to actively participate through the activity of communication, as discussed in this paper from Dewey's (1946) point of view.

By returning to the problem question of our research (how can the public communication of science contribute to the scientific dissemination of a University closer to society?), we understand that the mediation of Agência Escola's team not only contributes

to the democratization of access to scientific knowledge but also has a fundamental role in promoting the public communication of science. The team brings scientists, society, and the press closer together. In the exchanges with the public, we highlight three messages sent to the team. They say they felt as if they were talking to scientists: "it felt like I was in a doctor's appointment when I read the answer"; "the important thing is to help clarify doubts with the right people"; "I really admire your work (scientists and journalists), you are essential to bringing information to the population. Gratitude".

To promote a closer and more direct dialogue with society, the Agência Escola of the UFPR is experimenting with a hybrid format of *Pergunte aos Cientistas*. Besides all the already established content packaging and format of the action, in the August 2022 edition, which had the theme "Política e Democracia" (Politics and Democracy), the Agência Escola's team visited the Julia Amaral Di Lenna Municipal School, in Curitiba, Paraná, in Brazil, to collect questions from teenage students on the subject. Subsequently, political scientists who answered the questions will go to the school with Agência Escola's team to talk to the students. Thus, this process strengthens a more direct and circular dialogue and interaction between scientists and society.

The dynamic of *Pergunte aos Cientistas* was also planned considering the actions of digital social network platforms. Studies on public participation in social media platforms (Macedo & Quadros, 2021; Quadros, 2005) show us the need to establish rules to promote a fruitful debate in the digital environment. *Pergunte aos Cientistas*, although it brings in its name the centrality of scientists, arises to open space for the public with the mediation of a communication team prepared and being trained to disseminate science.

The experience of other actions of the Agência Escola, which seek to debate topics of interest to citizens, has shown that it is still necessary to establish editorial policies for public participation, such as the dynamic created in *Pergunte aos Cientistas*. For example, in the second edition of "Divulga Ciência AE" (Disseminate Science AE; an event promoted by Agência Escola) on its YouTube channel, scientists debated the use of drugs in the treatment of COVID-19. The debate attracted more than 1,500 viewers, and its repercussions were discussed on Agência Escola's digital social networks and the UFPR's official profile, which also publicizes these actions. The scientists receive all kinds of messages, such as critical, complimentary and offensive ones.

In the COVID-19 pandemic, we have evidenced more effective citizen participation at Agência Escola of the UFPR. *Pergunte aos Cientistas* was planned to bring knowledge to the public, trying to listen to their concerns. This Agência Escola initiative, added to others, has brought the public closer to the university. We know that maintaining this interaction with the public requires an effort beyond the scope of a communication team. However, we realize that the number of scientists who feel the need to adopt open science in their research and interact with the public is increasing. About the rules of this interaction, we argue that they must be built by the public involved so that the processes of this approach actually promote the participation of all.

Public communication of science, which involves the participation of different social actors, requires in-depth knowledge of its audiences. Knowing their interests, needs,

and contexts makes it possible to contribute to scientific dissemination closer to society and, thus, to encourage the debate that benefits all publics and science itself.

Translation: Pedro Wiezel

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Situated Learning, Praxis, and the Understanding of Biological Invasions From Sun Coral Collectors on the Brazilian Coast

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Abstract

We investigated the management of biological invaders as a socio-scientific practice from situated learning and dialogues with the Vila do Abraão local community in Rio de Janeiro, Brazil, while aiming to amplify the learning processes on this theme. Historical-dialectical materialism was used as a theoretical-methodological perspective. When considering the learning process through social practice, we seek contributions from the philosophy of praxis and Paulo Freire, so the management participants constructed the concept of biological invasions and their meanings. The Marxist contributions of praxis and Paulo Freire were necessary for the theoretical synthesis of this work, pointing to the potential of the *catação* (picking; management) practice as a place of exchange between science and society through praxis, awareness, and action on reality.

Keywords

biological invasion, awareness, non-formal education, social practice

Aprendizagem Situada, Práxis e Saberes Sobre Invasões Biológicas de Catadores do Coral-Sol no Litoral Brasileiro

Resumo

A partir das proposições da aprendizagem situada e dos diálogos entre ciência e a comunidade local da Vila do Abraão — Rio de Janeiro, Brasil, foi investigada a conceituação do manejo de invasores biológicos enquanto prática sociocientífica que amplifica os processos de aprendizagem sobre questões que envolvem esta temática. O materialismo histórico-dialético foi utilizado como perspectiva teórico-metodológica. Ao considerar a aprendizagem por meio da prática social, buscamos as contribuições da filosofia da práxis e Paulo Freire. Assim, o conceito de invasões biológicas e suas significações foram construídos pelos participantes do manejo. As contribuições marxistas

da práxis e de Paulo Freire foram necessárias para o processo de síntese teórica deste trabalho, que aponta as potencialidades da prática de catação (manejo) como local de intercâmbio das relações entre ciência e sociedade através da práxis, conscientização e ação sobre a realidade.

Palavras-chave
bioinvasão, conscientização, educação não-formal, prática social

1. Introduction

Biological invasions as a topic have gained increasing attention due to the recurrent introduction of exotic species in Brazil and the world. This problem is considered the third most significant cause of biodiversity loss on the planet (International Union for Conservation of Nature, 2012). Furthermore, despite being perceived as something restricted to ecological realms, its impacts cause considerable damage to the economy and society (IUCN Species Survival Commission, 2000). The African snail in Brazil can be cited as an example when considering the direct impacts of extractivist cultures and their relationship with nature or public health. Nevertheless, how can society participate and become involved in the scientific enterprise, including those affected by bio invaders, and actively search for public policies?

We looked for examples of public involvement on this issue. We found the case of a biological invasion on the Brazilian coast by two species of sun coral native to the Pacific Ocean: *Tubastraea tagusensis* and *Tubastraea coccinea* (Oigman-Pszczol et al., 2017). As a biological invader, the sun coral significantly impacts local human communities and ultimately on consumers of marine resources in urban centers mainly due to the speed of its growth, proliferation, and impacts on the food chain (De Paula et al., 2014). In addition, other studies show that it is a threat to endemic species in Brazil, such as the brain coral (*Mussismilia hispida*; Creed, 2006).

The Sun Coral Project (SCP), supported by the non-governmental organization Brazilian Institute of Biodiversity, is a socio-environmental initiative to tackle the problem of biological invasions. Its main activities are intensive scientific research on the biology, ecology, and possible impacts of the sun coral in Brazil. It is composed mainly of researchers from universities in the state of Rio de Janeiro (especially the State University of Rio de Janeiro). Its leading research site is Ilha Grande Bay, located in Sul Fluminense, where the presence and impacts of coral are visible.

In close relationship with researchers in collecting sun coral, the SCP and residents conduct an activity dubbed "picking" (*catação*) to manage its abundance in the environment. That brings the local population closer to the scientific dimensions of data collection, interpretation, application of results, and debates in institutional spheres such as the Ministry of the Environment on Ilha Grande. The participation of Ilha Grande residents in invasive coral management activities represents a process of immersion in a scientific, social and environmental enterprise, which according to Gohn (2014),

operates within their own reality, presenting a possibility of learning in a "world of their own lives", that is, in their daily lives.

According to Gohn (2014), "the sociocultural environment where one lives and the social class to which one belongs is part of the construction of an individual's culture" (p. 39). Thus, education in non-schooled environments is seen as a forum and process of collective participation, sharing of experiences, elaboration of knowledge, and above all, political exercise (understood mainly by relationships), something associated with the ideal of participatory democracy. At this point, it is impossible to separate the ideas mentioned above from participatory and emancipatory ways for the collective construction of a multidimensional scientific culture. It is centered not only in the internal processes of an investigation but also in the entire historical and cultural apparatus that situates any scientific enterprise and in the circulation and appropriation of its knowledge.

The management activity promoted by the SCP consolidated an educational process without schooling and within a sociocultural context, where scientific culture emerges as one of its constituent elements. As such, it is possible to understand how knowledge about the biological invasion problem is appropriated and shared through practices developed within a socio-scientific universe. To this end, we question how a management practice becomes a constituent of social and situated learning processes when framed by the theoretical perspective of situated learning (Lave & Wenger, 1991).

Lave and Wenger (1991) place their analytical learning perspective in the Marxist tradition. For the authors, learning is integral to social practice and cannot be interpreted as a linear and individual process. From this perspective, it was necessary to create a dialogue with the Marxist understanding of the philosophy of praxis, which is based on the dialectical relationship between human beings and objective reality. Within this perspective, the world is an object to be transformed through conscious action in unity between theory and practice (Konder, 2018).

The investigation of the practice of managing the sun coral (or *catação*) brings us important parallels and connections with Paulo Freire's liberating education and his synthesis of the Marxist idea of praxis in the educational universe. Freire (2018) contributes with significant reflections on the importance of what he describes as a non-banking participatory education that prioritizes respect for the cultural and historical context of the subjects through a process of cultural synthesis. That is understood by the relationship between knowledge of living on the island and participating in management as part of the scientific enterprise with the continuous dialogue between educators and learners for critical awareness of reality.

Thus, we intend to understand the learning dynamics and transformative potentials in non-formal education scenarios that consider popular participation with researchers for environmental restoration, learning, and praxis as dimensions of scientific culture. In this universe, our research objectives are: (a) to understand the learning process about biological invasions, systematizing the dimensions of socio-environmental issues brought by participants during management; (b) to conduct a process of synthesis supported by Marxist and Freirean contributions based on reflections on learning and represented in

the concepts of conscientization and praxis, and lastly; (c) to provide subsidies for the expansion of debates on social participation in scientific issues.

2. Theoretical Framework

2.1. Situated Learning

Situated learning emerges in anthropology from ethnographic works developed in different historical-cultural contexts. Unlike other views on learning, especially the cognitivists, which are based on the individual, these works sought to understand learning in the sociability of subjects. Jean Lave (1996) considers that the learning processes involving the constitution and development of someone who learns are complex and encompass one who is situated in a given time and space. Consequently, "theories of situated activity do not separate action, thought, feeling, value and their collective cultural-historical forms from localized, interested, conflictual, and meaningful activity" (Lave, 1993, p. 7).

We take as an example Lave's research from the 1970s on the Van and Gola tailors and their apprentices in Liberia (Lave, 1996; Lave & Wenger, 1991). In this perspective, Lave (1996) observed that what was learned was not simply a body of isolated techniques for shaping a garment but a series of social practices and cultural values inherent to the history of a learning community, including building one's own life, growing up, becoming a master tailor, and recognizing the respect and truth in this occupation.

Social practice sustains the learning community in its cultural-historical structure, but it also modifies it. As such, learning manifests itself as a change in participation through practice within this community, which does not only involve the gain of individual motor or mental skills. It is also the understanding of multiple meanings of participation and belonging. Therefore, the learners appropriate themselves at the same time as they are part of constructing a vast cultural repertoire that involves knowledge, specific skills, and contextualized socio-political issues. Here, we speak of a repertoire belonging to and constituting a scientific culture, where knowledge shared by the SCP team is balanced with their own and promotes new forms of participation and learning, thus shaping the relationship between science and society.

2.2. Praxis and Consciousness

To Marx (1890/1980), man[1] transform his history and make himself subject by creating the necessary conditions to exist socially. Thus, man is "acting on external nature and modifying it, at the same time modifying his own nature" (p. 202). In other words, man becomes a subject in a process of humanization, as Leontiev (2004) considers,

[1] We chose to use the term "man", as in Marxist texts, because we understand that it carries its own historicity. We are aware, however, that it is also impregnated with an exclusion of gender issues.

which allows them to him his history and culture. This transformation is only possible through the mediation of practical activity, best represented by Marx (1890/1980) in the form of the concept of work in general, a human activity aimed at an end.

Nevertheless, in transforming an object, it is necessary to become aware of its usefulness, consider its constitution, and seek its end from the existing reality. Vásquez (2007), in this perspective, brings an important analysis of the common human consciousness and how it transforms the human into a "practical man". The common conscience, as the author reports, is the one that limits man to an unreflective practical activity by which everyday actions are not based on complex thoughts and aim at nothing more than the utilitarian response to what the world demands.

Thus, the concept of theoretical activity appears with the concept of practical activity as determinants of human action when we refer to the transforming unit of praxis. Theoretical activity is distinguished from practical activity by taking as objects raw material and elements of the psychic and subjective plane such as perceptions, sensations, concepts, theories, and hypotheses that are transformed into the ideal plane (Vásquez, 2007). As such, "the immediate purpose of the theoretical activity is to elaborate or transform the ideal – and not the real – to obtain products and theories that explain a present reality, or models that ideally prefigure a future reality" (Vásquez, 2007, p. 233).

Vásquez (2007) states that "today more than ever, men need to theoretically clarify their social practice and consciously regulate their actions as subjects of history" (p. 57). This process is related to awareness in Freire. According to his work (Freire, 1980), reality does not present itself as a knowable object through its critical consciousness at first. In the spontaneity of relations between man and the world, the natural position is not a criticism but naive. The ascension to what he calls maximum possible consciousness implies overcoming limiting situations, the spontaneous sphere of apprehension of reality "to reach a critical sphere where reality presents itself as a knowable object and in which man assumes an epistemological position" (Freire, 1980, p. 26). The more we become aware, the more we enter into the phenomenal essence of the object, and the more we become instrumental in transforming reality. This process does not exist outside of praxis (Freire, 1980).

3. The Theoretical-Methodological Possibility of Historical-Dialectical Materialism

The processes of learning and awareness were investigated from their consideration as objects determined by a series of essential integrative issues which allow their existence as a concrete reality. Thus, it cannot be investigated only from the empirical point of view and end up in abstractions/generalizations that do not construct a dialogue with the real world. We understand our investigation as a path that starts from concrete reality, is mediated by the abstract, and returns to concrete thought. In other words, "the concrete appears in thought as a result in the process of synthesis, not as a starting point" (Marx, 1859/2008, p. 258).

As a concrete reality, the social phenomenon is dialectical and tensioned by elements belonging to its essence. The path from appearance to essence (which reveals the concrete in thought) becomes the construction of the elementary praxis of research in itself. From this reasoning, Gimenes (2016) states that "the essence of an object does not immediately manifest itself to man. Therefore, research is a possibility of understanding between representation and reality. It is a process of reproduction in the thought of the dynamic structure of its object" (p. 85).

However, this process of overcoming is possible through identifying and abstracting the connective elements in the object's body and composing its dynamic characteristics. At this moment, we sought the mediations and contradictions (Netto, 2011) as fundamental points for analyzing the handling/picking practice as a place of learning and awareness.

4. Sun Coral Management Practice: *Picking*

Vila do Abraão is located in the municipality of Angra dos Reis, Rio de Janeiro, and is the stage for the SCP's activities. Creed et al. (2017) bring a list of reasons that underlie the emergence of management activities in Vila do Abraão: a large number of coral populations in the region of Ilha Grande Bay, proximity to the village, availability of residents who have enough affinity with the sea in order to participate in activities, and the strong influence of tourism and subsequent high flow of visitors.

Run by the SCP within the Brazilian Institute of Biodiversity, the picking was the management aspect that involved the participation of residents between 2006 and 2012. When considering the origin of the coral picking, it is also necessary to highlight that this practice was born from a non-governmental organization's socio-environmental initiative in partnership with researchers and residents in 2006. That was interrupted due to the end of the sponsorship previously given by Petrobras Ambiental in 2013. Therefore, this research focuses on a very early stage of this practice that could have developed over the following years if there were no external (but structuring) issues, such as economic viability.

This activity was carried out periodically by SCP members, who determined where and when the management would be carried out based on occurrence data. The methodology used in other management actions in Brazil is the manual removal of coral colonies using chisels. The collectors dived (freediving) in pairs with a box and did the work. In the end, colonies were removed, and all the work was accounted for and evaluated.

5. Collectors and Interviews

Coral collectors are subdivided into coordinators or novices. The coordinating collectors started their activities together with the construction of the SCP in 2006. As of 2009, the number of collectors increased and remained at around 20, many of them with limited or seasonal participation. Their ages, including coordinators (four people over time) and novices, ranged between 20 and 48 years, only half had completed high school, and 86% had their own residence (Creed et al., 2017). Most collectors, about 70%, received less than the minimum wage, and 79% did not have a steady job (Creed et al., 2017).

In 2016, through the intermediation of an SCP member who lives in Ilha Grande and still maintains friendly relations with some of the former collectors, we located five willing to participate in semi-structured face-to-face interviews, two being coordinators and three being novice pickers. It is important to emphasize that other collectors were located. However, some factors, such as shyness and the daily work on the island, influenced the possibility of conducting interviews since they were done in person on two trips to Ilha Grande with limited time and resources. We can mention, as an example, a local collector who was willing to participate; however, he operated a "taxi boat" service (maritime taxi), which made it impossible for him to have a fixed schedule. Therefore, interviews should take place at rest/night times, which also hindered them, as we understand that time off is invaluable in the world of work as we know it. Added to these findings, another limiting factor is the instability of the cellular and internet network on the island, which naturally hindered both telephone communication and the possibility of remote interviews.

The coordinating collectors C1 and C2 and the novices C3, C4, and C5 were interviewed about their dynamics and daily lives. All were over 18 years of age and agreed to participate in the research through an informed consent form. We emphasize that in the transcripts, we decided to keep the expressions of our own language with maximum fidelity, without adjustments and corrections in this sense. Thus, spoken words such as the vernaculars "pra", "tava", and "tô", for example, were kept in writing.

6. Some Context on Voices of the Island

For Lave (1993), structural contradictions are fundamental for establishing the relationships between meanings, the actions of subjects, and their contexts. Therefore, we consider it necessary to understand the context in which participation in practice occurs, as it is only in modulating dialectical relationships that any possibility of learning occurs. The way of life in Ilha Grande and the involvement of residents with environmental, social, economic, and political issues are some of the main aspects of the context in which management/picking is developed. Likewise, the historical processes of SCP's genesis and the very presence of coral and other biological invaders also materialize in reality.

The main economic activity on the island is tourism, and most collectors live, in some way, from this activity. The common occupations for collectors are janitor, inn employees, divers, and tourist guides. It is important to highlight their stories as residents of a place of unique beauty when considering the way of life of the collectors. The relationship with the sea emerges as a cultural element that permeates practice, bringing unity between the context and the collection;

> but because it is an island, the locals and the *caiçaras* already have great intimacy with the sea, surprisingly far above what one can apparently imagine. They are born on the island, canoe here and there, and play on the banks of the river. (C1)

In the following excerpt from collector C5's statement, we can also learn about the relationship with the sea and the perception of change in the environment after the arrival of the biological invader: "when we started diving as children, we had less of it, the quantity was smaller, but there was already a lot" (C5). Ilha Grande was already an environment modified by biological invaders; therefore, the experience of the *caiçara* population with these species is part of the context. In most cases, invasive species are not recognized as a problem, and their presence is taken for granted. The following speech exemplifies this aspect:

> for the *caiçara* born here, the jackfruit has been here since the discovery of Brazil. So when you arrive, there already is a biological invasion; there is bamboo everywhere, so a person is born looking at it in a way that they do not consider a biological invasion. (C1)

Another important aspect is raised by the collector/coordinator C2 when referring to the complexity of the expropriation processes and the difficulty in communicating with novice collectors in a language that is close to the daily lives of these subjects:

> Ilha Grande is experiencing a process of exclusion of these people, everyone who comes with preparation, with a much more competent way of setting up businesses, to take care of the place, to economically grow here, something people here do not have, they were excluded, and I think that when a project arrives and cannot speak the resident's language, this distance is only reinforced. (C2)

In the previous excerpt, collector/coordinator C2 refers to the scientific terms used by visiting researchers, revealing a contradiction regarding the construction of the practice within the context: the scientific and the popular. If the learning process is integrated into a context, it needs to be linked to the historical-cultural reality of the participants. In a way, sun coral picking becomes a form of approximation between concepts and reality, shaping the learning process.

Assuming that "people, actions, and the world are involved in all thoughts, expressions, knowledge and learning" (Lave & Wenger, 1991, p. 52), a brief construction of the context presented here was necessary. Furthermore, the reality of Ilha Grande is not only limited to the aspects raised here, and tensions are diverse. This multi-handed illustration was necessary in order to understand the learning and awareness processes that will be presented below.

7. Reflections on Situated Learning and Praxis in Sun Coral Collection

For Marx and Engels (1932/2009), "the production of ideas, representations, and consciousness are in principle directly intertwined with the material activity and material exchange of men, the language of real life" (p. 31). In these assumptions, "one cannot understand what people feel and think without knowing how they live and what they do"

(Konder, 2018, p. 129). When collectors recognize themselves as such, they carry their history and the local culture, which is inseparable from social practice. The gathering does not exist without diving and a boat, more than that, it does not exist without island residents immersed in their own intersubjective insular reality and, as Freire (2013) refers to, "own community knowledge". Here, we reinforce the situated character of learning and awareness of various issues in biological invasions.

8. Mediations of the Learning Dimensions of Biological Invasions

In this section, we work on dimensions created from the interviews' analysis and the understanding of the existence of a contradiction that historically dichotomizes and is based on filters such as scientific neutrality, the knowledge of the natural sciences, and socio-political aspects. We assume this distinction as mediating dimensions for understanding the specific issues in biological invasions (biological, social, political) revealed in the interviews. However, it is important to emphasize that in the course of the analysis, this distinction is overcome in the statements of the collectors. This will be better explained in our synthesis of the processes of awareness and praxis.

8.1. Learning Biological and Ecological Aspects

Meireles et al. (2015) applied questionnaires, did interviews at Ilha Grande, and pointed out that most of the population that participated in the research (60%, $n = 125$) had already seen some invasive exotic species, 43.2% had already heard about the sun coral, and 40% knew how to recognize some type of problem/concept related to biological invasions. These data show a high degree of empirical knowledge regarding biological invasions on the island.

Participation in management strategies can bring people closer to aspects of the environmental reality in which they live, such as the conceptual elaboration of biological and ecological aspects. In the following excerpts, the collector/coordinator C1 brings his understanding of biological competition and biological invasions:

> you start to make a relationship with the other animals; the marmoset here is an invader with no predators and, like a sun coral, increases with each year. (...) So it's the same thing at sea, you know? Same thing with sun coral. (...) The brain coral itself is directly impacted by the sun coral. Its procreation speed is much lower than the sun coral; they noticed it there, you know? (C1)

We can also see a movement from the general to the particular (Davidov, 1999) when C1 cites an example of another biological invasion on the island, the marmoset. Meireles et al. (2015) observe that the problem of the "marmoset that attacks birds" (p. 328) is well-known on the island.

When we turn to the statements of novice collectors, we also observe a knowledge of the problems and ecological procedures related to invasions in their own ways of expression: "the sun coral, it would bring damage to our place because it was spreading, then other living beings didn't stay there, they died since there was no space to grow" (C4);

> it was obvious that they were occupying places that they took away, they pushed the brain coral to one side, and that slowly killed them. Certain types of corals are taking up space from the native coral, you know? So this is the idea of the invasion, in this case, of a being that came from another country that is not from here and starts eating the very foods of the fauna and flora from here they were taking it all, you see? (C3)

Visualizing the problem from the contact with the coral was a very important aspect of understanding the biological and ecological questions relating to invasions. The collecting activity itself entailed care in concepts appropriated by collectors, such as the method of sacrificing colonies and taking care at the time of removal so as not to release more larvae into the environment:

> we have some instructions on how the sun coral should be taken out so that they do not multiply anymore, so we are very careful when removing it so as not to encourage breeding instead of controlling it (...) we would go with the chisel and take them out one by one, because the less adrenaline, the fewer spores they release. (C3)

The excerpt from C3's speech reveals the importance of the unity between theory and practice in collecting the sun coral. For management to be properly developed, it is necessary to know the central configurations of the biology of the coral, which was present in the interviews with all collectors.

Finally, the practice of collecting also made it possible to decode biodiversity, especially with underwater life previously little noticed by collectors, despite being excellent divers:

> like, in my case, I learned more about the species. I met many species there that I didn't know, that we were very curious and asked "what was that there", because we didn't have that view down there, right? Because when we dived, we only went to the sun coral, after which we went to see other species there. (C5)

We see evidence of knowledge about their own place being established, reinforcing the idea of rapprochement with the environment. Conceiving a transforming character of the human condition without knowledge of one's own reality is unlikely, and here this fact applies to biodiversity itself. Man modifies nature by knowing it, detaching himself from it as a merely functional part, and as such, he humanizes himself and produces history and culture (Leontiev, 2004).

8.2. Learning of Socio-Environmental and Political Aspects

The awareness-raising processes are more evident when considering the construction of socio-environmental and political learning. The socio-environmental manifestations of biological invasions by the collectors appeared mainly in the meanings given to the management activity. The main meaning attributed is the coral's control and/or eradication because it is somehow bad for the island. This strong relationship with the island highlights the determination in the collectors' context. According to Lave and Wenger (1991), "a learning curriculum is essentially situated. It is not something that can be considered in isolation, manipulated in arbitrary didactic terms, or analyzed apart from social relations" (p. 97). Still on this point, from her reading of Paulo Freire's dialogical action, Andreola (1993) states that "knowledge encompasses the totality of human experience. The starting point is the concrete experience of the individual in his group or community. This experience is expressed through the verbal universe and the thematic universe of the group" (p. 33).

Based on these considerations, we can go through the forms of knowledge shared by collectors when we refer to issues beyond a reductionist vision of the natural sciences. An important aspect of the management that appears in the speeches of the collector/coordinator C1 and the collector C3 is the aesthetic approach of the sun coral. This approach is something that must be taken into account when we think of biological invasion as a socio-environmental issue because it reveals ethical and economic contradictions related to the presence of a species of great visual appeal:

> certainly, we all worked at the time of picking with some heavy feeling (...) because it is a pity to remove it because it is beautiful, but the feeling goes beyond this because it is a living organism, any way you are eliminating a being, an organism, but the bigger feeling was that you gave an opportunity to those other organisms that were being harmed by the dominant presence of the sun coral, you know? (C1)

The aesthetic factor of the sun coral reappears in the following passage, this time in the statement from collector C3. This seems to be an important issue for understanding the socio-environmental dimension of the topic, as it is also related to economic activities and feelings:

> in Lagoa Azul or Lagoa Verde, we were almost forbidden to take the sun corals there. Because tourists like to see the wall infested with sun coral, and the sun coral is beautiful. (...) The tourist thinks it's beautiful, but the tourist doesn't know to what extent it can harm the environment of the Island there, you know? They are not aware of this. Only those who are aware of this, at first, the *caiçaras*, can pass this on to tourists because, in this case, tourists want to photograph and take pictures of beautiful things, but they are unaware of it. And there would have to be greater environmental education, an environmental education project even bigger in the tourist information aspect. (C3)

From the readings of C1 and C3, we can recognize that the issue of biological invasions is surrounded by social problems of equal complexity and was mentioned from a clear process of critical development. Looking through the prism of Freire's (2018) methodology, we can conceive biological invasions as the generating theme, one that can build new conceptions in the dialogic and intersubjective path and that is ramified in the historical complexity where students are immersed.

This association brings us closer to praxis as a political manifestation of historical-dialectical materialism. Thus, shared knowledge directs us to the contradictions that need action to overcome. The collector/coordinator C1 presents us with the ethical tension between "doing evil" and "doing good", as well as what C3 states about the aesthetic contradiction represented by the beauty of the coral. Both are propositional; they point out what would be necessary: projects and environmental education.

Another important emerging aspect from the interviews is the awareness of the collectors about the importance of control. More than eradicating the sun coral, they demonstrate a broad view of the imposed problem. Collector C4 brings his contribution on this point: "for us today after we began to understand that it was impossible due to the quantity" (C4). Still, within this aspect, C3 again highlights the importance of action based on her reflections:

> well, I think that human beings and society, in general, could always unite more and get engaged to have more projects like Sun Coral because they are important projects that regulate the diversity of nature, right? On an island or anywhere, mainly on the island, because we are isolated here in the middle of the sea, so there is both the sun coral and even the little monkeys, I think that in all aspects of an invasive species, we can have a solution to the invasion, which is not even to eradicate it completely, but at least to control the invasion, understand? (C3)

The role of collectors as amplifiers of the theme also appears in the interviews:

> I worked as a tour guide for a long time, I always thought it was a topic that should be included in any activity, whatever the profile of the tourist I was leading. I always touched on this theme, so it's something very present on the island. You have a lot of invasive species present here, I mean, there are some, but some are very evident. (C2)

Here, we can think of Freire's (2018) perspectives of dialogue, in which one learns and educates collectively, not from A to B, nor from B to A, but from A with B. All the collectors talk about the dialogues within the island, the heritage of collecting, and the importance of communicating with tourists. This is peculiar to the practice at the same time as it is liberating because it builds attentive, observant, and critical thoughts.

Finally, political/bureaucratic aspects of biological invasions also appear in collector/coordinator C1's statement. Its central participation certainly promoted greater involvement with other instances of the SCP, which made its participants perceive political

dimensions also related to the problem of biological invasions. In this case, the responsibility for the introduction itself is put at stake, as well as the responsibility for the control of invaders and the role of the government:

> I think the companies could be forced to give a part of their profit for its implementation, be forced to reverse some part of it. There are so many compensations there to mitigate these problems, right? But we don't see anyone politically committed. It was a crazy difficulty for us to get a license from IBAMA [Brazilian Institute of Environment and Renewable Natural Resources], to be able to remove the coral and to be able to use the skeleton as a product. It is a complication in the law itself; it was made in a way that favors this type of thing, these impacts, but does not favor the mitigation of these impacts. (C1)

The central figure of collector/coordinator C1 carries all this historical and cultural burden, built on his practice experience. In his speech synthesis, we can observe the potentialities of this type of socio-environmental initiative when we refer to the construction of learning trajectories, processes of awareness, and praxis. The implications of these last two concepts will be discussed further in the next topic.

9. Synthesis: Consciousness and Praxis

We now synthesize the dimensions previously presented, assuming our references of praxis and awareness (*conscientization* in Freire). Thus, we can observe from the data that there is a direction toward overcoming the biological versus social dichotomy. In general, the scientific knowledge specific to biology and other social and political issues was not presented in a polarized way, an important characteristic to understand in the articulations between critical awareness through theoretical appropriation and action on reality. As such, we defend that the approach to scientific questions must be guided by the integral relationship between subjects and the world. Gramsci (1975/1999) discusses topics in the natural sciences in his *Cadernos do Cárcere* (Prison Notebooks), pointing out that the philosophy of praxis does not operate to establish, for example, the structure or properties of a material that is known objects of the exact sciences and technology — but instead investigate the material forces of production and the expressive social relations in particular historical moments.

By looking at the conscious manifestations of biological invasions from the practice of sun coral collecting integrally, we return to Freire (2018), who states: "if the moment is already that of action, it will become authentic praxis, especially if the knowledge resulting from it becomes the object of critical reflection. In this sense, praxis constitutes the reason for the new oppressed consciousness" (p. 73). We can now evaluate the statements from collectors C1 and C5:

> so, when you see a *caiçara*, a guy didn't go to college. He works on the work he learned from his father, which was passed by his grandfather. For him, then he starts to get involved with a study, a work, a project that has a scientific nature proving the importance of all this, it's very good because the guy has a cultural gain, you know? This values him as a person and increases the self-esteem of a simple, humble person who has not had much access to education. This is the great thing about the project. So, you see this realization, and this guy's self-esteem increased because of the project; it was really cool for him to be able to go out and lead a tour and talk to people in his own way, in his humble way, but talking to people, that's very cool. (C1)

> I have the knowledge, and today I can pass on to someone else that the species is invasive. Because when people get there and see that beautiful underwater garden, they think: it's beautiful, interesting, etc. But they don't know it's an invasive species, do they? So nowadays we pass it along, even more so now that most collectors work with tourism, with boats, so when passing them by, we say: look, this species is invasive, it's bad for other animals. So there's this vision of passing it along. (C5)

Gimenes (2016) states that theory transforms our awareness of facts and ideas about things but does not transform things themselves. Meanwhile, practice presupposes effective action on the world and thus transforms it from the articulation between both elements. Vásquez (2007) probes the relationship between cognitive activity and teleological activity: the first results in knowledge about a certain thing, being thus restricted to theoretical activity. The second treats knowledge as an attribute suitable for a practical, material, and objective purpose since "one does not know for the sake of knowing, but in the service of an end" (Vásquez, 2007, p. 225). At this point, we can consider the knowledge about biological invasions integrated into the management methodology as a teleological element. Within the community, this knowledge is suited to a clear end: the control, or utopianly, eradicating the sun coral.

Belonging to the production process is inherent to non-alienated work. It is where scientific culture is inserted, such as knowledge of practice, practices, means of production, workforce, and the materialization of work in the commodity itself (Mészaros, 2016). C1 reinforces this idea when he mentions the importance of human contact with the issue of sun coral invasion in two moments: "the Sun Coral Project removes them, and it has a connection with a social part, it does not remove them with a chemical product, you do that with human work. This relationship is important, see?" (C1);

> it is certainly different from when it used to be when you knew something but did not actually participate in an action when you saw the project start and grow, and despite not sitting on the university bench, you add up knowledge, you learn the names of other organisms, you learn how the chain works. Well, this is a spectacle; this is a gain for the project. (...) The

> real gain is the cultural gain; it's what you learn in the involvement, from here, from those organisms, how that works, that's the cool thing. (C1)

The words of collector/coordinator C1 again bring us closer to Lave and Wenger's (1991) social learning theory. Collective participation in practice becomes not only a key mediation for the learning process for an integral construction of these collectors but also creates new ways of conceiving the relationship between science and society. On this subject, we agree with the vision of Gohn (2006) that community participation contributes to the transformation of reality, enabling environmental improvements, income generation, local development, and strengthening of social organizations. For the author, promoting citizen participation makes it possible to rescue self-esteem, but it also goes further by outlining life trajectories.

> The socio-political and communal participation from collectively-built projects that lead to a social intervention – for example, a public square, contribute to transforming the reality of the public served. It leads to urban improvements, the generation of income for families, and the development and formation of artisan cooperatives. Projects that encourage the citizen participation of young people contribute to the recovery of self-esteem but can go much further by outlining projects and life trajectories. (Gohn, 2006, p. 37)

Participation is essential in order to establish awareness. For Freire (1981), awareness is a process of dialectical experience between "objectivity and subjectivity, reality and consciousness, practice and theory" (p. 117). Adding to the importance of local knowledge, here we perceive in C4 a dialectical movement between subjectivity and objectivity, theory and practice:

> I worked with the sea; it was always my place, hence my experience of living with water. With time we know the places we could go, we see that the sea movement, and we go, and I managed to guide the guys about this and exchange a little experience in this area. (C4)

> This activity for me, as I told you, was important because it was already in an area where I like, the sea. And it was a learning experience; we were understanding what the sun coral was and what damage it would bring to our place because where it landed, it spread, so other living beings didn't stay there, they died, and there was no room to grow there. (C4)

The two excerpts from C4's interview outline the necessary movements between context and knowledge and the importance of participation as a mediator between subject and reality. This collection characteristic probably underpinned the learning processes associated with the awareness unveiled here and dialogued with elemental forms of the philosophy of praxis.

10. Conclusion

The learning process on biological invasions appears as a phenomenon in which collection is a part of the collective effort and a place for promoting and constructing scientific culture. Thus, given some determinations and tensions that enter this debate, we brought the mediating dimensions of biological invasions that emerged in the interview process: biological/ecological, socio-environmental, and political. In the biological dimension, questions related to the biology of the sun coral, ecological dynamics, and biological diversity were presented in a way connected to the collection reports. The same occurred in the socio-environmental and political dimension, where we highlight social participation for overcoming this problem and becoming indicative of economic and political factors.

With the contributions of Marxist thought and Paulo Freire, we could know and discuss the potential of learning processes in and through practice. The main contributions of this synthesis process were the access to evidence that social participation in management practices allows the conceptual construction of biological invasions manifested from the particularities of the historical and social construction of the subjects (mainly local dynamics and language). Dialogic processes sometimes guide it; it has a non-alienating structure; it implies awareness-raising processes that exchange learning; it presents aspects of the unity of praxis and involves affective relationships.

Finally, we believe that our analysis can be added to a theoretical framework that seeks to understand aspects of the relationship between science and society based on the connections between cognitive and social processes of learning with action in reality. In addition, it contributes to the promotion of educational dimensions in multiple socio-environmental actions and social participation in science and technology topics, many of which are not yet understood through the prism of education, as is the case with the collection of the sun coral itself. Therefore, from a study on learning, we indicate the importance of participation in issues commonly solely appropriated by scientists but which have profound social impact.

Translation: Beverly Victoria Young Mokross

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Bottom-Up and Reciprocal Citizen Science: Untapped Resources of Novel Ideas. Preliminary Experiences of a Citizen Science As Public Engagement Program

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Abstract

In scientific research, citizen science is widely regarded as an involvement of the general public in scientific research initiated by universities, scientific organisations or research centres. In this top-down approach (top-down citizen science), participating citizens usually collect data or provide samples for research — that is, they are considered volunteer research assistants following instructions. This study analyses alternatives of top-down citizen science: one, widely known, which is the bottom-up way of citizen science and another, the reciprocal approach suggested by the authors. Bottom-up is based on local initiatives and is constituted by community-led projects. For bottom-up citizen science, scientific organisations may provide methodological and organisational frames. However, the idea and the implementation remain in the competence of the participant citizens. Reciprocal citizen science emerged from a need for a more holistic policy toward citizen science. As part of this, identifying viable citizen-initiated projects, measuring their scientific and/or innovation potential, and integrating them into a citizen science mentor program are questions to be systematically discussed and solved. This study addresses methodological challenges in mentoring citizen science projects, covering a mentor training concept for citizen science designed by the Institute of Transdisciplinary Discoveries. Encouraging citizen research is needed for a new impetus to scientific discoveries. The perspectives of people with no scientific background can also advance problems — mainly those that require fresh and unbiased approaches. Citizen science may also be a solution for leveraging the knowledge of science leavers.

Keywords

citizen science, mentoring, bottom-up citizen science, empowerment

Ciência Cidadã Recíproca e de Baixo Para Cima: Recursos Inexplorados de Novas Ideias. Experiências Preliminares de um Programa de Ciência Cidadã Como Envolvimento Público

Resumo

Na pesquisa científica, a ciência cidadã é amplamente considerada como o envolvimento do público geral em pesquisas científicas iniciadas por universidades, organizações científicas ou centros de investigação. Nessa abordagem de cima para baixo (ciência cidadã chamada top-down), os cidadãos participantes geralmente recolhem dados ou fornecem amostras para pesquisa — ou seja, são considerados assistentes voluntários de pesquisa que seguem instruções. O presente estudo analisa alternativas de ciência cidadã top-down: uma, amplamente conhecida, que é o método bottom-up (de baixo para cima) da ciência cidadã e outra, a abordagem recíproca sugerida pelos autores. Bottom-up é baseado em iniciativas locais e é constituído por projetos liderados pela comunidade. Para a ciência cidadã de baixo para cima, as organizações científicas podem fornecer estruturas metodológicas e organizacionais. No entanto, a ideia e a implementação continuam a pertencer à competência dos cidadãos participantes. A ciência cidadã recíproca surgiu da necessidade de uma abordagem mais holística da ciência cidadã. Como parte disso, identificar projetos viáveis, medir o seu potencial científico e/ou inovativo e integrá-los a um programa de mentores de ciência cidadã são questões a serem discutidas e resolvidas sistematicamente. Este estudo aborda desafios metodológicos na mentoria de projetos de ciência cidadã, abrangendo um conceito de formação de mentores concebido pelo Instituto de Descobertas Transdisciplinares. Incentivar a pesquisa dos cidadãos é necessário para dar um novo impulso às descobertas científicas. As perspectivas de pessoas sem formação científica também podem trazer problemas — principalmente aqueles que exigem abordagens novas e imparciais. A ciência cidadã também pode ser uma solução para alavancar o conhecimento dos que abandonaram a carreira científica.

Palavras-chave

ciência cidadã, mentoria, ciência cidadã de baixo para cima, empoderamento

1. Introduction: Citizen Science As Public Engagement

1.1. Bottom-Up Citizen Science: From Science Communication to Involvement of the Public in Scientific Activities

The trend of universities moving from entrepreneurial to civic universities indicates that higher education institutes recognised the necessity of embeddedness of education and scientific organisations in society. The involvement of non-scientifically qualified citizens in scientific projects goes back to the mid-1990s (Vohland, Göbel et al., 2021), although, in the 1920s, citizen involvement in scientific questions was also described by the term "scientific citizen" (Cohen, 1920). Initially, people volunteered their time and energy to help with various research projects. Despite the many decades of history, "citizen science" (CS) and "citizen scientist" expressions first appeared in the *Oxford English*

Dictionary in 2014. The dictionary describes it as: CS as a "scientific work undertaken by members of the general public, often in collaboration with or under the direction of professional scientists and scientific institutions" (Haklay, 2014, para. 4). Citizen scientist as "a member of the general public who engages in scientific work, often in collaboration with or under the direction of professional scientists and scientific institutions; an amateur scientist" (Haklay, 2014, para. 6).

CS emerged from the recognition that science, technology, and innovation could respond better to environmental, social and economic challenges if a wider circulation of scientific findings is ensured. It is possible when local, national, regional and global participation in the research is available for any entity of the society. Since the first appearance of the expression CS in the literature, its meaning has changed. New expressions emerged to describe the level of involvement of citizens in scientific projects. The most common form of CS to date is when a university or other academic institution encourages citizens to collect data for research initiated by a person or institution with authority in the scientific field. That is the so-called top-down (TD) approach of CS. TD CS often serves for observing or monitoring environmental phenomena, and data are used at the national or international level (cf., Eicken et al., 2021, p. 468).

Bonney et al. (2009) developed an often-used categorisation of CS projects. Their framework defines:

- *contributory* projects as projects where scientists design the project and participants are involved in collecting and analysing data according to predefined protocols;
- *collaborative* projects, participants may also be involved in adjusting protocols, drawing conclusions, and proposing new directions for research;
- *co-created* projects include citizens in all stages of the scientific process; scientists and citizens collectively design and develop the project.

Another categorisation often cited is based on the levels of participation. In Haklay's (2013) classification, levels range from

- citizens as *sensors* (crowdsourcing), and
- citizens as *interpreters* (distributed intelligence),
- to levels where participants are more involved in problem definition and collection protocols (participatory science) or are *even part of the entire development of the scientific process* (extreme CS).

Growing dissatisfaction within academia and industry hot environmental and societal topics of interest to the public, leading to the more active participation of the public in science. The UNESCO Recommendation on Open Science (2021) is one of the most important international documents, stating that science must be open to the widest possible public and that scientific data from stakeholders must also be incorporated into research. Open science (broadly in line with the concept of CS), according to the recommendation,

> should not only foster enhanced sharing of scientific knowledge but also promote inclusion of scholarly knowledge from marginalised groups (such

> as women, minorities, Indigenous scholars, non-Anglophone scholars, scholars from less-advantaged countries) and contribute to reducing inequalities in access to scientific development, infrastructures and capabilities among different countries and regions. (UNESCO Recommendation on Open Science, 2021, p. 5)

This approach is the same as that represented by the so-called bottom-up (BU) CS. BU CS is a growing method of public engagement with science, in which citizens perform scientific activities, including data collection or even complex research, in order to address local and global issues. Contrary to TD CS projects in which citizens collect data in institutionally controlled projects, the BU approach is citizen-initiated. "Observing or monitoring efforts defined and undertaken at the local scale and brought forward to higher-level bodies, often with a focus on supporting outcomes desired by a local community" (Eicken et al., 2021, p. 468).

1.2. Criticism of Top-Down Citizen Science

In general, citizens can engage in different levels of the scientific process, including the development of research questions and hypotheses, data collection, data analysis, drawing conclusions, and disseminating data. The most popular form of CS, as described above, is when citizens collect data under the direction of professional scientific institutions (TD approach, cf., Haklay et al., 2021, pp. 15–18). In these scientist-led projects, the level of citizen engagement varies but is limited: citizens can be involved only in data collection, or they can analyse and evaluate gathered data. The advantage of this type of CS is that professionals regulate research projects. Therefore, the collected data are more reliable. Some critics of TD CS mention that these projects exploit citizens by making them collect data and/or be scientific assistants for free, or these projects do not give eureka moments to citizens (Vohland, Land-Zandstra, et al., 2021, pp. 2, 5). In addition, the TD CS strategy emphasises unequal relationships between the academic sector and the citizens. Although it can be viewed as an exercise to connect research and citizens, it rarely allows ordinary citizens to peek behind the doors of a research lab or institute. Thus it is an insufficient exercise to break down the "ivory tower" image of universities. However, some researchers continue to suggest that valid scientific results can only come from scientist-led research legitimised by a scientific institution (Haklay, 2013).

Universities in the most developed countries exercise the civic university ethos and even integrate citizens actively in the design and planning of the research (Follett & Strezov, 2015; Haklay et al., 2021, p. 14). Therefore, we find some examples of scientific institutions supporting the BU approach. The most typical BU projects are more active (and activist) because citizens lead their own projects, which are mostly related to solving some community problems or needs, but in most cases, the idea or the encouragement is from a scientific institute (Ostermann-Miyashita et al., 2021, p. 5). BU type of CS is focused on the needs of stakeholders.

However, BU has weaknesses as well. The danger of BU projects is that the citizens can be personally involved and/or interested in the project, so they can easily be biased. Another difficulty is that they do do-it-yourself research without sufficient scientific methodological knowledge resulting in wasted efforts and outputs that the scientific community cannot accept, further inserting a wedge between the research and citizen community.

BU calls attention to the potential of citizens' own discoveries and suggests that the role of scientists can also be supportive. In BU projects, citizens can approach scientists looking for assistance with their projects.

Citizens can also be involved in scientific projects in a more extreme way than BU. In the extreme CS approach (Haklay, 2013), participants try to design and develop new devices and knowledge creation processes that can be useful for society, considering local needs, practices, culture and works. It enables any community, regardless of their literacy or scientific qualifications. Stakeholders can be an active part of the whole process — from problem definition, data collection, and analysis, and visualisation to action. Therefore, those people who do extreme CS are empowered to be part of the entire development of the scientific project. Of course, using this method, there is a threat that citizens use scientific data from unchecked sources or draw incorrect conclusions. That is particularly dangerous when citizens are involved in sensitive local affairs as hobby researchers.

Given the above, there is a need for an approach to CS that builds on stakeholder issues but works with a methodology that meets the highest possible scientific criteria. In our paper, we propose such an approach by combining the benefits of TD and BU CS.

2. Methods of Reciprocal Citizen Science

A novel approach to CS, the so-called "reciprocal CS" (RCS), introduced by the Institute of Transdisciplinary Discoveries (ITD), University of Pécs, Hungary, in the "International Transdisciplinarity Conference" (Sík et al., 2021), combines the advantages of TD, and BU approaches. RCS is based on citizen-initiated research ideas and is citizen-led. In order to avoid pseudoscientific or biased approaches, the university (or other scientific institution) provides scientific support, especially in the field of methodology and equipment, if needed. RCS differs from the BU approach in that the former is more organised and systematised due to the supervision and because the support provided for the citizens is useful for the university as well because it helps to elaborate more modern and efficient ways of scientific mentoring and it can lead to novel approaches of scientific problems. We call this approach reciprocal (see Table 1) because the university also benefits from a research project that solves a local community or even individual problem. In RCS, the source of the research idea is the citizen, and the role of the scientific institution is support, encouragement, and scientific coaching (research design, methods, scientific presentation and writing). If the citizen needs it, the institution can provide equipment as well.

Approaches to citizen science	Motivation	Stakeholder benefit	Methodological accuracy	Scientific networking	Main characteristics
Top-down	↓	↓	↑	↑	Citizens involved in data collection Research regulated by professionals
Bottom-up	↑	↑	↓	↓	Projects based on citizens' ideas and needs Research regulated by citizens
Unleash your inner scientist (reciprocal citizen science)	↑	↑	↑	↑	University encouraged and supported projects Citizen-initiated topics and citizen-led research

Table 1 *Reciprocal citizen science compared to top-down and bottom-up approaches*

RCS can be implemented through a comprehensive *mentoring programme*. In the field of CS, almost all the mentoring programmes represent the TD approach. That is, a scientific institution prepares the citizens for the scientific data collection and possibly for the use of the application or other data organisation solution that the institution uses for the scientific research (cf., Haklay 2013). A huge difference from TD mentoring programmes is that in RCS, citizens get specific mentoring according to their needs. After an initial assessment, similar to a placement test, the mentoring program's organisers decide what training the mentee needs. In addition to developing research methodology, scientific database searching, scientific writing, and presentation skills, mentees can be provided with entrepreneurship coaching and incubation programmes if their ideas are worth enlarging into a startup.

The main novelty of the RCS approach is that it applies citizen engagement through mentoring. RCS encourages citizens to bring their own ideas to scientific institutions, which provides them mentoring, and support and gives scientific assistance tailored to the needs of the citizen. RCS uses a BU methodology because incubated research projects are based on citizens' ideas. They initiate and lead their own projects based on local or own interests or public issues. However, RCS uses the advantage of the TD approach to the extent that it is academy-encouraged and -supported. In addition, RCS provides methodological knowledge, research tools and infrastructure and entrepreneurial training in the case of projects with innovation potential. This multifaceted approach encourages citizens to publish their results or start a venture in the business field.

Considering that this combination of TD and BU approaches, by its very nature, leads to mutual knowledge and experience exchange among all levels of academic representatives and citizens, we define our approach as RCS. ITD of the University of Pécs elaborated a RCS mentoring program with the title of Unleash Your Inner Scientist. Unleash Your Inner Scientist is a transdisciplinary program that provides a mentoring framework for supporting citizen-initiated and -led scientific and innovation projects while developing

a complete, practical-based methodological strategy for the scientific mentoring of citizens. Unleash Your Inner Scientist is currently in the pilot phase. It combines the benefits of TD and BU, making it RCS-based and unique in that it provides a comprehensive mentoring program for citizens, which aims to make the scientific or innovative results developed in the program known to the general scientific public. The scientific institute's role is to provide support and scientific coaching (research design, methods, scientific presentation and writing), equipment and entrepreneurship coaching (if needed). At the societal level, the RCS-based mentoring program's benefit is the encouragement of civic activism in a scientific way avoiding or at least controlling pseudoscience.

2.1. Advantages of Reciprocal Citizen Science in Approaching the University and Society

2.1.1. Reciprocal Citizen Science As a Transdisciplinary Method

Since CS is conducted by lay people, or at least by people who do not practice scientific research within an institutional, standardised framework, it is surprising that there are few CS mentoring programs. We can find among the few examples a mentoring and training program for open science ambassadors whose purpose is to empower citizen scientists to become effective open science ambassadors in their communities. However, this project is only for life science. Other CS mentoring programmes are focused on TD approaches and training citizen scientists as data collectors.

RCS offers a novel approach to CS and opens opportunities for involving lay people more extensively in science while maintaining all the advantages of the TD and BU approaches as researchers-led projects. Also, civil activism and social innovations remain viable. This approach exploits the citizens' scientific and/or innovation potentials while consistently contributing to their skill development. Importantly, the RSC implements a crucial aspect of the citizen-academy relationship: transdisciplinarity. When universities or research institutes look beyond the organisation's wall and seek the involvement of external stakeholders, then they create transdisciplinary projects and implement what is in the ethos of the civic university model.

2.1.2. Reciprocal Citizen Science As Innovation Potential

RCS can be embedded in the civic university approach. Civic university (Goddard et al., 2016) is based on the societal embeddedness of the university, when higher education institutes collaborate with local area and community, in partnership with local organisations, taking social responsibility.

The overall goal of RCS is to create a new way of citizen involvement in scientific research. Even the most extreme citizen involvement approach, the idea to be developed is either created or co-created by a scientist neglecting the huge potential of the non-scientific community. Considering that scientists make up only a small fraction of the adult human population, it would be unreasonable to think that citizens are not full of ideas that have *innovation potential*. In this project, we tap into this pool of ideas by

creating the citizen-led project development approach. This unique approach also has a *knock-on effect on the academia-public relationship*. Since universities gradually move to "civic university" engagement recognising the embeddedness of universities in society, this approach brings the two sectors closer together. It builds trust in the academic sectors from the civil and general public points of view.

The core concept is that the knowledge and innovation potential of lay and/or non-scientific people often do not receive enough visibility, although many inventions and discoveries are also tied to these people. The knowledge generated by these people cannot be ignored in the information society.

> Involving citizens and broader communities beyond universities and traditional research institutions as participants in research systems has been defined as one of the megatrends that will influence future research policy. There is an increasing focus on how laypeople and other communities outside of traditional research institutions can be involved in all levels of research activities, including data collection and categorisation. (Magnussen, 2017, p. 394)

There are few researchers in society, so in scientific research and innovation, it would be a waste to miss someone who is not an institutional researcher.

Laypeople's inventions cannot be underestimated because some of them changed humanity. For example, the first operational aircraft was invented by the Wright Brothers. In these projects mentoring plays a crucial role in the success and effective progression.

RCS's development goals align with the *most in-demand core skills for work and life*. According to the *Future of Jobs Report 2020* of the World Economic Forum (2020), some of the top skills for 2025 are analytical thinking and innovation, active learning and learning strategies, complex critical thinking and analysis, problem-solving, creativity, originality and initiative, reasoning, problem-solving and ideation. Besides individual skill development, RCS is expected to have impacts at several levels in the lives of individuals and smaller or larger communities.

2.1.3. Reciprocal Citizen Science As Bridge of the Gender Gap

Even in the 21st century, relatively few women choose a career in science, and many leave the research career. According to UNESCO Institute for Statistics (2019) data, less than 30% of the world's researchers are women and women leave science careers in greater numbers than men. CS is an ideal option for women who do not have the time or opportunity to conduct scientific research professionally but would continue their previously discontinued research or embark on a career in science and/or innovation. In this way, these women can satisfy their desire for scientific success and have the opportunity to develop their ideas. Because the RCS can be done on a flexible schedule, it also fits into the agenda of mothers with children. Our preliminary market research shows the same: 62% of the respondents are female. Therefore, RCS can reduce the gender gap, providing empowerment to women and other underrepresented genders in scientific

research. RCS can also be a solution for disadvantaged citizens who have not had access to higher education or cannot engage in scientific research due to financial constraints.

2.1.4. Reciprocal Citizen Science As Empowerment of Less-Advantaged Communities

RCS is not only able to solve local social and environmental problems but also to bring more citizens closer to academia. In the long run, this could even reduce university dropouts. Eurostat (2018) data show that 25% of students drop out of universities in the European Union. That means millions of students in a few years who will no longer make use of their academic knowledge after a few years. If a small portion of this group can be kept in the circle of scientific thinking with the help of RCS, it means that the knowledge taught at the university is not wasted, nor is it such a loss for individuals. The advantages of RCS are deepening and expanding scientific knowledge, improving understanding of research methods, deepening and expanding their knowledge of scientific research methodology, strengthening their researcher confidence, and developing their presentation and scientific writing skills. Moreover, what is important from the point of view of the labour market, is increased potential for career mobility and promotion and the opportunity to be in a supportive environment in which successes and further development opportunities can be evaluated. RCS provides people networking opportunities and empowerment.

2.1.5. General Motivational Factors

To better understand why people are participating in CS projects and why CS projects can attract people from non-scientific communities, firstly, we need to understand why people do voluntary activities. The following six motivational factors (volunteer functions inventory; Clary et al., 1998) can give us an explanation:

1. values — a possibility to express altruistic and humanitarian values;
2. understanding — an opportunity to earn knowledge, skills, and abilities;
3. social — an opportunity to strengthen and develop relations with others;
4. career — an opportunity to gain career-related benefits from volunteering activities;
5. protective — an opportunity to reduce guilt over being more fortunate than others;
6. enhancement — a possibility to aid the ego to grow and develop.

Therefore, CS is an ideal voluntary activity because CS projects can be based on altruistic and/or community goals, and at the same time, citizens' research activities can widen their knowledge base. CS provides an ideal opportunity to develop social relations, that is, in a local community. Citizens' projects often need new competencies which can be used in the labour market as well, and, hopefully, and this is not a very utopian idea, CS can contribute to the citizen's personal development.

Parthenos (2019) also collected CS's benefits for the citizens. These outcomes, of course, are ideally aligned with participant motivations:

- new/increased scientific knowledge and understanding;
- building/belonging to a community; social learning;
- empowerment;

- raised awareness;
- data access;
- development of personal capacities — the experience of self-efficacy and a sense of purpose.

These benefits are especially true if the CS project is implemented in an organised manner, linked to monitoring, and the citizen receives scientific assistance. Therefore, we believe that RCS is the ideal form of CS because it includes organised supervision and assistance for the citizens, and all the support is tailored to citizens' needs.

2.1.6. Reciprocal Citizen Science As a Solution for Burnout of Academic Researchers

RCS brings benefits not only to citizens but also to academic institutions. Involving university researchers in CS projects, such as mentors, can help them think from a broader perspective and face new social, environmental or other issues. Burnout in researchers and academics is a little-studied phenomenon. One of the best-known theories of burnout was provided by Maslach and Jackson (1982). They reveal the burnout phenomenon in three dimensions: first, emotional exhaustion (which is the leading symptom of burnout and suggests that the person's deep emotional resources have run out). Second, negative attitudes and impatience towards clients, colleagues and the job itself and third, reduced sense of effectiveness (a high degree of negative self-esteem is also associated).

While in other sectors of the economy, employees are increasingly appearing as key players in corporate performance, as their competence, efforts, motivation and commitment fundamentally affect competitiveness, the key role of employees in educational organisations is uninteresting for the employer in this respect (Jármai, 2018, p. 116). Large companies (especially multinational companies) are taking more and more serious care to organise their employees' mental, physical, and rest needs. However, there is no organised opportunity for teachers to discuss problems, supervise, maintain and develop their own personalities (work equipment). So, because of this feature, the quality of work can only be assessed indirectly, as there is no acceptable, standardised way or consequence of direct superior and student assessment, or not even its social recognition. Education plays a key role in society. The subjective well-being of its workers hardly preoccupies economic, professional, or even institutional decision-makers. There are aspirations for change and initial attempts to introduce various incentive systems to motivate employees based on performance to improve their work, but the information they receive reflects a mixed experience. The basic condition of subjective well-being is the feeling of satisfaction arising from professional self-fulfilment and self-realisation.

Burnout caused by overload particularly affects researchers in the science, technology, engineering, and math sectors (Site, 2017). Burnout is a direct consequence of competition. When scientists reach their goals, win an award, or are promoted, those successes help their recovery from stress. However, scientists' lives consist of more unsuccess and lack of time and money, or even the lack of positive feedback are extra factors of burnout.

Among the solutions to mental burnout, in addition to consulting a professional and having more rest, we also find knowledge transfer. A *Nature* article from 2020 (Gewin, 2020) encourages researchers to spread their knowledge. The article emphasises the importance of knowledge transfer not only from the societal point of view. The author believes that knowledge sharing helps researchers achieve a more balanced mental state. From this, we can deduce that CS is a possible form of researcher burnout prevention or treatment. Of course, it is not the only solution, but it can expand the repertoire of offerings and societal functions of universities. Another important factor in academic burnout is that the researchers need to build relationships for recognition. Publications and conference presentations are often exhausting for researchers (Site, 2017). CS offers a more relaxing network because it is based on more informal relationships and communication forms.

CS offers a new kind of connection for researchers, in which they do not need to solve difficult scientific tasks but can use their existing knowledge, learn new perspectives, and successfully solve scientific or social problems. Positive impacts of RCS for researchers as mentors are different and vary a lot according to their motivation and fields of interest. In general, scientists may encounter approaches to scientific phenomena and problems, which can serve as an inspiration even in their own research careers through challenging discussions with people who have fresh perspectives. Academic lecturers can benefit from developing their mentoring (communication, interpersonal, conflict management) skills by expanding their mentoring tools. The out-of-the-box thinking can provide them opportunities to test new ideas and gain further knowledge, improve their ability to share experience, knowledge, competencies and skills, and capacity to motivate another person. Finally, RCS provides a potential to renew enthusiasm for their role as experienced researchers and opportunities to reflect upon and articulate roles and responsibilities.

3. Preliminary Experiences of a Reciprocal Citizen Science-Based Mentoring Program

3.1. Unleash Your Inner Scientist Program

Combining the benefits of TD and BU and implementing an RCS-based practice, ITD of the University of Pécs elaborated an RCS mentoring program titled Unleash Your Inner Scientist. It provides a comprehensive mentoring program for citizens which aims to make the scientific or innovative results developed in the program known to the general scientific public. The scientific institute provides support, scientific coaching (research design, methods, scientific presentation and writing), and equipment and entrepreneurship coaching (if needed). At the societal level, the RCS-based mentoring program's benefit is the encouragement of civic activism in a scientific way avoiding or at least controlling pseudoscience.

Unleash Your Inner Scientist is based on transdisciplinarity, providing a mentoring framework for supporting citizens' scientific and innovation projects through a complete,

practical-based methodological strategy for empowering local initiatives. The project aims at the general public (lay people, citizens) interested in science to develop primarily their scientific and, secondarily, their entrepreneurial and communication skills. The programme aims to support citizens in elaborating their area of interest on a scientific level, however, without integrating them into formal educational frameworks. The core element of the programme, that is, the citizen empowerment process, uses the tools of scientific and business mentoring, coaching and project consultation and provides scientific training to citizens (mentees). Parallelly, another important part of the core element is network building for mentors who form a learning community, sharing methodological expertise and the experience generated during the mentoring process. The experience share is cyclic: the experience and data collected in the pilot are used in the second cycle and so on (see Figure 1).

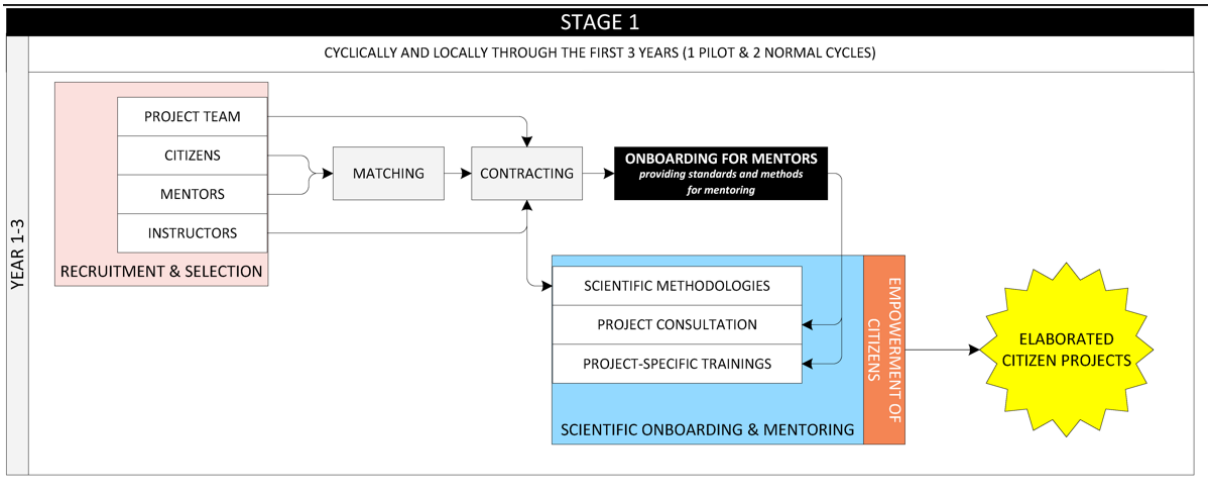

Figure 1 *Unleash Your Inner Scientist's process*

The advantage of the mentoring method is that the mentees (citizens) are supported by involving them as active leaders in their own learning and developing processes.

Beyond the project-specific scientific mentoring support, it is also reasonable to apply coaching methods and tools to encourage and empower citizens and tackle the natural anxiety that former experiences in institutional learning can cause.

Since the individuals in the target public may have no or only rudimentary experiences in scientific research, mentoring is preceded by a capacity-building programme where basic scientific knowledge is learned (research methodology, academic writing, scientific presentation). Besides basic scientific training, the programme includes a mini-course on entrepreneurial skills and knowledge development for those who want to launch a startup based on their innovation. The capacity-building programme is provided by an instructor board.

Onboarding, mentoring and continuous supervision is provided for mentors as well, in order to provide them with standards and methods and develop their

mentoring-coaching skills and help them work effectively with citizens from potentially different backgrounds.

3.2. Preliminary Experiences of Unleash Your Inner Scientist

Unleash Your Inner Scientist is currently in the pilot phase. The pilot is based on *preliminary market research* made in Hungary by ITD. A quick quantitative and qualitative survey assessed potential mentees' needs and research interest areas. A total of 52 people with specific research ideas showed interest in the mentoring program. The main needs of citizens ($n = 52$) are mentoring and scientific consulting (90% of respondents marked this need), access to scientific databases (49%), financing (49%) and access to laboratories (20%). About 43% of the potential mentees are willing to do research in the field of psychology, and 25% want to conduct a project in cultural studies, followed by literary studies (18%) and other fields (14%). That means that, according to the needs assessment results, citizens need not expensive tools but rather scientific guidance.

The pilot program started in June 2022 with three mentees, but ITD formed a consortium with five European universities that would apply the same project in their local communities. The three mentees were selected by simple criteria: motivation, immediate availability of mentors and, for practical reasons, organisers selected proposals without the need for specific tools.

The pilot's preliminary experience shows that the mentees started the program with good basic knowledge and methodological background. The organisers and mentors of the program had the preliminary assumption that among the applicants, there would be a large proportion of people with pseudoscientific views or at least very simplistic scientific attitudes. It did not turn out that way. The three mentees are strongly committed to their research and are motivated to learn about scientific research methodologies.

3.3. Sustainability and Impact Measurement of the Unleash Your Inner Scientist Programme

The project's sustainability is based on, among others, the inclusion of prototyping environments (makerspaces or FabLabs) in the process. Citizens whose projects require tools and equipment can use the resources of the university's subcontracted local prototyping institution(s). Moreover, a digital infrastructure will be developed that allows citizen scientists to identify, obtain, and set up the technical aspects of their work (which today virtually always include a digital component in hardware or software, and usually both) and to document them with scientific rigour to support replicability and further research. The tailor-made Unleash Your Inner Scientist knowledge and data infrastructure for CS projects addresses the key challenges in citizen scientists' successful engagement in obtaining and documenting the "materials and methods" for their work.

CS can have broad-spectrum effects, influencing science itself and having societal, environmental, and economic impacts. However, as Somerwill and Wehn (2022) emphasise, in many CS projects, impact assessment is simplistic. After a systematic literature review, the authors identified best practices and approaches for measuring attitudes, behaviour and knowledge change in environmental CS projects. However, this approach, although it criticises superficial impact assessment practices, uses a qualitative method. Therefore, ITD elaborated a quantitative approach for measuring Unleash Your Inner Scientist's impact. The method can be applied to other projects as well.

The method is based on a quantitative questionnaire. The mentees fill out the questionnaire at the beginning and end of the mentoring programme, and the change over time is assumed to show the project's impact. In order to ensure the accuracy of the measurement, we use a control group which does not get any scientific mentoring. One part of the questionnaire is an attitude measurement related to science and the university, and in the other part, the mentees must analyse case studies from the point of view of which scientific research methods they would use.

4. Conclusion

The literature on CS has been analysing the potential of BU CS for years. RCS offers more than BU in that it includes more organised scientific oversight, which prevents citizens' projects from pseudoscience, and offers reversible benefits for scientific institutions. Examples of such benefits are reducing research burnout and the application of new scientific and innovative perspectives. RCS is also worth introducing in an international context because of various successful CS projects, although the vast majority are based on the TD approach. RCS offers an important component to CS: organised mentoring has been missing from a significant proportion of CS projects. RCS not only provides benefits to the academic sectors but also has the potential to improve the critical thinking skills of citizens, thus reducing the spread of pseudoscience on a large scale.

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Interview With Eloy Rodrigues: "There Will Be No Open Science If the Excessive and Wrong Use of Metrics Is Not Abandoned"

Entrevista com Eloy Rodrigues: "Não Haverá Ciência Aberta, Se Não For Abandonado o Uso Excessivo e Errado das Métricas"

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Eloy Rodrigues is a member of the Expert Group on Science 2.0/Open Science of the European University Association, representing the Council of Rectors of Portuguese Universities. Deeply aware of open science issues and one of the main stakeholders of this movement in Portugal, he is the director of the Documentation and Library Service of the University of Minho (UMinho) and one of the main advocates for the adherence to open science practices and for the inclusion of open access in institutional policies. Eloy Rodrigues has coordinated UMinho's participation in more than a dozen projects (such as *OpenAIRE*, https://www.openaire.eu/, and *FOSTER*, https://www.fosteropenscience.eu/) funded by the European Union and concerning repositories and open science. He is a distinguished player in implementing open access from institutional repositories. He was the Chairperson of the Executive Board of the Confederation of Open Access Repositories (https://www.coar-repositories.org/) from 2015 to 2021 and is, since 2008, the coordinator of the UMinho team that develops the project *Repositórios Científicos de Acesso Aberto de Portugal* (Open Access Scientific Repositories of Portugal; www.rcaap.pt).

Elsa Costa e Silva (ECS): The open science movement is expanding and getting widespread institutional support. In November 2021, the General Assembly of the United Nations Educational, Scientific and Cultural Organization, UNESCO, approved a recommendation on open science (UNESCO Recommendation on Open Science, 2021), calling on member states to develop policies and incentives for open science. What do you think is the reason for this consolidation of open science?

Eloy Rodrigues (ER): Open science encompasses several dimensions, such as open access to the results of scientific activity, namely publications and research data, and openness in the research process. The concept and the movement of open science have gained ground in the last decade from the open access movement (open access to publications), which is now over 20 years.

I believe the consolidation of the open science movement in recent years is due to the convergence of several phenomena and factors. On the one hand, the growing maturity and scale of open access to scientific publications, despite contradictory and worrying

aspects (such as those relating to the model based on publication fees), has proven its advantages both for authors and the institutions where they work (visibility and increased impact). It also has advantages for the agencies and governments that fund them (maximizing the return on their investment in research and development) and the overall operation of the scientific system. On the other hand, there has also been a growing awareness of the benefits of managing and sharing research data, whose importance is growing in an environment where science is increasingly digital.

Finally, the COVID-19 pandemic, and the way the scientific community and society at large have reacted since the early 2020s, has demonstrated what the advocates of open science have been claiming: research conducted in an open, collaborative and transparent way, facilitating the sharing and communication of processes and results (data, publications and others), is the most efficient means to promote the progress of science and the generation of new knowledge.

The political support for open science, which already had a significant outreach before, has been greatly strengthened since the pandemic.

ECS: The COVID-19 pandemic was a moment of great expansion of open science. Do you believe it was an emergency solution, or are we facing a new normal?

ER: Open science has already been the answer to past health emergencies, such as those related to ebola or zika. However, given the global nature of the COVID-19 pandemic, the impact was much faster and more profound than in previous situations. Research practices and dissemination of results changed profoundly during the pandemic, particularly in the biomedical field, with the adoption of open science tools and principles: publication and sharing of results as quickly and openly as possible, allowing their reuse, adoption of innovative publication and dissemination channels and models (preprints, open peer review, overlay journals, social media, etc.).

The pandemic has demonstrated the benefits of these practices, and the ethical question we should ask ourselves (if we make knowledge relating to SARS-CoV-2 and COVID-19 available, why should we not do the same for other diseases, such as cancer, problems such as climate change, or other societal challenges?). However, it is not certain that the pandemic has mortally wounded the old practices and the scholarly communication model controlled by commercial interests.

The traditional scholarly communication system has so far proved to be quite resilient due to the strategic action of the commercial entities that dominate it and benefit from it, and, above all, to the conservatism and lack of vision and courage of the scientific community and its institutions. Therefore, it is legitimate to question whether adopting open science will survive the pandemic.

For open science to become a new normal, the institutions that do or fund research need to be able to sustain infrastructures run and controlled by the scientific community (and not by the dominant commercial entities) and to reform the evaluation of careers and research deeply. If the evaluation and reward systems are not changed, researchers will be driven back to old habits and practices.

We currently have contradictory indicators in this field: on the one hand, worrying signs that part of the scientific community is returning to the pre-pandemic "normality" but, on the other hand, a strong stimulus and political support to reform initiatives in research evaluation.

ECS: We have witnessed a greater openness of the scientific community to society, dialogue strategies, and calls for citizen participation. To what extent can we consider that the open science movement also contributes to the democratisation of science?

ER: While in some cases the access to knowledge only benefits the scientific community itself (due to the degree of specialisation and prior knowledge necessary for its reuse), in many others, it provides an immediate benefit, direct or indirect, to citizens and society, democratising its availability and facilitating its use.

As I mentioned earlier, open access to results is only one part (though the fundamental one) of open science. The other dimension is openness in methods, tools and infrastructures: the openness "in the doing" of research. Such openness also helps make science more socially responsible and more aware of the social consequences and implications of decisions taken in research, from the definition of agendas to the participation of citizens in research, to the methods and tools used for sharing or privatising its results. Open science and responsible research and innovation (RRI) are concepts with different origins but with many affinities and overlaps.

ECS: Alan Irwin (1995) coined the term "scientific citizenship" in 1995 to describe a new approach to involving citizens by calling on them to participate in the production of knowledge. How does open science relate to this citizen science movement?

ER: Citizen science is another element or dimension of open science, increasingly drawing attention and interest. When we talk about citizen science, in the context of open science, we are not only referring to the participation of citizens in research activities, such as observation or data collection, in a totally subordinate and relatively passive way. As we have already mentioned, we are also referring to participation in discussing and setting research agendas, evaluating projects and discussing their results and impact.

ECS: Open science has been growing as opposed to a closed and hierarchical model of science, organised according to impact factors. What do you believe are the main problems of this model of scientific production and dissemination?

ER: The current model has many problems. It is very expensive, and the high prices borne by the scientific community bear little relation to production costs and are largely determined by an "economy of prestige". The system lacks transparency and is controlled by a handful of large, monopolistic groups (about three-quarters of the articles indexed in databases such as Web of Science or Scopus are published by the five largest

publishing groups). It is hardly innovative and does not allow one to capitalise on the digital environment's potential.

Most importantly, it is closed and ineffective: research is hampered because researchers cannot access the entire corpus of literature in their field, they cannot perform text and data mining to extract new knowledge, and research results are not available and cannot be easily adopted by other social players, thus not serving the interests of research, the scientific community and society.

Using metrics such as the impact factor to evaluate research and the people and institutions that do it is an essential aspect of the current model, with very negative consequences. Firstly, because the impact factor is a completely inadequate metric to evaluate people/institutions, it was created to evaluate journals. Secondly, metrics can and have been increasingly manipulated. Finally, evaluation based (in some cases exclusively) on metrics has led to a research culture that encourages competition and the production of a specific outcome, the scientific article, in the largest quantity possible, in journals with the highest possible impact factor. That hinders the research agenda, the topics chosen, the methods used, and the results sought to its "publication potential".

As I often say provocatively, I fear that in some contexts, to satisfy the metrics and rankings, one stops publishing because one is researching and starts researching mainly to publish.

ECS: There is also a fact noted, for example, in a 2002 paper (Bordons et al., 2002), about geographical inequalities, since in peripheral countries, national publications are rarely published in the most prestigious databases...

ER: Yes, that is another problem getting worse. The lack of equity in scholarly communication, which has an obvious geographical dimension (although there are others among disciplines or institutions in the same country or region), has not diminished in recent years. In fact, the model involving the payment of publication fees (APC, or article processing charges) for publication in open access, which the large publishing groups quickly adopted and, unfortunately, is supported by several countries and institutions with greater economic resources, only magnifies the problem. It replaces (or rather adds to) the challenges many have in accessing articles published in scientific journals with the impossibility of being able to publish in those same journals.

ECS: A key variable to consider in this context is the financial side and the turnover revolving around scientific publishing. Don't you believe this aspect will be one of the major obstacles to developing open science?

ER: Yes, of course. The big publishing groups have fantastic business. The scientific publishing market is estimated to be worth more than $10,000,000,000, and each paper published in a traditional scientific journal generates about $5,000 in revenue on average. The APC in traditional journals is around $2,500. However, the Springer Nature

Group has signed an agreement with the Max Planck Society, whose researchers will publish in open access in Nature-branded journals for $9,500 per article. According to available data, the profit rate of the publishing business of the Elsevier group has been over 30% in recent years.

Hence, it is only natural that these large groups strongly resist change or try to make it only in the payment model/moment, maintaining their control over the entire scholarly communication system.

Less natural and understandable is that the scientific community is still unable to free itself from this control, from this kind of Stockholm syndrome from which it seems to suffer. That it has not yet managed to reform the scholarly communication system, making it more efficient, innovative, inclusive and governed by the community. By establishing a system driven by the primary purpose of scholarly communication and the first journals created in the 17th century — to record and disseminate the results of research and scholarly work — and not steered by commercial interests.

ECS: Considering the costs related to publishing, is it possible that open science will intensify the already known inequalities in access to the production of science and that it is only a movement for the so-called "developed countries", the only ones with the means to support these new structures?

ER: That is a serious risk if the fee-paying model of open access publishing becomes dominant, as the commercial publishers want. The regional, institutional and disciplinary inequalities mentioned above could be accentuated, and there are already some signs of this. In the project *ON-MERRIT* (Observing and Negating Matthew Effects in Responsible Research & Innovation Transition), we are part of, explored this problem and produced recommendations: ON-MERRIT *Recommendations for Maximising Equity in Open and Responsible Research* (Cole et al., 2022) to mitigate the inequalities identified.

ECS: What is the role of institutional repositories in this new context? Can they really be a new trend in institutions producing science?

ER: Repositories and other institutional infrastructures will be pivotal for a new model of scholarly communication. Not only as another outlet for content originally published elsewhere but as the starting point for scholarly communication.

Whereas when journals were published on paper, which meant that the roles of registration, certification, dissemination and archiving, essential for scholarly communication, were handled by the same entity (the journal), in the digital world, these four roles can advantageously be distributed among different players and infrastructures.

Repositories can be the foundation of a distributed and globally connected infrastructure for scholarly communication. They can ensure registration and archiving roles and facilitate external value-added services (such as peer review, certification, and

dissemination) provided by other entities and infrastructures, such as journals or publishing platforms.

That is an innovative vision of scholarly communication, which we have been promoting, namely through the Pubfair framework proposal (Ross-Hellauer et al., 2019) and the *Notify* project (Confederation of Open Access Repositories, n.d.).

ECS: One of the constraints for open science is that indexing provides clear references to the visibility and reputation of publications. Will there be conditions for the emergence of new models for validating the scientific quality of publications within the context of open science?

ER: There will be no open science if the excessive and wrong use of metrics is not abandoned. And I say the same about the possibility of a good evaluation system for researchers and research. Metrics, such as the impact factor, shift the evaluation from the content (intrinsic to the publication) to the container and circumstances (extrinsic) and replace human qualitative evaluation with an automatic quantitative evaluation.

The excessive use of metrics, and especially indirect metrics such as impact factor, has been strongly criticised for almost 1 decade, with successive declarations (such as the San Francisco Declaration on Research Assessment, in 2012, and the *Leiden Manifesto for Research Metrics* [Hicks et al., 2015], in 2015, or, more recently, the Paris Declaration — Paris Call on Research Assessment, 2022). It seems consensual today that the current model will have to be replaced by alternatives that combine qualitative and quantitative assessment and, in the latter dimension, by the limited and responsible use of metrics.

ECS: Among the main challenges to the idea of open science, which do you think are the most difficult to overcome?

ER: I honestly think that the main challenges and obstacles are inertia and the difficulty in coordinating and taking concerted action on the part of the scientific community and its institutions. Open science does not require more financial resources (it is quite likely that if it is led by the scientific community and not by commercial entities, it will allow for savings regarding the publication and dissemination of results). On the other hand, it has advantages repeatedly proven in emergency situations and everyday science, so there is no significant opposition to open science in the scientific community.

However, although it already has a very significant adherence in some countries, institutions and scientific disciplines, and among young researchers, the spontaneous adoption of open science practices is still limited, and the major advances were made through "top-down" political stimuli. Traditional academic conservatism, inertia, and especially evaluation systems that reinforce the incentives to use traditional practices make old habits die hard. Cultural changes are always difficult and time-consuming, and this is particularly evident in academia.

Finally, the widespread adoption of open science, managed by the scientific community, and serving the interests of science and society, calls for a systemic change, which requires the coordinated and concerted action of all institutions, from funding agencies to universities and other research organisations. Such alignment must happen globally, involving the main institutions and their members in the different regions, which is anything but trivial.

Translation: Anabela Delgado

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A Comparative Study of the Work of Professional Caregivers of Battered Women

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Abstract

The care service for women victims of violence constitutes a risk space for the manifestation of burnout syndrome and secondary post-traumatic stress disorder caused by listening to traumatic experiences. Therefore, this article aims to present a comparative picture of cross-cultural research carried out in Brazil and Spain with 32 subjects. The objectives are: to describe the work conditions, investigate the experience of attending to female victims of violence, and observe the self-care practices the professional group carried out at the personal, professional, collective, and institutional levels. The analysis of data from the Brazilian context was performed with Iramuteq through the descending hierarchical classification, which resulted in five classes, namely: assistance to women victims of violence; conflicts, violence, and professional activity; authors of harassment practices and working conditions; self-care personnel; managing obstacles in the work environment. The results collected from the Spanish professionals were also subjected to the same data analysis, resulting in five classes: trajectory, professional performance and working conditions; assistance to women victims of violence and forms of self-care; complaints about conflict and violence; personal self-care; forms of harassment and conflict. The elaboration that confronted the categories of the two surveys identified similarities regarding the subjective experience and distancing in the self-care characteristics undertaken by Brazilian and Spanish professionals. This study proposes to reflect on the institutional dynamics of these environments.

Keywords

social work, occupational risks, self-care

Um Estudo Comparativo do Trabalho dos Profissionais de Assistência a Mulheres Agredidas

Resumo

O serviço de atendimento a mulheres vítimas de violência constitui um espaço de risco para a manifestação da síndrome de burnout e transtorno de estresse pós-traumático secundário, ocasionado pela escuta de experiências traumáticas. Por isso, este artigo tem por finalidade descrever as condições de trabalho, investigar a experiência de atendimento a mulheres vítimas de violência e observar as práticas de autocuidado exercidas pelo grupo profissional em níveis pessoal, profissional, coletivo e institucional. O texto apresenta um estudo comparativo realizado no Brasil e na Espanha com 32 sujeitos. A análise dos dados oriundos do contexto brasileiro foi realizada com o Iramuteq, por meio da classificação hierárquica descendente, resultou em cinco classes, a saber: atendimento às mulheres vítimas de violência; conflitos, violências e atividade profissional; autores de práticas de assédio e condições de trabalho; autocuidado pessoal; gerenciando os obstáculos no ambiente de trabalho. Os resultados coletados com as profissionais espanholas também foram submetidos à mesma análise de dados, resultando em cinco classes: trajetória, desempenho profissional e condições de trabalho; atendimento a mulheres vítimas de violência e formas de autocuidado; afirmações sobre conflito e violência; autocuidado pessoal; formas de assédio e conflito. A análise comparativa apontou para semelhanças no tocante à experiência subjetiva e um distanciamento nas características de autocuidado empreendidas por profissionais brasileiras e espanholas. Refletir sobre a dinâmica institucional destes ambientes e a influência dos fatores socioculturais no autocuidado são propostas deste estudo.

Palavras-chave

trabalho social, riscos ocupacionais, autocuidado

1. The Work of Professional Caregivers of Battered Women

Violence against women is a phenomenon characterized by the use of real or symbolic force by someone aiming to subject a woman's body, mind, and will (Bandeira, 2014). It is a fact that deserves both attention and care of a professional care network in countries such as Brazil and Spain. This reality is the result of official movements and demarcations that have led to the creation of this network of services for these targets in the Brazilian and Spanish realities.

In Brazil, this reality became significant when the country signed the Convention on the Elimination of All Forms of Discrimination against Women (1979). In order to fulfill the obligations outlined in this provision, Law No. 11.340 (Lei nº 11.340, 2006), also known as the "Maria da Penha Law", was created in 2006. This legal framework lists forms of violence against women, integrated prevention measures, assistance to women in situations of intimate partner and family violence, and the actions to be taken by the police authority and protective measures. According to this legal framework, the forms of violence against women are physical violence, psychological violence, sexual violence, property violence, and moral violence (Lei nº 11.340, 2006).

The national policy to fight violence against women (Secretaria Nacional de Enfrentamento à Violência contra as Mulheres, 2011) was also developed as a means

of qualifying the conceptual axes, principles, guidelines, and practices for institutional actors immersed in the fight against violence against women. This paper details the service network for the cases served. Among the services listed for this purpose are the Women's Reference Centers, the Specialized Women's Assistance Stations, and the Specialized Referral Center in Social Assistance.

In Spain, this type of service became available after the approval of the Organic Law on Protective Measures for Comprehensive Protection against Gender Violence in 2004 (Ley Orgánica 1/2004, 2004), in line with the United Nations recommendations. This legal instrument sets measures of sensitization, prevention, detection, and care for violence against women. The latter includes guaranteeing access to information and integrated social services through continuing and emergency care services by a multidisciplinary professional team. These services are offered through different means: telephone lines, emergency centers, shelters, associations, administrative, judicial, and police services, among others (Gomà-Rodríguez et al., 2018).

Practicing this type of activity involves a strong emotional mobilization, though, as appointed by a study, the involvement of professionals engaged in dealing with cases of violence against women in an intersectoral network. The results indicated that the respondents perceived their work as exhausting and experienced many doubts, feelings of impotence, sadness, anxiety, distrust, frustration, discouragement, stress, and fear, given the cases attended. Another occupational risk for workers' health in this type of service is secondary traumatic stress (Vieira & Hasse, 2017).

This syndrome is characterized by cognitive, emotional, somatic, and motor reactions, such as intrusive thoughts, insomnia, hypervigilance, and feelings of emptiness and hopelessness, among others (Caringi et al., 2017). A systematic review pointed out the differences in susceptibility to secondary post-traumatic disorder in physicians from child protection services, family violence, and sexual abuse care centers, and care for disaster survivors. It concluded that there is a propensity for the occurrence of this illness in female professionals whose explanations point to one of these aspects: a greater chance of women have already been victims of violence at some point in their lives, and a greater tendency for them to report suffering excites (Baum, 2016).

Thus, given the potential risks to the health of professionals and staff involved in providing services to victims of violence, self-care is suggested as a resource against these diseases and to preserve health. This term refers to a set of daily human practices which reflects the strengthening of skills, and actively promoting health care, whether in the individual or collective scope (Cantera & Cantera, 2014). At an individual level, self-care practices are developed through actions aimed at maintaining physical and mental health, such as careful meal composition, quantity and times, physical activities, sleep, participation in leisure activities, development of cognitive stimulation activities, preservation of good communication with important bonds (family, friends, co-workers) and implementation of self-observation disposition to manage one's own behaviors (Sepúlveda et al., 2014).

Within the professional teams, the incorporation of self-care is materialized through the creation of spaces to address the following latent themes for the practice of this type of service provision: the work burden and surplus work and how these affect the development of activities, impotence/omnipotence mobilized in the approach of the cases served, and affective overidentification with the reports assisted. In addition, these environments represent opportunities to organize, delegate, and coordinate activities within the group, developing a sense of trust among professional team members. These proposals offer benefits for professionals as well as communities by avoiding the reproduction of violence in the very care for the targets served (Holguín & Velázquez, 2015).

The work of art has the potential to release feelings, as well as facilitate a sharing of connection with their peers and, thus, reducing group stress, emerging more positive feelings. The results of an intervention proposal, within a qualitative and quantitative methodology construction, pointed out that a social action art therapy intervention reduces participants' stress, as measured by the results of post-intervention research (Ifrach & Miller, 2016).

Another form of action to preserve these professionals' health was proposed through a quantitative and qualitative exploration in the United States. The intervention was promoted by including professionals allocated to adult care services for survivors of child abuse, sexual assault, and violence against women from four community organizations in the holistic healing arts retreats characterized by a focus on the present, empathy, acceptance, and positive regard for the other. Different physical and emotional variables were measured before and after the intervention to investigate the effects of this proposition. After participating in these retreats, there was a decrease in the levels of insomnia, symptoms of secondary traumatic stress disorder and depression, perceived stress, an increase in life satisfaction, levels of physical and bodily esteem, attention to self-care, and self-efficacy (Dutton et al., 2017).

Taking into account the expansion of assistance centers for women in situations of violence and the occupational risks described in care for victims of violence against women, and the relevance of incorporating self-care as a health maintenance resource for these workers, it becomes relevant to carry out studies on the work situation of professionals assisting women victims of violence. This paper will present a comparative picture of the primary data from research carried out through a partnership between the Federal University of Sergipe and the Partner and Workplace Violence research group of the Autonomous University of Barcelona based on the following objectives: to describe the working conditions, investigate the experience of attending to female victims of violence and observe the self-care practices the professional group practiced at the personal, professional, collective, and institutional levels.

2. Method

This cross-sectional and descriptive research was carried out in care centers for women victims of violence in Brazilian and Spanish territories. Convenience samples

were constructed, adopting the following inclusion criteria for participation in the research in the two countries: (a) to work in the centers for women victims of violence; (b) to be linked to the psychological, social, or legal assistance of cases of women victims in specialized services; and (c) to be available to participate in the research.

The sample of this cross-cultural study consisted of 32 subjects working in care for victims of violence against women. Thus, in the Spanish context, this sample consisted of 20 professionals, 18 women, and two men, in this area with an average age of 47 years, who work at different care centers of public and private associations in Spain. In Brazil, the sample consisted of 12 female professionals, with a mean age of 35 years, from four care centers for victims of violence against women in the city of Aracaju and the interior of Sergipe.

In Brazil and Spain, representatives of the care centers for cases of violence against women intermediated contact with the participants to map the number of professionals who specialized in offering services this kind of service and who were willing to participate in this study. The instrument used in both countries was an interview script with 15 questions concerning statements about violence, conflict and work, and self-care. The study started after the participants had signed the free, prior, and informed consent form, which contained a brief description of the purposes of this research.

In addition, this study was approved by the Ethics Committee of the University Hospital of Aracaju/Federal University of Sergipe, according to CAAE 82003917.5.0000.5546. In Spain, the information is anonymous and confidential, following the Organic Law 3/2018 and the ethical requirements of the European Union safeguarded by the research institution (Autonomous University of Barcelona).

After this stage, the date and place were arranged with the care professionals for victims of violence against women to conduct the interviews. The interviews were recorded with an electronic recorder, and the researchers later transcribed the content. The data collected in the two studies were separately submitted to the software Iramuteq.

This computer method allows the manipulation of a large volume of texts, identifies the context in which words occur, and presents different forms of textual analysis, resulting in an understandable and clear organization of the collected written material. Iramuteq provides the following textual analyses: textual statistics, specificities, correspondence factor analysis descending hierarchical classification (DHC), similarity analysis, and word cloud (Souza et al., 2018).

For this research, the DHC, Reinert's method, was chosen for being an analysis that fragments the text or text corpus into text segments. The text segments represent text fragments, and their size is usually three lines, estimated by Iramuteq, depending on the text. These segments are classified according to their vocabularies, and their grouping is divided according to the frequency of reduced forms (Camargo & Justo, 2013).

DHC results from a correlational logic that uses the segmentations of the text corpus, together with the list of reduced forms and the computer program's adapted dictionary, to represent a hierarchical classification scheme. Classes of text segments have vocabularies similar to each other, significantly associated with that class, and distinct from text segments of other classes (Camargo & Justo, 2013).

This analysis allows for mapping representation systems and organizing the vocabulary in classes in a tree diagram that clarifies their relations (Souza et al., 2018). In this way, DHC makes it possible to track and organize the vocabulary extracted from the transcribed interviews, presenting representative classes of the ideas that the textual corpus conveys.

3. Results

Data analysis was extracted from the interview script applied in the Brazilian context using DHC. This analytical procedure allowed us to track and organize the transcribed vocabulary into the most quoted words and their chi-square (x^2), arranged into five classes representative of the ideas the text corpus conveys (Camargo & Justo, 2013).

For this, DHC generated a 12 initial context units that matchs to the interviews corpus. These were divided into 1,283 text segments, corresponding to 86.13% of the text material, an acceptable level of material utilization, whose value needs to be higher than 75%, and 4,177 words, with a frequency of 10,51 words per response. The constructed tree diagram, based on the similarity of the text segments, presented five classes of text segments. Through the "profiles" tab, the lexical contents of each of these classes are verified (Souza et al., 2018).

The words displayed in each class of the tree diagram correspond to the first 10 words exhibited in each class. The reports of the investigated words or text segments demonstrated in this comparative analysis were taken from the "profile tab" so that the scenario of each class is presented by text segments specific to the investigated reality.

This DHC divided the corpus' five classes into three subcorpora so that, on the one side, Classes 5, 2, and 4 are shown and, on the other, Classes 1 and 3. Next, Class 5 was separated into Classes 2 and 4 (Figure 1).

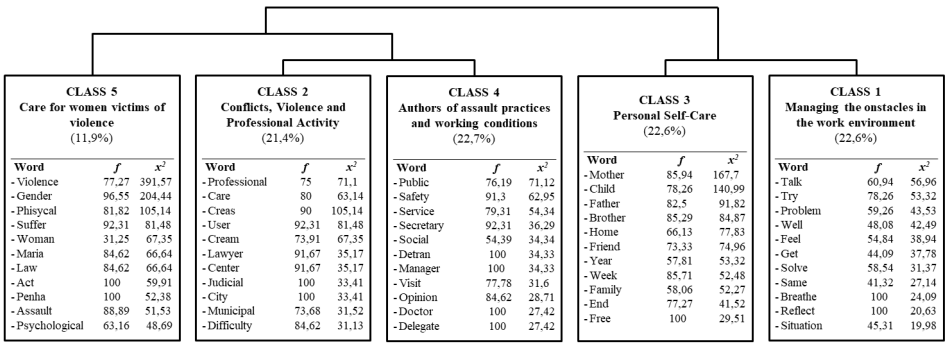

Figure 1 *Tree diagram of descending hierarchical classification for the corpus "work of professional caregivers for victims of violence against women in Brazil"*

As shown in Figure 1, the corpus "work of professional caregivers for victims of violence against women in Brazil" consists of five classes. Hence, Class 5, called "care for female victims of violence", corresponds to 11.9% of the text segments and presents discourse referring to aspects related to the attended demand and the contact with this reality. The following words are representative of this class: "gender" (*f* = 92.55%), "suffer" (*f* = 92.31%) and "violence" (*f* = 77.27%).

The segments from the interviews in Class 2, called "conflicts, violence and professional activity", corresponding to 21.4% of the text segments, identify the characteristics of the situations of conflict and harassment and describe the obstacles faced by the professionals' activities. The following words are representative of this class: "user" (*f* = 92.31%), "center" (*f* = 91.67%) and "difficulty" (*f* = 84.62%).

The reports in Class 4, entitled "authors of assault practices and working conditions", corresponding to 22.7% of the text segments, denote these professionals' precarious working conditions and the hierarchical superiors' abuse of power. The following words represent this class: "manager" (*f* = 100%), "secretary" (*f* = 92.31%) and "safety" (*f* = 91.30%).

The excerpts in Class 3, designated "personal self-care", portrayed in 22.6% of the text segments, outline the space and time available for this purpose. The words "mother" (*f* = 85.94%), "brother" (*f* = 85.29%) and "friend" (*f* = 75.33%) represent this class. Lastly, the excerpts in Class 1, "managing the obstacles in the workplace", based on 22.6% of the text segments, characterize how professionals deal with conflicts, difficulties, and other issues related to the relationship between professionals and the compliance with the demands received in the work context. The following words are representative of this class: "breathe" (*f* = 100%), "reflect" (*f* = 100%) and "try" (*f* = 78.26%).

On the other hand, the data analyzed in the Spanish scenario, using the DHC, were arranged in 20 initial context units that matchs to the interviews, organized in 1,304 text segments, corresponding to 90.11% of the text material and 5,188 words, with a frequency of 15,29 words per answer. The elaborated tree diagram followed the same construction criteria explained in the DHC of the Brazilian context (Figure 2).

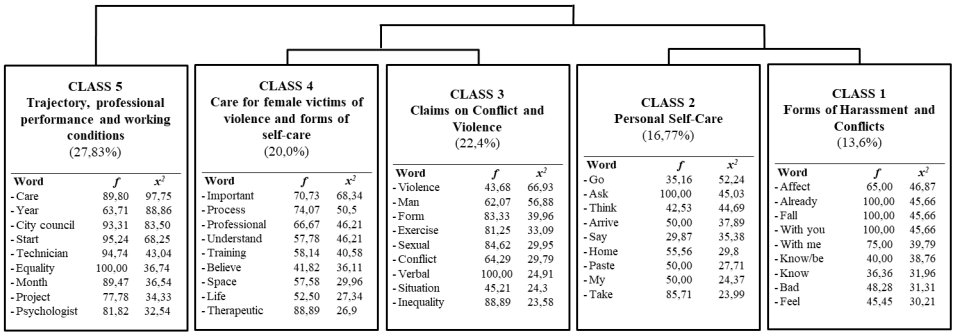

Figure 2 *Tree diagram of descending hierarchical classification for the corpus "work of professional caregivers for victims of violence against women in Spain"*

Thus, the words presented in each class correspond to the first 10 exhibited in each category, and the statements extracted for this comparative construction were selected according to the characteristics of the reality described. The corpus of this tree diagram was divided into two subcorpora. On the one hand, Class 5, and on the other, Classes 4, 3, 2, and 1. In the next step, the second subcorpus was divided into two (second partition), showing Class 4 and 3 on one side and Classes 2 and 1 on the other.

The corpus "work of professional caregivers for victims of violence against women in Spain", as presented in Figure 2, consists of five classes. Thus, the excerpts in Class 5, entitled "trajectory, professional performance and working conditions", corresponding to 27.83% of the text segments, report on the practice, these workers' professional trajectory, and work circumstances. The following words are representative of this class: "start" (f = 95.24%), "technician" (f = 94.74%) and "care" (f = 89.80%).

On the other hand, the excerpts in Class 4, entitled "care for female victims of violence and forms of self-care", corresponding to 20% of the text segments, include the characterization of the respondents' precarious work situation, the self-care forms the professionals promote at the personal level and the characteristics of this care at the institutional level. The words "process" (f = 58.15%), "therapeutic" (f = 88.89%) and "training" (f = 83.33%) illustrate the class.

The excerpts listed in Class 3, entitled "claims on conflict and violence", based on 22.04% of the text segments, address the elements and nuances characteristic of the attended women's violence situations and the situations the Spanish professionals experienced within the work context. The words "verbal" (f = 100%), "sexual" (f = 84.62%) and "form" (f = 83.33%) represent the class. The statements in Class 2, then called "personal self-care", based on 16.77% of the text segments, address the personal and social mechanisms to preserve health. Representative of this class are the words: "ask" (f = 100%), "take" (f = 85.71%) and "home" (f = 55.56%).

Finally, the excerpts in Class 1 exposures, labeled "forms of harassment and conflicts", corresponding to 13.6% of the text segments, point to the practices, authors, and consequences of the conflicting and aggressive situations in the work environment. These are illustrative words of this class: "fall" (f = 100%), "bad" (f = 48.28%) and "feel" (f = 45.45%). Thus, this discursive analysis will pair the findings of the classes in the Brazilian and Spanish corpora to indicate and discuss similarities and differences.

4. Discussion

The results of this comparative study have demonstrated similarities in terms of work conditions, experiences of harassment at work, the lack of institutional self-care, and the experience of attending to victims of violence against women among professionals assisting victims of violence against women the woman in Brazil and Spain. On the other hand, there are differences in recognition of the occupational risks inherent to the activity of attending to victims of violence and in the forms of personal self-care.

Class 4, from research in Brazil, and Class 5, from the Spanish dendrogram, reveal the working conditions of professionals from specialized centers in their respective countries. When comparing the percentage of text segments related to this theme between the two countries, a higher percentage of text fragments in Spain was identified. Spanish professionals are subject to precarious forms of work characterized by weakening contractual relationships, burden, long work hours, and low remunerations. This picture refers to a scenario characteristic of the female workforce as women, that made up a large part of the participants interviewed in Spain, are more exposed to precarious and informal forms of work, reflecting the sociocultural deployment of the sexual division of labor, in which monotonous and domestic activities of lesser social prestige are attributed to women (Braga et al., 2019; O'Keefe & Courtois, 2019).

According to the participants' discourse, in the Brazilian context, these precarious work conditions are mostly related to the lack of physical infrastructure, availability of human and material resources, security, and disarticulation of the network for care to victims of violence against women. These issues are also highlighted in the Observe reports (Pasinato, 2011; Rocha et al., 2010).

The precarious work context of professionals working in centers for women in situations of violence in Brazil and Spain reflects the acceleration of the individualization processes of contemporary Western societies, which rejects the construction of collective spaces for discussion and exchanges as recommended as a form of personal and institutional self-care. Furthermore, the value hierarchies within this type of society lead to the denial of the possibility of recognizing some essential activities, especially those with non-productive characteristics (Mendonça, 2016).

In addition to precariousness, Brazilian and Spanish professionals are confronted with harassment practices, as in Class 2 in the dendrogram in Brazil and Class 1 in the DHC in Spain. These practices are represented by devaluation, isolation, and denial of communication, exercised by hierarchical superiors, a characteristic circumstance of rigid and hierarchical structures (Freitas et al., 2008). There appears to be a higher percentage of text segments related to the issue of conflicts and practices in Brazil. This form of institutional management raises obstacles for Brazilian professionals to accomplish the activities, generating feelings of frustration for the workers. This reality becomes yet another factor of illness for this group of Brazilian participants.

It is observed that the managers of these services for women victims of violence do not fulfill the role of managing conflicts and promoting self-care of the institutions for women victims of violence workers (Sansbury et al., 2015). This institutional role is also described by a study carried out in the United States in care centers for women victims of violence, which pointed out how cultures and practices in the workplace, encouraged by the institution, influence the self-care practice of workers (Cayir et al., 2020).

In the same comparative sense, statements from Class 5 in the Brazilian context, and Class 3, identified in the Spanish research, with a similar percentage of text segments, point out the specific emotional experiences of attending to victims of violence. The provision of services to listen to and welcome female victims of violence causes

feelings of impotence, insecurity, discouragement, and exhaustion in the Brazilian and Spanish professionals who have contact with this reality. This finding aligns with different research results (Dworkin et al., 2016; Skovholt & Trotter-Mathison, 2016; Vieira & Hasse, 2017) that indicate the psychosocial risks inherent to this type of experience.

By combining similar findings from the Brazilian and Spanish scenarios, one identifies how the presence of the rigid and hierarchical institutional figure lays the ground for mental illness due to the lack of attention to conflict resolution and to the management of the psychosocial risks inherent in providing services to victims of violence against women. Although the same feelings and experiences cross the Brazilian and Spanish professionals in their contact with battered women, there is a significant difference in recognizing the occupational risks of this activity and adopting individual self-care practices between Brazilian and Spanish professionals.

In Class 4, identified in the Spanish context, all professionals, who did not occupy management positions, were found regarding both the knowledge and identification of forms of illness and burnout, and secondary stress disorder (Oliveira, 2015), as well as statements about the individual experience of these psychopathologies. This scenario was not identified in the Brazilian research context, as in Class 1.

In general, it appears that the institutions do not prioritize the psychological well-being of professionals in care centers for women in situations of violence, failing to provide resources for the practice of good self-care (Jirek, 2020). The Spanish workers' identification of occupational hazards makes them seek forms of care for their own health, such as participation in psychotherapeutic processes. This difference between Brazilian and Spanish professionals in self-care also figures at the individual level, as will be discussed next.

The self-care of the professionals surveyed is represented by Class 3, from Brazil, and Class 2, from Spain, with a higher percentage of text segments in the Brazilian survey. The self-care of the Brazilian workers is linked to the support networks, mainly consisting of the family members, such as a mother figure, child, and husband, and with little time available for self-care. For female professionals in Brazil, the family environment is a highly relevant source of security and support, constituting a very impacting source of social support.

This support modality is considered the source of interpersonal relationships that enable feelings of protection and support, generating the feeling of acknowledgment, care, and acceptance, as well as the support that grants the conditions to face daily stress (Campos, 2016). Recognizing the social support within the family environments and the unavailability of time for self-care points to the confinement of these women to the private and family spaces and privatization of their time and space in care for the home and/or other people. This scenario reveals the Brazilian strongly male-dominated culture that models and imprisons women in staunched and private social spaces and roles (Saffioti, 2011).

The Spanish professionals' self-care is found in physical activities, which they consider as a way of recognizing the problems experienced more clearly, strengthening

and maintaining their mood, or even valuing the exercise itself. Physical activity and care for the body-mind balance are characteristic actions of individual self-care (Brady, 2017; Posluns & Gall, 2019).

The self-care bases of the Spanish professionals are based on identifying and recognizing their subjective experiences, which permit personal empowerment and better management in providing services to the clients served and in the relationships with other agents in their workspaces. That is because, through this self-empowerment, they establish limits, intervene and respond within the contact with the clients and co-workers in an assertive, active, and safe spectrum. In order to preserve their health and minimize the impacts of this type of activity, the Spanish professionals resort to individual forms of self-care, understood as a set of actions and practices aimed at promoting health and quality of life, exercised individually or collectively (Taylor et al., 2018; Velázquez et al., 2015).

This confinement of the Brazilian participants becomes more latent when compared with the findings concerning this same aspect for the Spanish workers, as highlighted in the confrontation between the self-care findings of Classes 3 and 2. It is noted that the participants in Spain have greater autonomy over their time and space so that they undertake actions focused on themselves, as illustrated by the quote: "establish some spaces. More or less basic, for me therapy is sacred" psychotherapy, therefore, is a space for recognition of their subjective experiences (Correa, 2015).

As scored in the comparison between Classes 1 and 4, the lack of knowledge about the occupational hazards involved in the practice of this type of activity and the institutions' retreat from addressing the Brazilian female workers' health are significant issues that reveal a combination of more illness-causing elements in the Brazilian than in the Spanish context. In addition, this picture points out that the professionals working in the care for victims of violence against women in Brazil do not possess comprehensive training concerning self-care or knowledge about the occupational risks intrinsic to helping relationships (Oliveira, 2015). However, as highlighted above, the institutions do not support the self-care of Brazilian and Spanish professionals. It is a context in which the attribution of responsibility for self-care occurs at the individual level.

The results associated with the exercise of listening to cases of women victims of violence demonstrate how the activity of attending to victims of violence evokes a strong emotional mobilization for the participants in Brazil and Spain. In addition, it indicates how these professionals are impacted by institutional difficulties that generate contexts of conflicts, violence, and losses in these professionals' health. On the other hand, the male-dominated system clearly demarcates the Brazilian female workers' spaces, attitudes, and time regarding individual self-care practices. However, at this point in the discussion, it should be noted that the Spanish female workers are also immersed in this same male dominance and patriarchalism, whose expressions differ from the Brazilian variant. It is marked by subtlety, imprecision, and performance at the micro level, such as the lack of financial benefits institutions offer for funding self-care activities (psychotherapy and physical activities) mentioned by professionals in Spain.

5. Final Considerations

The analysis carried out reveals the existence of similarities between Brazilian and Spanish female professionals concerning the emotional mobilization in response to the cases attended and the experience of conflicts, violent and illness-causing relationships due to rigid hierarchical structures that do not pay attention to the inherent risks of care for victims of violence against women. On the other hand, these approaches are also present when it is detected that the obstacles to Brazilian female workers' professional performance are mainly located in structural work conditions. In contrast, Spanish professionals are more exposed to precarious work conditions characterized by work burdens, long hours, and low remuneration.

The differences take the form of attention to self-care issues. It is observed that the participants in Spain recognize the risks inherent in the activity and seek individual self-care actions focused on empowering their subjective experiences and activities focused on their well-being. On the other hand, the participants in Brazil do not recognize the harm the practice of this activity causes due to the lack of professional training focused on health care in the practice of aid relationships. This scenario is also determined by sociocultural factors and characteristics of the Brazilian job market, which lead workers to perform their work activities to the detriment of their health. Moreover, these workers' personal self-care practices are characterized by confinement in family spaces and the lack of time and space for individual and private self-care practices.

This investigation represents an unveiling of the subjective experiences of workers involved in the care for victims of violence and the institutional difficulties these professionals face, which foster violent relationships and limit the spectrum of care for the attended female clients. This way, this study demonstrates how the participants in both countries are deprived of institutional self-care. It also addresses the importance of self-care in professional training in this field and reflects how sociocultural and labor market aspects are potential modelers of self-care practices.

It is known that the state, in the neoliberal context and the removal of collective issues in Brazil and Spain, promotes a maximization of occupational risks for these professionals that is operationalized by exposure to precarious working conditions, without labor guarantees, based on a personalistic management model and little or no attention to the health of these workers.

Therefore, this framework maximizes the vulnerability of professionals who assist victims of violence against women. Indirectly, it also weakens those assisted by this service since the illness of the team and its members affects the quality of the services provided.

We conclude that the self-care of the professionals allocated in specialized services for women victims of violence is linked to the ways of managing and caring for the workers' physical and mental health by the institutional managers and to social and cultural factors, such as the patriarchal system. That is due to the lack of systematization of practices and public policies aimed at promoting the health of these workers in the two countries researched. Therefore, it becomes fundamental that public and non-public organizations, such as unions and associations, mobilize their efforts to implement public policies aimed at the mental health of these professionals.

The following limitations can be listed in this study: (a) professionals allocated to health services, such as hospitals and health clinics, who attend battered women, were not interviewed; (b) absence of questions exploring symptoms of burnout syndrome and secondary post-traumatic stress disorder; and (c) absence of respondents allocated to management positions.

Acknowledgments

To Partner and Workplace Violence research group of the Autonomous University of Barcelona.

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Leisure & COVID-19: Forbidden Bodies and Changes in Leisure Dynamics in the Cities of Maia (Portugal) and Curitiba (Brazil)

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Abstract

This article intends to place, at the heart of a critical, political, and theoretical reflection, the changes in urban leisure dynamics, namely in the cities of Maia (Portugal) and Curitiba (Brazil), the fruit of the COVID-19 pandemic. We believe, through the lens of cultural studies, that COVID-19 constitutes an essential and unique opportunity to understand human phenomena around an extreme health situation that triggered biopolitical processes and technological control mechanisms in the mobility and leisure of bodies and continues to do so. This article highlights how the pandemic has blurred the domestic, work, and leisure boundaries, much to the service and benefit of the neoliberal and capitalist systems. Our methods combined ethnographic collection (conducted from March 2020 through June 2021), qualitative data analysis, and theoretical contributions by Foucault (1979/1998, 1996/1999, 1975/2002, 1994/2006, 2010a, 1976/2010b), Deleuze (1992, 1995), Certeau (1980/1994, 1993/1995), Haraway (1997, 2018), Braidotti (2020) and Mbembe (2003/2018) in a very particular articulation with the locus, the social and political context of the spaces and the pandemic consequences acting in a very specific and insidious way in each one. We were able to verify that, in the pandemic, leisure is (re)claimed and valued as a fundamental right in the face of regulation, control, and discipline over bodies. Data indicate that subjects reclaim their lost mobility and space, challenging the order, law, and authority put in place. A pertinent theoretical and empirical articulation was also evidenced between the sanitary policies in place and the observed disruptive and subversive performances, which show, in time and space, a gradation and progression of the subversion of bodies in leisure parks, which are privileged loci of freedom.

Keywords

leisure, COVID-19, pandemic, body, public policy

Lazer & COVID-19: Corpos Proibidos e Alterações nas Dinâmicas de Lazer nas Cidades da Maia (Portugal) e Curitiba (Brasil)

Resumo

Este artigo pretende colocar no cerne de uma reflexão crítica, política e teórica as alterações nas dinâmicas de lazer urbano, nomeadamente, nas cidades da Maia (Portugal) e Curitiba (Brasil), fruto da pandemia de COVID-19. Consideramos, sob a lente dos estudos culturais, que a COVID-19 constitui uma oportunidade fundamental e única para compreender os fenómenos humanos em torno de uma situação sanitária limite que acionou e continua a acionar processos biopolíticos e mecanismos de controlo tecnológico na mobilidade e lazer dos corpos. Este artigo destaca a forma como a pandemia diluiu as fronteiras entre o doméstico, trabalho e lazer, muito em serviço e benefício do sistema neoliberal e capitalista. Recorrendo a uma recolha etnográfica (realizada entre março de 2020 e junho de 2021), à análise qualitativa de dados e aos contributos teóricos de Foucault (1979/1998, 1996/1999, 1975/2002, 1994/2006, 2010a, 1976/2010b), Deleuze (1992, 1995), Certeau (1980/1994, 1993/1995), Haraway (1997, 2018), Braidotti (2020) e Mbembe (2003/2018) numa articulação muito particular com o locus, o contexto social e político dos espaços e as consequências pandémicas que atuam de uma forma muito específica e insidiosa em cada um dos espaços, foi possível verificar que o lazer é, na pandemia, (re)valorizado e reivindicado como direito fundamental em face da regulação, controlo e disciplina dos corpos. Os dados indicam que os sujeitos reclamam a mobilidade e os espaços perdidos, desafiando a ordem, a lei e a autoridade implementadas. Evidenciou-se, igualmente, uma pertinente articulação teórica e empírica entre as políticas sanitárias implementadas e as performances disruptivas e subversivas observadas, que apresentam, no tempo e no espaço, uma gradação e progressão da subversão dos corpos nos parques de lazer, locus privilegiado da liberdade.

Palavras-chave

lazer, COVID-19, pandemia, corpo, políticas públicas

1. COVID-19: "The China Plague"

No one could foresee that entering the second decade of the 21st century would bring a pandemic capable of violently altering and shaking the daily lives of everyone without exception. In this century, the world experienced its second pandemic. However, it was the most serious and with greater social, economic, and political implications. COVID-19 joins the album of pandemics as one of the greatest trials and tests to humanity since the bubonic plague, smallpox, cholera, swine flu (H1N1), and the Spanish flu, which was also assigned a nationality.

Even though the origin of the new coronavirus is still unknown, the ideological war, the global political conflict, the hegemonic influence of Western policies, and the far-right political movement dictate the locus for the strongest and the weakest. They assign nationalities to viruses, convey information about conspiracy theories involving virus fabrication, and minimize COVID-19's deadly and harmful influence on the life and death of humanity. A "democratic virus" that cares not about age, profession, social or economic status. A few news agencies broadcasted that the new coronavirus first appeared in a

popular market in Wuhan province, China. As the appeals of voices, confined and hopeful for the future echoed from the domestic space and disseminated throughout neighborhoods, cities, countries, and the world, symbolized by a rainbow postulating that "andrà tutto bene" (everything will be fine), discordant and dictatorial cries assigned, in an intense geopolitical contest, a stigmatizing nationality to the new coronavirus and its various variants or strains: "China virus", Amazon, British, South African, Californian, Mexican, Filipino and Indian strains or variants[1]. Donald Trump (*Trump Volta a Culpar China por "Deixar a Praga Escapar" e Troça de Biden por Usar Máscara*, 2020), Mike Pompeo (*Mike Pompeo Afirma que Existem "Imensas Provas de que Coronavírus Vem de Laboratório em Wuhan"*, 2020), Aleksandr Lukashenko (Lopes, 2020), Jair Bolsonaro ("Da 'Gripezinha' à Imunidade do Brasileiro: Dez Momentos em que Bolsonaro Desvalorizou a Covid-19", 2020) jokingly dubbed the coronavirus as "the Chinese plague"[2], a fanciful "little flu", "the Chinese virus" "created in a laboratory in Wuhan" that can be cured with "vodka" or with the "miraculous" chloroquine. They condoned the spread of misinformation and fake news, even declining any responsibility for the disastrous, harmful and genocidal management of the pandemic or the implementation of strategies to combat the high mortality rates registered in the United States of America (Trump administration) and in Brazil (Bolsonaro administration): a genocidal necropolitical strategy of letting people live or die, or, if we want to be more crudely theoretical, indirect murder as mentioned by Rosi Braidotti (2020), Achille Mbembe (2003/2018) and Michel Foucault (1979/1998, 1976/2010b), which serves more obscure and less humane interests.

The action and (in)action of countries with negationist governance in the face of the pandemic scenario is the clear expression of a practice of sovereign power, technologically mediated, "capable of dictating who can live and who should die (...). To be sovereign is to exercise control over mortality and define life as the implantation and manifestation of power" (Mbembe, 2003/2018, p. 5). In the pandemic context, it is not

[1] More than 1 year after the appearance of COVID-19, the new SARS-CoV-2 variants were renamed by the World Health Organization in May 2021 precisely to avoid stigmatizing and discriminatory associations. References to the geographical locations where the variants and sub-variants were found are no longer used. They are now named using the Greek alphabet: *alpha* (British), *beta* (South African), *gamma & zeta* (Brazilian), *delta & kappa* (India), *epsilon & iota* (North American), *theta* (Philippine), *eta* (in several countries; *Alpha, Beta, Gamma. Alfabeto Grego Passa a Designar Variantes do Coronavírus*, 2021). Hate crimes (physical and verbal) against people of Asian origin increased exponentially, in the United States and Brazil (and all over the world), during the pandemic, due to the xenophobic, racist, hate speech and fanaticism by the former North American President Donald Trump and the Brazilian President Jair Bolsonaro, making China and, consequently, people of Asian origin responsible for the appearance and spread of the virus worldwide. Ignited by presidential speeches and tweets, the aggressors unleashed dozens of violent attacks (some fatal) against people of Asian origin, mainly Chinese and mostly women. They demonized and blamed them for the existence of COVID-19 ("Biden Condena Ódio Contra Asiáticos: 'O Nosso Silêncio É Cumplicidade. Não Podemos Ser Cúmplices", 2021; Nakamura & Terao, 2021; Salcedas, 2021). In response to the attacks, demonstrations were held, and a wave of resistance emerged on social media that viralized the #StopAsianHate hashtag. According to a report by the organization Stop Asian Americans and Pacific Islanders Hate, between March 19, 2020, and February 28, 2021, 3,795 hate crimes against the Asian-American community were reported in the United States, for example (Correia, 2021). In May 2021, the current United States president, Joe Biden, signed a law to strengthen the fight against hate crimes and racial violence. It promotes greater protection for citizens of Asian origin or descent in the face of the increased crimes against this community (*Estados Unidos Registam Milhares de Ataques a Asiáticos Durante a Pandemia*, 2021).

[2] In the words of Donald Trump, former president of the United States of America: "we built the greatest economy in history; we closed it down because of the China plague" (Kapur, 2020, para. 15).

a matter of eliminating enemies of the state but, by naturally biological means, eliminating, through inaction, incompetence, and/or necropolitical strategy, those individuals who are less economically interesting or who do not serve the neoliberal and capitalist machine or dynamic of the states.

During the first phase of the pandemic, the effects of COVID-19 were clearly devastating, not only in the body of those affected by the disease but also in their loved ones, still mourning irreparable losses in the process of inhuman grief, irrational and (un)real pain, while watching the demonstrations of pandemic deniers.

In the first months of the pandemic, the social, personal, political, and economic effects of the total confinement of bodies and minds were visible and of unprecedented magnitude: economic recession, political instability, a sharp rise in unemployment and food aid, obesity, depression, domestic violence, increased domestic workload and stress associated with unequal task distribution (Bonalume, 2020; Coelho et al., 2021; Instituto Nacional de Estatística, 2021; Teixeira et al., 2022; United Nations, 2020; World Health Organization, 2022a, 2022b).

In Portugal, the state of emergency was in force from March 18, 2020, to April 30, 2021, and in Brazil, from February 4, 2020, to May 22, 2022. COVID-19 has caused big changes not only because of the way policies protected, forbidding the mobility of individuals' bodies but also because of the way these subjects appropriated the measures and subverted them, the law and rules, on behalf of the fundamental right to leisure - which, interestingly, is markedly absent as a fundamental right in the Constitution of the Portuguese Republic (Constituição da República Portuguesa, 1976) and present in the Constitution of the Federative Republic of Brazil (Constituição da República Federativa do Brasil de 1988, 1988). Indeed, within this absence in Portugal, we realized the need for leisure as a fundamental right in pandemic and confinement contexts. Meanwhile, in Brazil, this right is constitutionally guaranteed but, in practice, is not in effect. Thus, we intend to cast a watchful, critical and political eye on the profound changes in leisure dynamics in parks/ecotrails, squares and streets — in this particular case, with the example of Maia ecotrail, Portugal, and São Lourenço Park/bike paths in Curitiba, Brazil. We also intend to analyze the measures implemented, expressions of public power, and regulatory control over bodies (Foucault, 1979/1998, 1976/2010b), as well as phenomena of appropriation/negotiation/implosion of these same measures by its users. Under Foucault's theoretical paradigm, we intend to interrogate leisure in the pandemic context and its implications for leisure dynamics.

2. Methodology

This research was developed during the decreed of the state of emergency as a result of the COVID-19 pandemic, and for this reason, the temporal context in which this study took place offered us, in real-time, data revealing the impact of COVID-19 and public health policies in the subjects' leisure practices. The fact that we captured, *in loco*

and in real-time (without direct contact —, i.e., no interview —, due to the high risk of contagion in force during the period in which the study was carried out), the practices of the subjects under the health policies in force at the time and the scientifically and legally reasoned prohibitions, which directly influence their mobility, allowed us to:

- reveal the exposure and practices of the subjects regarding the leisure that is crossed and affected by a pandemic;
- understand the impact of process and control mechanisms (necessary, in the case of the COVID-19 pandemic) on the bodies and that were, a priori, deeply naturalized and subtle, given the absence of a limiting, unstable and uncertain context;
- understand the context marked by its originality, magnitude, and exacerbation, placing the subjects in a matrix of denaturalization when confronted with the new and prominent mechanisms of sanitary and technological control.

The pandemic reality, a context of crisis enhancing exceptional or atypical practices, offered a kind of magnifying glass that revealed disruptive practices. Such practices, according to the articulation between the collected data and the available theory, highlight the performance of mechanisms of power over the bodies and the necessary sanitary practices revealed, consequently, processes of resistance to them as defense and claim of the right to public space and leisure. However, although we do not defend these same disruptive practices or resistance to the law and do not stand against mandatory confinement, as cultural scientists, it would be imprudent to neglect this issue or the existence of these practices. The practices observed concerning the sanitary measures adopted do not represent the authors' personal positions and opinions. This investigation, taking advantage of an ethnographic observation methodology with subsequent qualitative analysis, studies leisure cut across by a limited and unprecedented situation.

To carry out this empirical study, we used ethnographic collection and qualitative analysis of data (Bardin, 1977/2007; Guerra, 2010), which integrated a selection of photos we took during an observation period between March 2020 and June 2021, which covers three distinct contexts: pre-state of emergency, during its enforcement, and the post-state of emergency and vaccination period following the COVID-19 pandemic. Along with a photographic survey in Maia ecotrail/Portugal and Curitiba/Brazil, we mobilized a theoretical framework derived from cultural studies, which interrogates what the photographs express (what is said) and obscure (what is unsaid).

The collection of photographic material was conducted between March 2020 and June 2021. We captured the performances of bodies and the marks they left in the locus of leisure: Maia ecotrail, a part of the former Guimarães railway, about 3,300 m long, in a context of extreme restrictions to mobility. In Curitiba, the option was to perceive such practices in São Lourenço Park, with an area of 203,918 m2 and 9 km of bike paths extending to the city center.

We proceeded with the organization and chronological division of the collected material, articulating it with the policies and decisions adopted in the pre-, during, and post-state of emergency context. The importance of this articulation and configuration

became evident not only for the organization of the vast collected data but also because the initial hypothesis suggested the possibility of finding theoretically relevant results concerning the COVID-19 pandemic, allowing us to theoretically explore leisure as a need, a right, and a subversion to the imposed order of confinement, as observed in this study. The data collected in 15 months of observation during the pandemic allowed us to achieve theoretical and empirical saturation (Guerra, 2010; Schnapper, 1999/2000), showing a clear and unmistakable relationship between the observed performance, the gradation or progression in the subversion of bodies, pandemic policies and the theoretical exploration of key concepts such as "biopolitics", "biopower" and "technological extensions" (Braidotti, 2020; Deleuze, 1992; Foucault, 1979/1998, 1996/1999, 1975/2002; Haraway, 1997, 2018; Haraway et al., 1985/2009).

3. Between Two Worlds: COVID-19 in Brazil, a Case of Destruction and Precariousness

Aware of the many differences between Brazil and Portugal, including political, economic, and cultural, we entitled this section "Between two worlds". We start from the general idea that the crisis is global but generates different local impacts: "it is about distinguishing almost microbial operations that proliferate within technocratic structures and alter its operation by a multitude of 'tactics' articulated on the 'details' of everyday life" (Certeau, 1993/1995, p. 41). Such operations are distinct between countries, and in this sense, we question how the differences between individuals, cities, nations, and territories practiced in public space are established, coexist, tense, or combine within the globalizing pot of cultures. For the author, we need to ask, "how is it that an entire society is not reduced to this process (...) and what popular procedures (tiny and everyday) play with these mechanisms and do not conform to them, except to change them?" (Certeau, 1980/1994, p. 41).

At the moment, we have a "mutating" virus, with cases occurring randomly, with different impacts that affect, in a slightly milder way, some countries that already had progressive public policies in the structural sphere and whose impacts are quickly resolved. In other more peripheral and unstructured countries, however, these impacts acquire perverse effects, as is the case of Brazil, with the average number of daily deaths rising to 2,390 victims due to COVID-19 (Marins et al., 2021).

These data make us reflect on the extent to which this drastic world experience of COVID-19 separates us into two "worlds", that is, the world of rich and central countries, with more access to prevention and vaccines versus poor and peripheral countries without access to basic urban structures and vaccines for everyone. We are, therefore, faced with unequal worlds in terms of social well-being. Where in some cases, one chooses between those who must live or die, poor or rich, old or young, information or misinformation, truth or lies, care or lack of attention, democracy or autocracy, control or freedom, among many other ambiguities and tensions brought to light by the current global health crisis.

Brazil is facing acute precariousness, which generates successive and radical transformations in different cities and bodies, altering daily practices and perversely affecting the country's already dramatic social problems. Such social problems require analyzes related to politics, education, health, science, habits, customs, social and moral norms, basic sanitation, housing, urban planning, leisure, and culture, among others. Thus, there is a clear worsening of problems, accentuated by the current health crisis, which increases and enhances (micro)resistance and appropriation of the different public spaces of leisure (Neca & Rechia, 2020).

Currently, in Brazil, certain political actions and practices reveal the use of a narrative, on occasion, anchored in the denial of the virus lethality, inducing certain populations, especially the working class, with less access to information and carrying social markers of difference such as race, gender, age, ethnicity, and socioeconomic power, into a false idea of security and control over their bodies. It so happens that, at times, the discourses used to validate such negationist policies can end up reinforcing some stereotypes, segregation, impoverishment, and even death in certain groups. We can observe the materialized concept of "necropolitics" in Brazil. We ask: has the state the legitimacy to decide who should live and who should die to maintain economic order in the country (Mbembe, 2003/2018)?

It should also be noted that combined with this concept are the concepts of "biopolitics" and "biopower", coined by (Foucault, 1975/2002), which will be pointed out and developed in later sections, and demonstrate that power suffered "mutations" during the civilizing process, weakening social relations in modern cities and, mainly, in official narratives. For the author mentioned above, modern civilization has been affected by several transformations in its structures of power and knowledge, for knowledge, the laws and policies have transformed in the course of history, suffered even more impact after the industrial revolution, and accelerated today with radical changes in the "ways of doing" in large urban centers, resulting in questionable government strategies. From this mark, technocracy generated knowledge and strategies aiming to control urban ails, such as agglomeration, cleaning of public spaces, epidemics, organization of the economy, law enforcement, regulation of leisure experiences, and systematic organization of cities and their basic infrastructures. Such aspects simultaneously generated political, economic, and democratic crises, which influence each other, especially in present-day Brazil, not putting an end to conflicts between unequal worlds.

Urban hygiene, from controlling the population's bodies and daily activities, demonstrates the supremacy of one group over another. In other words, the more established define who should go out to work, which activities are regarded as essential, the days and hours of operation, regulating the work, social and cultural life with decrees, which usually strike the working class more cruelly, their bodies always at risk. For Mbembe (2003/2018), it is evident that "necropolitics is the power to dictate who can live and who should die. The 'killable' body is at risk of death at all times" (p. 18). In this sense, in Brazil, some facts of history reinforced the idea that in the name of the power of some,

the lives of certain groups can be taken, by disqualifying the person, their bodies, the most vulnerable communities (for example, in Brazil, trivializing and normalizing the 21 years of dictatorship, the 300 years of slavery, the war on drug traffic, urban violence, crime, femicide, among others). This reality strengthens the view that there are subordinate places and that some lives that are "worth less" may be extinct or dehumanized and their bodies discarded.

These policies are underway in Brazil and, unfortunately, widely accepted based on the power exercised by the state and its administrative structures (Castilho et al., 2021). Thus, through the official discourse, such practices have become acceptable, even inducing the exclusion of certain groups.

BBC News Brazil, on July 7, 2020, published a story with the title *Relembre Frases de Bolsonaro Sobre a COVID-19* (Remember Bolsonaro's phrases on COVID-19), which points out the discourses of the state from such categories of analysis as: "the issue of the virus is over-dimensioned"; it's a "little flu"; "we will all die one day"; "so what?"; "ask your governor"; "no need to panic", among others. These discourses make it clear that from the beginning of the new coronavirus pandemic, President Jair Bolsonaro has been minimizing and dismissing the seriousness of COVID-19, conveying to the public messages that contradict the global guidelines of health authorities. Thus, more than the problems caused by COVID-19 itself, the pandemic raises questions about political, social, and infrastructural problems, which require debate and reflection.

It should be noted that even though they are subject to certain strategies, individuals articulate gimmicks — come up with other ways to subvert the mechanisms imposed on them — which, to Certeau (1980/1994), are "ways to employ the products imposed by a dominant economic order" (p. 91).

4. COVID-19 and Biopolitics: Forbidden Bodies and Stages

The COVID-19 pandemic clearly and evidently demonstrated that leisure is central to maintaining individuals' minds and bodies and of a certain social dynamic. Moreover, work/employment has always been hyper-valued, endowed with an essential, even self-defining, importance for individuals — a situation that must be articulated with the market's neoliberal and capitalist influence, which conceives individuals not just as objects that produce wealth, but also as consumers of products. To Baptista (2016),

> free time, non-work time, only becomes of interest to the contemporary economic system, while it can also be an economic activity, with subjects being eternally and constantly summoned to participate in the market, whether as consumers or as producers of goods. (p. 28)

In managing its useful and active time, humanity circulates in a vicious and insidious process fostered by the economic and capitalist system, which is divided between production and consumption. According to Baptista (2016), "western reason has

dedicated itself to promote work as an indisputable value, devaluing that other time which opposes it: leisure time" (p. 21).

Free time allows individuals to regain their energies so that, in a moment, the machine-man/body, intensively exploited and tamed (Foucault, 1976/2010b; Lafargue, 1977/2011), may return to production and that, in this fraction of time, may he spend the fruit of his labor, which is even a benefit of the system. The COVID-19 pandemic and the associated regulatory confinement led to the suppression of leisure habits and dynamics that reinvigorated individuals from their physical and intellectual effort, oppressing them, as if since they do not have work or do not find themselves in the usual conditions for production in the market context, they had no right to leisure (Figure 1 and Figure 2).

Figure 1 *Maia ecotrail (Portugal), March 16, 2020, in a period pre-state of emergency (first general confinement)*

Credits. Fernanda de Castro and Maria Manuel Baptista

Figure 2 *São Lourenço Park (Curitiba/Paraná/Brazil), in May 2020. Under red flag (high risk of COVID-19 contagion)*

Credits. Simone Rechia

With the coronavirus pandemic, the tension between capital, work, and leisure, not only through political sovereignty but also through the influence of the power of capitalism, clearly shows how power relations affect our lives. We understand that, in a context oppressive of individual freedoms, individuals act as if, consciously or unconsciously, they recognize the importance of leisure in their lives and their bodies: to suspend leisure is a real assault on the dynamics of individuals' lives, in essence, to their own humanity. It was necessary to experience mobility restrictions with the body to understand and value the importance of leisure and the way biopower and power dynamics regulate life (Foucault, 1979/1998, 1976/2010b) since the gap between work and leisure is diluted with teleworking and mandatory confinement, for example. The idea that leisure was synonymous with laziness, loitering, or morally reprehensible contributed to this devaluation and the negative image that free time still has (Baptista, 2016).

While one might think of leisure as a fundamental and undeniable right, especially after a long total confinement with too many social, economic, and cultural consequences and implications, the truth is that the right to leisure, contrary to what Gorz (2013) and Doistua (2006) postulate, does not seem to be a universal right when we analyze the Portuguese Constitution (Constituição da República Portuguesa, 1976) and the Universal Declaration of Human Rights (Declaração Universal dos Direitos Humanos, 1948). These exclude the right to leisure, specifically with regard to the unemployed, vulnerable social groups, the elderly, which have no place in the unrestrained, exploitative productive wheel of the capitalist structure since work is an absolute value in this system.

The power relations that cut across society through hegemonic conceptions and discourses police, domesticate and make bodies docile to exploit and extort their productive resources as much as possible (Foucault, 1979/1998; Hall, 1992/2006). The right to leisure, specified in the first paragraph of Article 59 of the Constitution of the Portuguese Republic (Constituição da República Portuguesa, 1976) and Article 24 of the Universal Declaration of Human Rights (Declaração Universal dos Direitos Humanos, 1948), is thus, reserved for workers, particularly those who produce, collaborate and contribute to the capitalist market.

> 1. All workers, regardless of age, sex, race, citizenship, place of origin, religion, political or ideological convictions, have the right: d) to rest and leisure, to a maximum limit of the working day, to weekly rest and periodic holidays with pay. (Constituição da República Portuguesa, 1976, Article 59)

"Everyone has the right to rest and leisure, including reasonable limitation of working hours and periodic holidays with pay" (Universal Declaration of Human Rights, 1948, Article 24).

Even though the right to leisure does not have a universal character in the Portuguese Constitution, the truth is that in the various decrees and guidelines of the General Directorate of Health, in the pandemic context, leisure is present and is essentially articulated with physical activity, which, according to the General Directorate of

Health, entails great risks and potential for high viral transmission. Despite being controlled and sometimes banned in the specific locus for carrying a great potential of virus transmission (parks, gardens, walkways, ecotrails), the theme of leisure was expressed in the policies and measures adopted, even within a system of measures restricting rights, freedoms, and inspection of behaviors and bodies:

> Citizens (...) may only circulate in public spaces and streets, or private spaces and streets equivalent to public roads, for any of the following purposes: Short-term travel for physical activity, the exercise of collective physical activity is prohibited (Decreto n.º 2-A/2020, 2020, pp. 2–3)

"Physical activity and outdoor sporting activities that do not involve physical contact are now allowed, provided they comply with hygiene and sanitary rules" (Resolução do Conselho de Ministros n.º 33-A/2020, 2020, p. 10).

> Authorized travels are those aimed at: (...) h) Travel to libraries and archives, as well as to green and outdoor spaces in museums, monuments, palaces, and archaeological sites or similar; i) Travel for physical activity and individual and outdoor sports (Resolução do Conselho de Ministros n.º 33-A/2020, 2020, p. 13)

In Brazil, the right to leisure is guaranteed in Article 6 of the Constitution of the Federative Republic of Brazil (Constituição da República Federativa do Brasil de 1988, 1988): "the social rights are education, health, work, housing, leisure, safety, social security, protection of maternity and childhood, assistance to the destitute, following this Constitution" (Chapter II of "Direitos Sociais" [Social Rights], Article 6), but decentralization, democratization, and access are still barriers to the full exercise of this right, especially in communities socially and economically more disadvantaged and vulnerable.

On March 16, 2020, Curitiba was in a situation of emergency in public health, confirmed by Decree No. 421 (Decreto Nº 421, 2020). Also, in Curitiba, in the Diário Oficial do Município, the determinations, suspensions, and prohibitions are similar to the Portuguese ones:

> where there are gates, they will be completely closed. In non-barred units, parking is still restricted. That is the case, for example, of the Barigui, Tingui, and Náutico, São Lourenço parks. Access to these locations and irregular parking will be monitored and inspected by traffic agents and municipal guards (...) In parks, the practice of individual outdoor activities is allowed exclusively, with the use of masks, without physical contact between people and with social distance (Decreto Nº 520, 2021, p. 7).

"Spaces for the practice of collective sports activities are located in squares and other public and private properties, with the prohibition extended to condominiums and residential areas" (Decreto Nº 520, 2021, p. 5).

For Foucault (1994/2006), power emerges through discourses: "power is something that operates through discourse, since discourse itself is an element in a strategic device of power relations" and "establishes and regulates what can be said in certain social and cultural conditions" (pp. 253–254), but also the authority of who can speak. During the pandemic, the body was and continues to be regulated and disciplined by hygienic and disciplinary guidelines, measures and decrees produced by the government with the help and advice of technology (Deleuze, 1992; Haraway, 2018; Haraway et al., 1985/2009) which, at the same time it contains and protects "some" bodies, also imprisons it in the name of collective health and welfare, following a biopolitical management (Foucault, 1979/1998, 1996/1999, 1975/2002, 1994/2006): respiratory etiquette, recurrent hand washing following a timed ritual, the preference for spaces with little movement of people (Direção-Geral da Saúde, 2020b); the mandatory or prophylactic reclusion or confinement of bodies, especially the most fragile and elderly, the practice of social distancing, the successive renewals of the state of emergency in order to mitigate the transmission of the disease and the ultimate goal of containing the spread of the virus (Decreto-Lei n.º 20-A/2020, 2020; (Figure 3 and Figure 4).

Figure 3 *Maia ecotrail, March 16, 2020, under the state of emergency (first general confinement)*
Credits. Fernanda de Castro and Maria Manuel Baptista

Figure 4 *Bosque do Papa (Curitiba), July 2020, orange flag (medium risk of COVID-19 contagion)*
Credits. Simone Rechia

In Curitiba, faced with the worsening of COVID-19 and the impending lack of beds in the healthcare network, the Curitiba Prefecture extended the restrictions on activities in the capital: only essential activities such as supermarkets, bakeries, and gas stations continued to operate, with restricted hours and a requirement to comply with the Health and Social Responsibility Protocol; under a red flag on the alert level, activities in the city parks were vetoed and suspended, as well as classes in the education system; consumption of alcoholic beverages was forbidden in public spaces (Decreto N.º 565, 2021).

Bodies become hostages to medical technological extensions (Deleuze, 1992; Haraway, 2018; Haraway et al., 1985/2009) that determine a greater influence of medicine in public and private spaces (Foucault, 1976/2010b). If, for Foucault, the body is, in the 18th and 19th centuries, historically constructed and a result of the convergence and intersection of various discursive practices of a disciplinary nature (Foucault, 1979/1998; 1975/2002, 1994/2006), for Deleuze (1992), in modern times, the body becomes a source of technologically obtained and socially controllable and monitorable data.

According to Deleuze (1992), the modern control society has created subjects who are controlled by the data their bodies produce, a more effective and refined form of control and surveillance than the disciplining and docilization of bodies carried out by a society of discipline, as theorized by Foucault (1979/1998). For Deleuze, individuals were transformed into sources, samples, markets, or (data) banks, operating with technological energy machines that feed capitalism, while the disciplinary Foucaultian man was a subject who made use, in the 18th and 19th centuries, of simple machines and lesser or almost zero technological demand. Thus, these modern bodies, which are, in part, no longer docilized, constitute themselves as sources of information (Deleuze, 1992), digitized and dated. Indeed, it is impossible to think of control societies without the Foucaultian contribution of disciplinary societies precisely because control arises from the articulation between discipline and biopolitics (Deleuze, 1992). The deepening of knowledge of the

society of control is born, together with Foucault's contributions, from a context in which the exponential development of new technologies is verified, a new weapon capable of generating, storing data, and managing, manipulating, and controlling subjects.

In the 19th century, capitalism was based on concentration, production, and ownership, the factory was the privileged working space, and the capitalist was the owner of the means of production. In the 21st century, with the pandemic and technological resources serving the market, the "factory" or the static locus of work is deterritorialized to the domestic environment. Control, unlike discipline, deterritorializes and radiates its power in streams, enhancing the control over subjects from anywhere: technological control is thus the new means through which power is executed (Deleuze, 1992).

In this sense, the pandemic allowed for a gradual installation of a new system of remote work, which is a system of control, docilization, surveillance, and domination of technologically mediated bodies, feeding the possibility that, even after the pandemic, this mode of production is normalized. Indeed, fear, insecurity, and instability lead individuals to accept conditions and control measures that jeopardize their privacy, not questioning who controls and under what security conditions the biometric data of their bodies is stored – as it happens, for example, with COVID-19's mobile monitoring applications or databases created for this purpose. In fact, measures to control and combat COVID-19 are based on and depend mostly on technology, strongly articulated with methods of monitoring citizens.

In this sense, and for Deleuze (1992), control societies are no longer based on structures that favor a particular physical space but on mobile spaces, flows, ways, and environments of technological surveillance, which are clearly articulated with the capitalist machine. With the pandemic, the contribution and proliferation of technologies that allow the surveillance and mediated production of subjects are undeniable.

Although Deleuze (1995) considers that control societies no longer operate through the physical confinement of subjects to a space (the enclosed space of discipline theorized by Foucault, 1979/1998), monitoring is now carried out through flows that cut across spaces, unrestricted. Moreover, through the continuous control of communication made possible by the development of technologies, the pandemic has provided an insidious articulation between the bodies' production, control, and confinement to a domestic space that is seized and captured by the market and institutions.

In a pandemic context, an extreme and unprecedented situation in this generation, we are not facing an evolutionary transition from the disciplinary to the control society, as suggested by Deleuze (1992) and Foucault (1979/1998), but an insidious coexistence of both types of society. The individual is forced to self-discipline for the greater good or disciplined by the authorities and biopolitically and technologically controlled. In pandemic times, governments try to raise awareness and control individuals, evoking the example of the "good citizen" who abides by sanitary rules and measures, suggesting and advising self-discipline over their bodies.

During the time and stage of the pandemic, the body is temporarily dispossessed of exercising the right to movement. It may even be compulsorily confined, by decree, to the home or other facilities, for example, to reduce the risk of contagion and carry out the measures to prevent and combat the pandemic.

Rules for the protection of citizens' individual and public health are established. Bodies, suspect and tending towards subversion, are sensitized on public roads by every means, including persecutory drones, to comply with the civic duty of mandatory confinement and physical distance (Resolução do Conselho de Ministros n.º 38/2020, 2020) within a "regime in which one of the purposes of state intervention is the care of the body, of bodily health, the relationship between sickness and health" (Foucault, 1976/2010b, p. 171).

Bodies find themselves in vicious, chaotic, anxiogenic, and cyclical rituals that involve constantly washing their hands, repeatedly putting the mask on their faces, wearing gloves, paying uninterrupted attention to physical touch, and distancing from it. It is not just a matter of discipline that is imposed on the body by the central and governing power, but also of a process of self-control and memory almost machinic but necessary: the body is public and political, even and above all, in the pandemic (Butler, 1990). In this way, the body is regulated by central power and by the subject in a kind of shared biopower responsibility (Foucault, 1979/1998) or biotechnopower (Haraway, 1997). While rejecting the order, the body consents to it by necessity, survival, and, above all, the fear which makes it docile. According to Foucault's conception, it is a kind of biopower and docilization of bodies and minds, of disciplinary techniques, controls, and powers over behaviors (Foucault, 1979/1998, 1975/2002, 1994/2006). We are witnessing control over life and (self)policing of the pandemic body, as it constitutes a transmitter agent or threatened or threatening body.

5. Monitoring Bodies

Looking at the monitored body makes us think about the interdict, which, for Certeau (1980/1994), is unsayable but visible, clarifying the parallels, transfers, and tensions between urban realities in Brazil and Portugal. The crisis triggered by the COVID-19 pandemic made us realize the importance of the relationship between the public and private spheres in our lives.

For Eva Illouz (as cited in Rodríguez, 2021), "the house without the public sphere" can become an "extremely oppressive" experience (para. 1). The author suggests that we design our homes not so much for a living but "as a place, we come back to" (para. 2). Illouz emphasizes that this relationship generates "these forces [that] make us what we are: both inside and outside our homes, we are who we are because we participate in a public culture" (para. 21). Therefore, this crisis revealed to us that we are sociable beings because, from social distancing, we noticed the impossibility of replacing face-to-face

meetings with virtual ones for a long time. The search today is for more spaces for sociability, for more leisure.

These situations question the conceptions of life and how to live in large urban centers. There is a necessary sanitary control, which includes controlling leisure spaces and forbidding their enjoyment. However, there does not seem to be any control or regulation of the working hours of essential workers and the teleworking regime. There is no balance; the scales are tipped for the economy, but only to some sectors of society. Such aspects generate a movement of risk exposure in both dimensions, mainly through the desire for life in society because if their lives and bodies are for work, they are also for leisure. Thus, we live in the tension between adopting the official isolation decrees or resisting, seeking loopholes and tactics to take care of ourselves, others, and the place we live. It is a tension between two poles: enjoying leisure time and space in riskier or in less risky situations? Work or take a risk? Eat or die?

We believe these are not choices but biological, social, and economic needs. "Obligations" are all that some have left — those without digital access, without access to education, health, housing, or favorable economic conditions, which in Brazil represent the majority. Under a discourse of "stay home and only go out to consume and work", the state's guidance to communities has operated, to borrow a term from Certeau (1980/1994), as "bricolage", for citizens adopt some of the guidelines, adapt, discard and reinvent others.

Perhaps the subject does not submit but synthesizes and subverts order, making a change of place, that is, from a passive subject, receiver of messages, to an active subject that establishes the bricolage; that operates with various information it receives and produces something new, therefore, of the individual subject — the "unsubmissive subject" in leisure time and space (Certeau, 1980/1994).

It is worth noting that the most vulnerable people, who cannot consume the "amusements", subvert this order by seeking leisure experiences in the ways accessible and possible to them and, little by little, expand from the home to public spaces. We must consider that the houses of the most vulnerable people in Brazil are not appropriate housing. Many Brazilian families live in small, overcrowded rooms, without basic sanitation, far from large urban centers, and with no minimum living conditions. Furthermore, confinement within domestic spaces has increased the recurrence of other social problems linked to the risk of death, such as suicide and domestic violence (Marques et al., 2020).

Another alarming factor in the living conditions of Brazilians is revealed by data from the Brazilian Institute of Geography and Statistics (BRK Ambiental, 2018): only 41.5% of Brazilian municipalities benefited from the National Basic Sanitation Plan in 2017. This reality exposes the lack of planning with effects on public health. According to the Brazilian Institute of Geography and Statistics, one in three municipalities registers the occurrence of epidemics or endemics caused by the lack of basic sanitation.

We observed that the municipal decrees of the city of Curitiba demand social isolation, name teleworking as an alternative, and prohibit leisure experiences in public spaces. Such guidelines aim to deter displacements so as to avoid agglomerations, which is not possible for the most economically vulnerable, for they have activities that cannot be performed remotely (essential services). In the surroundings of houses, in socially vulnerable neighborhoods, there are no spaces qualified for experiences in the context of leisure time/space.

COVID-19 thus generated the aggravation of an already existing crisis in the country. Its consequences revealed the extremely high social inequality in some regions where isolation is practically impossible. Such reality unveils and highlights necropolitics in places of high social vulnerability, with effects on Brazilian society, for we are confronted with the existence of several worlds within a single country.

In this already chaotic scenario, there is also a debate, similar to the Portuguese scenario, about what the priority policy should be at this moment: saving lives or saving the economy. Thus, in Brazil, despite the monitoring of "some" bodies — the monitorable ones — Brazilians play the cards they have, with the possible insubordination, with "everyday rhetoric and practices that are equally definable as manipulations internal to a system, that of language, or that of an established order" (Certeau, 1980/1994, p. 80). Branded in the interstices of the time between strategies, cultures, bodies, and decrees.

6. (A)Live Bodies Under COVID-19: Subversive Bodies and (De)oppression

Within the pandemic context of total confinement of bodies, leisure was configured and appead, not only as an imperative and indisputable need but also as a right that, as seen in the pictures we collected, was claimed through the invasion and re-appropriation of public space (Figure 5 and Figure 6) by individuals, eager for mobility and freedom during the state of emergency and in the state of calamity, in which there were strong restrictions on the use of spaces intended for the practice of physical exercise.

Figure 5 *Maia ecotrail, March 17, 2020, in a post-state of emergency and under the state of calamity*
Credits. Fernanda de Castro

Figure 6 *Square in Tatuquara Neighbourhood (Curitiba), March 2020, under the red flag (high risk of COVID-19 contagion)*
Credits. Bruno David Neca Rodrigues

In fact, in the pre-pandemic period, we often heard reports about the high dependence on technology among young people, the excessive time spent by children on video games and the computer, the social interactions in cafes and restaurants where both the children and adults spent most of the time in silence, staring at mobile phones or tablets screens, on a broken and technologically mediated face-to-face communication.

With the COVID-19 pandemic, technology is no longer just a voluntary and optional resource. It necessarily became a constantly present resource in the lives of individuals,

without any breaks, contributing to the implementation of a different paradigm and organization of labor than what was previously in place. Teleworking, a technological way of life, relegated and led to a reconfiguration of time and labor, leading workers to toxic productivity, with risks of exposure to long working hours without regulation and psychological and sociability implications (Agência Europeia para a Segurança e Saúde no Trabalho, 2021; Durães et al., 2021): "it is mandatory to adopt a teleworking regime, regardless of employment status, whenever the functions in question allow it" (Resolução do Conselho de Ministros n.º 38/2020, 2020, p. 7).

After all, the promised technological future assured less physical effort and even less emotional commitment to technological development. Fiction fueled our imagination, promising flying cars, and teleportation, among other technological wonders. Our gift was teleworking from a domestic context, which brought about ailments of equal viral severity: less humanity; less social contact; machining function beyond the reach of the info-excluded workforce; obesity; muscular, nervous, and cervical problems; extension of time at work; family conflicts; physical and bodily tension in the, sometimes minimal, domestic space; aggravated pressure, violence and family and emotional stress through the concentration and lingering of individuals within the same home for 24 h, 7 days a week.

Physical exercise, teleworking, classes, family life, and housework took place in the same space, within the same walls. That led minds and bodies to exhaustion, often not only due to confinement but also to the technological dependence in order to be and exist: "physical activity can be good for you and your family. Look for online classes that help you exercise at home" (Direção-Geral da Saúde, 2020a, p. 9). With the pandemic, power relations at the heart of the home were articulated with a technocratic way and organization of life, where biopolitics, as a regulatory mechanism, is influenced by economic, neoliberal, and capitalist dynamics, often with a raise of awareness regarding a pandemic duality: life/health or the economy? What is more important?

We believe these facts have led to the results we obtained when taking pictures in public space: a subversive claim for leisure as a necessity and a right, even overcoming the obligation to comply with government measures. The desire to eliminate physical limitations and the technological and symbolic elements that imprison bodies is visible: confinement in the garbage, no order to stop will be fulfilled (Figure 7 and Figure 8).

Figure 7 *Maia ecotrail, May 17, in a post-state of emergency period and under the state of calamity*

Credits. Fernanda de Castro and Maria Manuel Baptista

Figure 8 *Crowded bicycle path in the surroundings of São Lourenço Park (Curitiba), June 2021, under the red flag (high risk of COVID-19 contagion)*

Credits. Simone Rechia

During the first and second general confinements, we were *on-site* witnesses to disruptive practices, practices that subverted the order imposed, and performances of resistance to the state of emergency, which decreed the temporary closure of sports and leisure spaces in the two countries in question. That measure aimed at preventing the spread of the disease that necessarily implies control over the freedoms and mobility of bodies through controlled, domiciled, and domesticated performances (Foucault, 1979/1998).

Despite the permission to go on short hygienic walks within the area of residence during the state of emergency, the truth is that ecotrails, Maia ecotrail included, the parks and bicycle paths of Curitiba, were closed off to the public to avoid agglomerations.

Although disregard of measures would result in incurring the crime of disobedience, the fact is that, for several days, we saw insubordinate bodies with a subversive potential, a month after the state of emergency was declared, particularly in April and May. They resisted the order and reconquered, reappropriated, and reterritorialized themselves (Deleuze & Guattari, 1980/1997) in the public space, often violently challenging the discipline imposed on their bodies (Foucault, 1979/1998, 1976/2010b). We even witnessed the Sisyphean intervention of the authorities, that closed ecotrails, parks, and gardens daily and continuously in an attempt to control the possible agents of disease transmission that yearn for mobility and the return to a supposed "normality" and, therefore, defy the state and the order imposed (Figure 9 and Figure 10).

Figure 9 *Maia ecotrail, February 14, 2021, under the state of emergency (second general confinement)*
Credits. Maria Manuel Baptista

Figure 10 *Children entering a closed school in Tatuquara Neighbourhood (Curitiba) to play, October 2020*
Credits. Gabriela Resende Cardoso

These images portray a very sneaky and creative disobedience to the prohibitions and social norms, which break with imposed barriers (Certeau, 1993/1995). Despite incurring the crime of disobedience within the dynamics of *discipline and punishment*, the (dis)obedient, docile, domesticated, and medicalized bodies (Foucault, 1979/1998, 1976/2010b) did exercise, walks, or nature contemplation into political resistance. For these subjects, all subterfuges are valid to circumvent the law and make the exception rule, including individuals eager for movement who simply walk on a leash, rent, or borrow animals for hygienic walks (Dias, 2021).

Every other day, the tapes and barriers that detained bodies at the entrance of Maia's ecotrail and in public spaces in Curitiba were torn down or knocked down and then put back to be subverted again by the body, which needs outdoor space and leisure time. In Maia and Curitiba, order, the imposition of discipline, and obedience were challenged:

> any act of active or passive resistance exclusively directed at legitimate orders issued by the competent public authorities in the execution of this state of emergency is prohibited, and its authors may, under the law, incur a crime of disobedience. (Decreto-Lei n.º 17/2020, 2020, p. 30)

"Disobedience to the legitimate orders of the competent authorities, when practiced during the term of the calamity situation and in violation of the provisions (...) constitutes a crime and is sanctioned under the terms of criminal law" (Resolução do Conselho de Ministros n.º 33-A/2020, 2020, p. 12).

Even though pandemic bodies internalize discourses of power (Foucault, 1979/1998), these bodies perform practices of resistance and subversion, giving concrete

and vital importance to leisure in a relevant political and performative praxis (Baptista, 2016; Figure 11 and Figure 12).

Figure 11 *Maia ecotrail, April 27, 2020, under the state of emergency (first general confinement)*

Credits. Fernanda de Castro and Maria Manuel Baptista

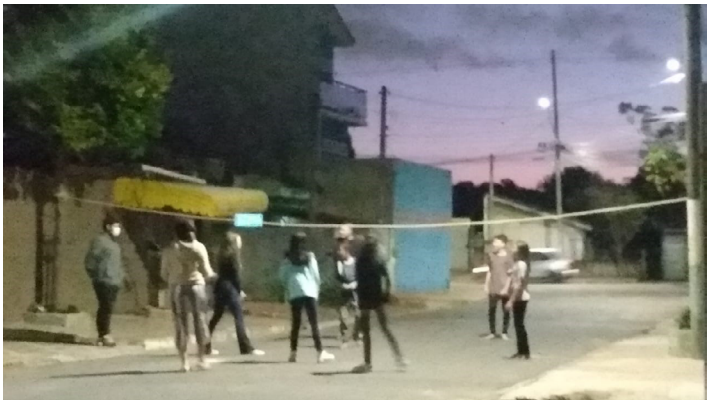

Figure 12 *Teenagers playing volleyball on the street in Tatuquara Neighbourhood (Curitiba), March 2021, under the red flag (high risk of COVID-19 contagion)*

Credits. Bruno David Rodrigues Neca

Adapting to norms, which (Certeau, 1980/1994) are called strategies, also generates "tactics" and "cunning" used by subjects to produce new ways of dealing with the norms imposed upon them. That is manifested, for example, in creating a new way to play or use the town's structures (streets, lawns, walls, stairs) due to any ban. In this sense, these creations are forms of subversion to the orders imposed in the appropriation of space.

Although it was possible to exercise during the state of emergency near home, a fundamental activity for the body and mind, the pictures reveal that these bodies need the specific locus of exercise, the ambiance that offers and redirects a certain context of normality of the pre-pandemic daily life: a false sense of normality and freedom. In

practice, the response of these bodies consisted in transgressing the sanitary norms symbolically inscribed on the barriers and tapes of social restraint.

In fact, it should be noted that short physical exercise was one of the activities allowed under the state of emergency and did not require the mandatory use of a mask. Dispossessing the mask through physical leisure provided the possibility of being and feeling the body without ties and technological extensions (masks, gel alcohol, gloves, or mobile applications; Deleuze, 1992; Haraway et al., 1985/2009), which censor and watch over human performances in the context of leisure, and soon return to the body after exercise.

This resistance to the inertia of bodily movement is not the only "art of the weak"; that is, "in the order organized by the power of knowledge, deviant practices (coups, trampolining, games, tales) are always possible" (Certeau, 1980/1994, p. 90).

7. Final Considerations

The COVID-19 pandemic and its disastrous consequences are a unique opportunity to understand leisure dynamics in the urban environment and the processes and mechanisms that normalize, operate, and reinforce the methods of technological control over bodies. The theoretical and epistemological means of Foucault (1979/1998, 1996/1999, 1975/2002, 1994/2006, 2010a, 1976/2010b), Deleuze (1992, 1995), Certeau (1980/1994, 1993/1995), Haraway (1997, 2018), Braidotti (2020) and Mbembe (2003/2018) seem particularly pertinent and sharp for thinking about current pandemic times.

The measures implemented in Portugal and Brazil by the central power during the pandemic period are expressions of public and political power with the clear goal of regulation, control, and discipline over bodies (Foucault, 1979/1998, 1976/2010b) in the face of an unknown biological enemy and for the benefit of the community. In this sense, leisure, a deeply human activity, and until today, under the symbolic yoke of laziness and loitering, seems to emerge and gain, with the pandemic, new meanings in society. In other words, it led subjects to act against the law and in favor of leisure as a necessity, right, and resistance. This learning, permeated by an intense and temporally long process of awareness, is carried out through the body that impels and stimulates the subjects to practices that challenge the (sanitary and politically imposed) order and the law.

In this study, we highlighted a clear and undeniable theoretical and empirical articulation between the observed performances, the gradation or progression of the subversion of bodies within the public space, and in close correlation with the temporal progression, the pandemic policies and the theoretical exploration of concepts and themes related to biopolitics/biopower, biotechnopower and necropolitics (Braidotti, 2020; Deleuze, 1992; Foucault, 1979/1998, 1996/1999, 1975/2002; Haraway, 1997, 2018; Haraway et al., 1985/2009; Mbembe, 2003/2018).

Regarding leisure, these thirsty bodies went through a process that goes from passivity and indifference to subversion: they are bodies with subversive power in their

appropriation of leisure space, initiating, in this sense, a relevant political and performance praxis (Baptista, 2016). Raising the flag of leisure is, for these bodies, an attempt to recover and claim back their world, the freedom and "normality" they formerly enjoyed, even if it means acting against the law. It is also a fight for the right to the city, including the appropriation of public spaces, considering them the pulse of urban life, for it is through them that the link between active participation and life in urban centers is established (Rechia, 2018).

More than producing answers, it is important for us to reflect and interrogate an unprecedented and troubling period that has drastically altered daily life, causing subjects, in the tension between their rights and duties/limitations to come and go, to perform disruptive and infringing practices in the light of the norm, as verified in the data collected in the parks. It seems decisive, under the lens of cultural studies, to question and reflect on the changes in the dynamics of leisure in public spaces, not only during the pandemic but also in a post-pandemic context, enjoying, in the future, a necessary distance, but with power in the context of sociability and the exercise of citizenship.

For Certeau (1980/1994), the tactical combat against the productive and social order takes place between the weak (the "ordinary" subject) and the strong, even if the weak do not cease to build, rebuild and produce their culture, from an active resistance by their moving bodies in the urban environment. The possibility of thinking about the world from another economy is crucial, where subjects do not define themselves solely based on their job or the basis of the capitalist and neoliberal market.

Santos (2005) warns us that if "we wish to escape the belief that this world thus presented is true, and do not want to admit the permanence of its misleading perception, we must consider the existence of another possible world" (p. 20), where the exercise of leisure rights have a prominent place in public policies in Brazil and Portugal.

What will be left of this pandemic experience in a post-pandemic world? What are the implications of returning to the long-awaited "normality"? What will be the place of technology in our lives? Will return to normal mean forgetting or belittling all the practices we experienced psychologically and bodily during the pandemic? Will there be time, space, and opportunities for reflection on leisure as an effective right that goes beyond the right to leisure only for those who are part of the labor market?

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