Resilience, protagonism, and readiness of Brazilian academic research to face the COVID-19 pandemic

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Abstract: This article seeks to understand the challenges that will face Brazilian public universities in the post-pandemic world, their products, roles, and relationships with different sectors of society, taking as a starting point the actions and experiences during the pandemic. For that, we carried out exploratory research based on bibliographical and documentary research and semi-structured interviews. We interviewed academics from seven public universities in the five regions of Brazil. All interviewees have conducted research projects or other initiatives related to COVID-19. We interpret the results from the method of content analysis of a qualitative nature. We hope to contribute to the evolution of the university's role in society and reflect on new capacities to be built or reformulated within the scope of public teaching and research institutions.

Keywords: COVI-19 pandemic, Brazilian public university, scientific readiness, dynamic capabilities, future visions.

Introduction

Amid the global health crisis triggered by the COVID-19 pandemic, higher education institutions worldwide had to react quickly and implement measures related to teaching, research, and administrative practices, considering the health and safety of the academic community and employees (Bergan *et al*.,

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2021). Many of these institutions, especially research-intensive universities, have also come to play a prominent role as key actors in tackling the many effects of the COVID-19 pandemic, precisely because they are centers of excellence in teaching, research, and innovation (Gardner, 2021).

Even amid the scarcity of resources and a crisis of legitimacy, Brazilian public universities began to play an important role, redirecting human and financial resources to carry out an extensive set of actions. They acted so much in the field of research, teaching but also carried out various actions of solidarity and support for their internal and external communities.

Brazilian public universities also engaged in the international effort of science, technology, and innovation (ST&I), with the most varied purposes, such as: unveiling the structure of the coronavirus, developing vaccines and diagnostic tests, creating and maintaining hospital equipment, strengthening epidemiological and statistical studies to support public policies and decision-making, in addition to contributing to the expansion of the State's testing capacity and the provision of hospital beds through university hospitals. Several elements configure this crisis of legitimacy, especially persecution of scientists, attacks, and threats to university autonomy, cuts in university budgets, drastic reduction in postgraduate funding, to name a few. postgraduate funding, to name a few.

This role was important because Brazil was the third country globally in infected people and deaths (615,674). Furthermore, since the pandemic, our country has shown a low capacity to apply diagnostic tests per million inhabitants compared to other countries (see Table 1).

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Table 1: Reported Cases and Deaths by Country or Territory

No.	Country	Total Cases	Total Deaths	Total Tests	Tests/1M pop	Population
1	USA	49,977,501	808,859	760,668,641	2,279,016	333,770,690
2	India	34,641,561	473,537	648,259,067	463,258	1,399,346,585
3	**Brazil**	**22,143,091**	**615,674**	**63,776,166**	**297,028**	**214,713,983**
4	UK	10,515,239	145,646	369,333,562	5,400,041	68,394,590
5	Russia	9,833,749	282,462	228,500,000	1,564,814	146,023,734
6	Turkey	8,901,117	77,830	109,449,755	1,278,130	85,632,738
7	France	7,917,264	119,535	167,925,512	2,564,549	65,479,543
8	Germany	6,212,747	103,826	85,782,441	1,019,205	84,166,070
9	Iran	6,137,821	130,277	39,415,479	460,864	85,525,133
10	Argentina	5,340,676	116,646	576,813	26,410,553	45,787,050

Source: Prepared by the authors based on Worldometer, December 06, 2021.

In this severe scenario, without the action of national scientific institutions, especially public universities, the harmful effects of the pandemic could have been even more severe. Many Brazilian public universities generated new knowledge about the coronavirus and the COVID-19, provided advice, and supported public managers for decision-making, despite the strong and growing scientific denial led by the Brazilian government and which gained strength during the pandemic.

This article presents the results of postdoctoral research (funded by Coordination for the Improvement of Higher Education Personnel – CAPES, Brazil), which studied actions carried out by Brazilian public universities in science, technology, and innovation (ST&I) and focused on facing the pandemic (The University Research Ethics Committee approved this research). The research had a double objective: first - to identify types and number of actions, target audience, reach, and importance of these actions; second – conduct interviews with academic scientists involved in these actions to identify their motivations, results achieved, competencies, or capacities developed, as well as their views on the

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challenges facing the Brazilian public university in the post-COVID-19 pandemic world. We used content analysis methodology with qualitative purposes to analyse the interviews, based on Bardin (1977, 2016).

On the following pages, we present a part of these results. In the first part of this article, we present a brief literature review with selected approaches on the roles of the university in society. Below, we bring data referring to the prominent role of Brazilian Science in Latin America and the world in the scientific production related to COVID-19. In the last part of the article, we present and discuss the views and opinions of academics from Brazilian public universities on the challenges faced in the post-pandemic world.

The results show that Brazilian public universities were only able to act promptly in the field of ST&I because they have an academic body of excellence, the result of long years of training and investment in the qualification of high-level human resources. However, the lack of resources for research and the budgetary restrictions that continually threaten their activities can seriously compromise the future of the Brazilian public university.

The Role of University and Academic Science in Society: Selected Approaches

The literature on university roles is broad and diverse. While some authors point out the critical role of the university in the generation and transfer of scientific and technological knowledge, others, on the other hand, emphasize the development of broader relationships with society and with its more direct surroundings, based on the commitment that these institutions must establish with the production of socially responsive knowledge.

In this sense, some scholars maintain that it is necessary to establish a "new contract" or "social pact" between academic science and society (Maassen, 2019, 2014, Olsen, 2007). As Olsen (2007, p. 25) pointed out, "the current dynamics raise questions about the University's long-term pact with society: What kind of University for what kind of society? What do the University and society expect from each

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other? How is the University assumed to fit into a democratic polity and society? To what extent and how are the University, government, and society supposed to influence each other? What is the extent and direction of change?". For Maassen, Andreadakis, Gulbrandsen, & Stensaker (2019), new or renewed views about the university's role reflect changes in the global political order, post-1945, in the role of government, in understanding the importance of innovation, scientific and technological progress, among others essential questions.

As early as the early 1960s, Clark Kerr, president of the University of California System, warned of the constant pressure on universities to take on multiple and complex functions. The university has become a "multiversity" (a term coined by Kerr), that is, a complex and multifunctional institution - formed by different internal communities (from different areas of knowledge) and which relate to different external communities (Kerr, 2005).

Lundvall (1992) and Freeman (1987), among other authors, discussed the systemic character of innovation and the importance of interactions and learning for "production, diffusion and use of new, and economically useful, knowledge and that a national system encompasses elements and relationships, either located within or rooted inside the borders of a nation-state" (Lundvall, 1992, p. 2). In this context, the National Innovation System (SNI) concept is as follows: "a network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies." (Freeman, 1987, p. 1). This approach explicitly recognizes that the main responsible for innovation is the company, but it recognizes universities as important centers for the formation and training of human resources, production, and dissemination of scientific and technological knowledge.

Finally, the "New Flagship University" approach, developed by John A. Douglass (2016), emphasizes that the university must broaden its scope of activities and social purpose so that it can be

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regionally and nationally relevant in the first place. According to Klemenčič (2012, p. 197), this discussion is important because

> […] many leading national universities have been transformed from serving national needs to competing for global prestige. There is a growing concern over the global competition imperatives resulting from rankings and the preponderance of the World Class University metaphor. Universities are adapting to these imperatives without necessarily reflecting on and scrutinizing the changes in their purpose and mission. Gaining a competitive global ranking has displaced service to society. With the New Flagship University model, we might find a path to a more relevant and thoughtful future.

Douglass (2016) hopes that research universities will take new paths that allow them, at the same time, to fulfill academic goals and meet the real needs of the societies in which they operate.

Brazilian Scientific Institutions and the Production of Knowledge about COVID-19

According to the Organization of Ibero-American States (OEI), Brazil was the Latin American country with the most active scientific institutions in the region during the pandemic in terms of scientific production related to COVID-19. The "*Ibero-American Observatory of Science, Technology, and Society* (OCTS)" has made a search tool, the "*Explorador de la investigación latinoamericana en COVID-19*", a real-time database designed to monitor information on relevant research to COVID-19 from universities and other scientific institutions in the region. Data comes from the following open access sources: notes from the "UNESCO Office of Science for Latin America and the Caribbean"; publications collected by the "Federated Network of Institutional Repositories of Scientific Publications ("La Referência); scientific articles from the "PubMed database", which is an open-access tool of the "Medical Literature Analysis and Retrieval System Online" (MEDLINE), of the National Library of Medicine of the United States, involving 4,800 journals from over 70 countries (OCTS/OEI, 2020).

Between August 2020 and April 2021, we searched on the "Explorador de la investigación Latinoamericana en COVID-19" and obtained the following results:

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- 21 countries in the base, and Brazil was the country with the most active institutions: 73 (in August/2020), 81 (in September/2020), 84 (in November/2020), 86 (in April/2021).
- Argentina appeared in second place with: 71 (in August/2020), 73 (in September/2020), 77 (in November/2020) and 79 (in April/2021).
- Mexico was in third place with 41 (in August/2020), 41 (in September/2020), 42 (in November/2020), and 45 (in April/2021) (OCTS/OEI, 2020).

By disaggregating the data referring to Brazilian institutions, it was possible to verify that more than 60 per cent public Higher Education Institutions (HEIs), most of these HEIs are universities, and about 13 are private HEIs. (see Figure 1).

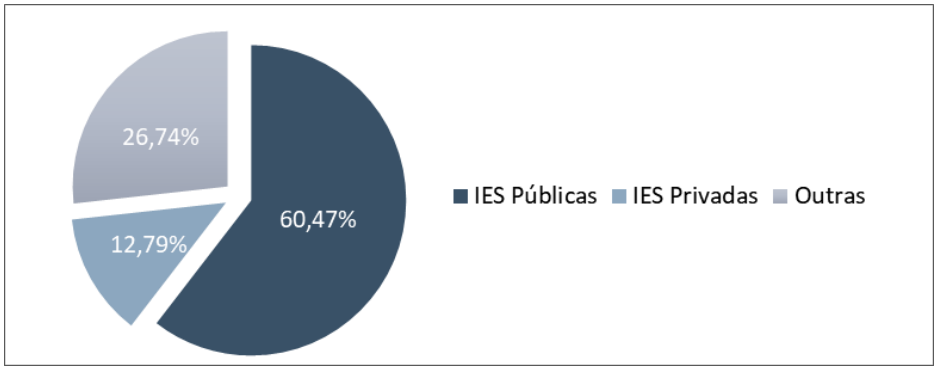


Figure 1: Brazilian Scientific Institutions.
Source: Prepared by the authors based on OCTS-OEI (April 20, 2021). *Note 1:* We prefer to use Higher Education Institutions (HEIs) because, although universities prevail in the base, there are also other types of HEIs, such as Colleges. *Note 2:* The category "others" includes public and private research institutes and centers, hospitals (including teaching hospitals), and Higher Education Institutes.

If we only consider data from PubMed/MEDLINE, which encompasses publications in biomedicine, medicine, and biological sciences, we can see that Brazilian researchers produced about 50 percent of the scientific articles. In other words, Brazilian science was responsible for 3,718 articles (in a universe of more than 7,000). Mexico came in second with 1,011, Argentina came in fourth with 586,

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Colombia came in third with 583, and Chile came in fifth with 561 articles (they are the top five in a list from 21 countries) (see Figure 2).

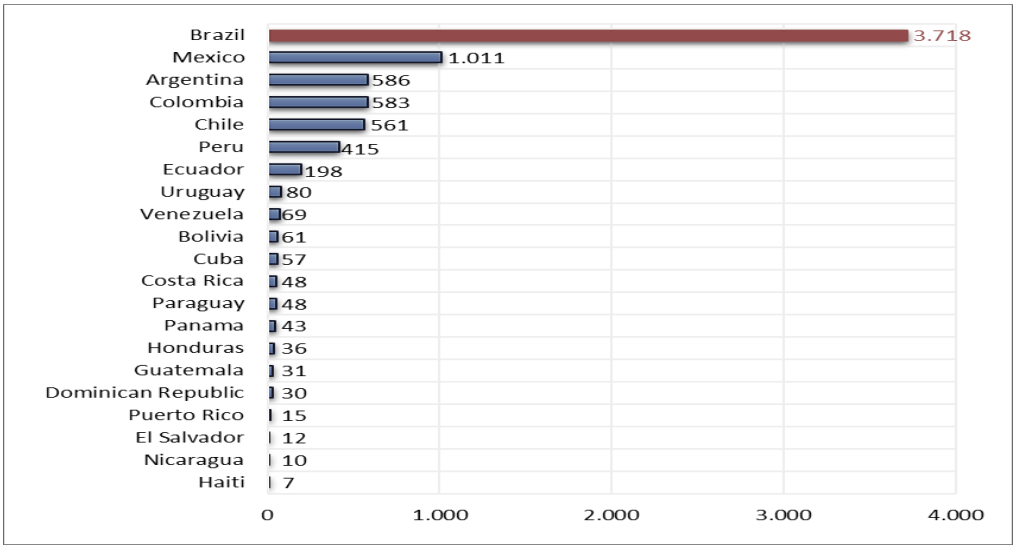


Figure 2*:* Scientific articles in biomedicine produced by Latin American researchers: PubMed database.
Source: Prepared by the authors based on OCTS-OEI (April 20, 2021).

Of the ten most active Latin American institutions, eight were Brazilian (seven were universities), as shown in Figure 3. The University of São Paulo (USP) was the Latin American university that published the most scientific articles on COVID-19 in the region in biomedicine (472 articles).

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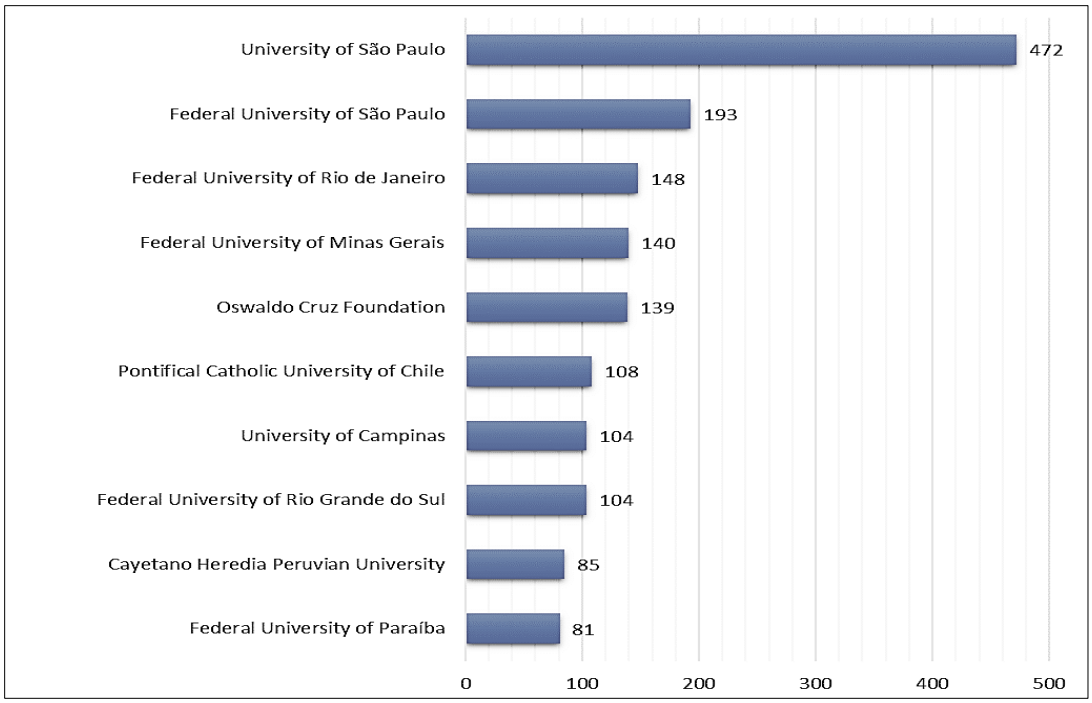


Figure 3: Articles on COVID-19: the most productive Latin American scientific institutions. *Source:* Prepared by the authors based on OCTS-OEI (April 20, 2021).

We chose to present here the performance of Brazilian public universities only in producing scientific knowledge about COVID-19, but this is just a tiny sample. As we mentioned earlier, with the arrival of the pandemic, they quickly mobilized their financial and human resources to engage in numerous initiatives that benefited both the internal community and society as a whole: production and application of diagnostic tests, production of hospital equipment, and other instruments, carrying out statistical and epidemiological analyzes and many other actions.

Below, we present the results of interviews with academics from Brazilian public universities involved in knowledge production and actions related to COVID-19. Before, however, we explain the methodological procedures used to select and analyze empirical data.

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Methodological Procedures

To select the interviewees, we carried out a broad online search to identify academics from public universities (usually professors, but they could also be postdoctoral researchers) who received funding from government agencies or even universities themselves for research on COVID -19. We also look for academics who received awards and recognition for their role during the pandemic. With a large set of data in hand, we selected a group of fifty-six potential academics to send out invitations. Due to the difficulties and commitments triggered by the pandemic, we were able to conduct interviews with only fourteen academics from the following seven public universities (see Table 2). We emphasize that all interviewees conducted surveys related to the COVID-19 pandemic.

Table 2: Universities and geographic regions of interviewees

University	Geographic Region	Interviewees
University of Campinas (UNICAMP)	Southeast	6
Federal University of Minas Gerais (UFMG)	Southeast	2
Federal University of Goiás (UFG)	Central-West	1
Federal University of Paraná (UFPR)	South	1
Federal University of Pernambuco (UFPE)	Northeast	1
Federal University of Paraíba (UFPB)	Northeast	2
Federal University of Amazonas (UFAM)	North	1
Total		14

We emphasize that all interviewees conducted surveys related to the COVID-19 pandemic. Furthermore, they represent universities located in each of the five regions of Brazil (see Table 2).

The relevant question is that the interviewees come from different areas of knowledge - biological sciences, humanities, medical sciences, engineering, and other areas (see Figure 4).

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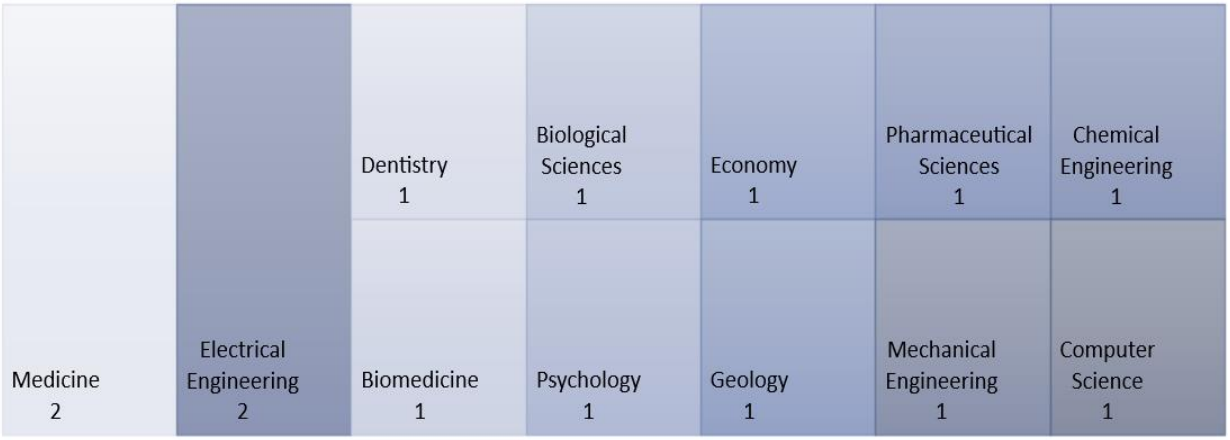


Figure 4: Courses/Areas in which interviewees graduated.

Of the fourteen interviewees, only one was not a full professor but a professor and collaborator researcher with a research grant from the Foundation for Research Support of the State of São Paulo, FAPESP.

The interviews took place between May and July 2021 through Google Meet and Zoom. We applied a set of ten questions to investigate the repercussions of the COVID-19 pandemic in terms of new research agendas, new relational dynamics, and perceptions and opinions about the public university in the post-pandemic world. We record and transcribe all interviews and then begin analyzing each interview in detail.

We followed the steps recommended by Bardin (1977) for carrying out qualitative content analysis, namely: "pre-analysis, material exploration, treatment of results, inference and interpretation" (p. 95). We work with thematic (or "categorial", in Portuguese) content analysis, grouping responses into convergent categories based on consensus and similar opinions present in the statements of all interviewees. We first establish general (or initial) analysis categories based on the questionnaire. Next, we create intermediate categories to group similar responses within these categories. Finally, we synthesize the intermediate categories into final categories, summarizing the consensus present in the responses.

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We organized the questions as follows: four general questions about the interviewee - their academic background, institutional affiliation, and research funding; and six more specific questions about their performance during the COVID-19 pandemic and their opinions on the challenges that will be presented to the Brazilian public university in the post-pandemic world.

The organization, categorization, and analysis of the data were carried out partially, with the support of the "NVivo Qualitative Data Analysis Software".

Table 3 below presents only the three specific questions more directly related to the research objectives.

Table 3: Specific Questions and Initial Categories

Questions	Initial Categories
Q.1 Have partnerships and external actors been intensified and changed during the pandemic?	**Impact of COVID-19 on partnerships and collaboration**
Q.2 Was it necessary to develop new capacities (dynamics, ways of acting) to face up to your current research agenda? Which?	**Learning and capabilities**
Q.3 What are the challenges and barriers to be overcome by the Brazilian public university in the post-COVID19 pandemic?	**Future visions**

As stated before, the initial categories above served as the basis for the entire development of the analysis. From them, we were able to group the central answers into intermediate categories, formed by a set of similar answers. Finally, based on the intermediate categories, we established final categories, which represent a synthesis of the main converging ideas. We will not list all the intermediate categories; otherwise, the article would be overly long. It will be more informative to start the discussion of the results from the final categories as they summarize the opinion of the interviewees. To facilitate understanding of the results, in Table 4, we present the initial categories related to each question or group of questions and the respective final categories.

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Table 4: Final Categories

Questions	Initial Categories	Final Category
Q.1	**Impact of COVID-19 on partnerships and collaboration**	*Favoring new partnerships/collaborations; solidification or renewal of existing partnerships/collaborations* *More interdisciplinary partnerships/collaborations*
Q.2	**Learning and capabilities**	*Readiness to establish new dynamics of action and offer responses in ST&I* *Development of adaptive capabilities to optimize time, work, resources, and processes*
Q.3	**Future visions**	*Robust, continuous, and stable government support* *Renovation required: understand the crisis as an opportunity for Brazilian public universities to reflect on their "modus operandi."*

Impact of COVID-19 on partnerships and collaboration

Favoring new partnerships/collaborations; solidification or renewal of existing partnerships/collaborations

Most interviewees reported that existing partnerships were intensified and deepened, having emerged several opportunities for interactions and collaborations with new partners. All interviewees made it clear, directly, or indirectly, that during the pandemic, the perception of the importance of networking and cooperation increased, and those interactions occurred in a more natural and accessible way than in the pre-pandemic period.

More interdisciplinary partnerships/collaborations

Several Brazilian universities carried out a task force to deal with the pandemic. In many cases, these initiatives induced and encouraged inter and multidisciplinary interactions.

The pandemic itself is a phenomenon that has affected different spheres of life in society: public health, economy, social relations, among others. Thinking only about the disease, COVID-19 also requires

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the interaction of different areas and disciplines as its effects and sequelae continue to defy science. In this context, inter and multidisciplinary interactions are the way to face different aspects and dimensions of the pandemic.

The interdisciplinary collaborations were frequently mentioned and highly valued in interviewees' responses. They understand that these interactions were not only essential for expanding knowledge about the virus and the disease but also allowed researchers to broaden their research agenda, in addition to generating personal and professional enrichment.

Learning and capabilities

This subcategory is related to the skills and learning that interviewees needed to develop for their performance during the pandemic. For this research, we work with the concept of dynamic capabilities.

Dynamic capabilities translate into skills that can enable change in uncertain environments. In the public sector, they can help organizations structure themselves to become agents of change in the broader contexts in which these organizations operate (Kattel & Mazzucato, 2018). The development of dynamic capabilities is essential, especially in turbulent environments that require quick responses.

Bejinaru (2017) explains that dynamic capabilities have great potential for universities to improve their abilities to organize, integrate, build, and reconfigure their operational capabilities, which is crucial for responding promptly to changes. This author recommends that universities should also be learning organizations and be knowledge-oriented organizations, developing a readiness to acquire new knowledge and integrate it into existing practices and structures.

However, Piening (2013) warns that dynamic capabilities are not necessarily related to an immediate superior organizational performance, as it often takes some time for the adoption of new practices and routines to take effect effectively. However, what is known is that dynamic capabilities allow the renewal of operational capabilities or the routines that sustain these capabilities. As Teece (2012)

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clarifies, dynamic capabilities depend on a set of elements, including individual skills, collective learning, and all the instruments that organizations have (equipment, facilities, technologies, among others).

Readiness to establish new dynamics of action and offer responses in ST&I

It is not a mistake to state that the global health crisis triggered by the advance of COVID-19 created a turbulent environment, forcing individuals and organizations to change their routines and forms of interaction drastically. The COVID-19 pandemic imposed the need to establish new practices, whether in research or internal and external interactions. These challenges tested the interviewees' capabilities and expertise, especially their resilience and readiness.

Therefore, interviewees faced significant challenges during the pandemic, especially working in laboratories, interacting with teams and networks, and their students. Allied to this is the intense search for answers, coming from different fronts (media, health authorities, other scientists, and other social actors), which forced them to interact with these audiences frequently, either by giving interviews or participating in virtual events, making informative notes, bulletins, among other sources of information. Thus, interviewees were unanimous in stating that there had been considerable improvements in their interaction and communication skills, especially for interdisciplinary work and multidisciplinary teams.

Another notable fact is the speed with which the interviewees managed to establish new research agendas or redirect the agendas already underway to incorporate themes related to the pandemic. As one of the interviewees explained, this only occurs when one is aware of the social function of science and the scientist, or in his exact words: “having the ability to see the important role that must be played and not running away from the obligation.” We found that all interviewees have this ability well developed.

Development of adaptive capabilities to optimize time, work, resources, and processes

The researchers and their teams needed to rethink how to reorganize their laboratories to obtain the

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best possible results, in the shortest possible time, with the maximum use of available resources, due to the need for quick responses and the various limitations imposed by the pandemic. Among the changes reported, the following stand out: reorganization in terms of research funding – directing resources to study COVID-19; improved capacity to adapt, to respond promptly, to reallocate resources, to reposition human resources, to use equipment; improved capacity to delegate tasks; development of a sense of collectivity: "spirit of teamwork"; laboratory professionalization: optimization of processes and quick responses – "this did not exist before the pandemic".

We conclude that the pandemic forced interviewees to seek new interactive dynamics, new ways to organize the work environment and operational routines, and that, in many cases, the positive effects of these changes are already being felt (more organized laboratories, with more processes agile and lean, maximizing time, and resources). The answers allow us to conclude that in practically all cases, they are not precisely new capacities, but renewed or improved capacities, as they were already latent, and the pandemic only accelerated or intensified this renewal process. It is essential to highlight that Brazilian public universities have excellent human resources in their staff. As mentioned in this work, it is enough to remember that Brazilian public universities are the central locus for postgraduate studies and scientific activities in the country.

Considering that the research carried out is exploratory and studied a phenomenon that is still ongoing, the results we have obtained are preliminary and deserve to be deepened in future research. Therefore, it is not possible to state that the learning and routines resulting from the new dynamics established to face the pandemic will or will not be converted into dynamic capabilities in the future. However, it is expected that the learning and legacies arising from this engagement will produce positive results in the long term and help the academic community and institutions incorporate qualitative changes, both in administrative processes and teaching, research, and university extension activities.

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Future visions

In this category, we identified two central themes in the interviewees' statements: the first concerns the role of the Brazilian State in valuing and supporting its educational institutions; the second concerns the universities themselves, that is, the need to rethink how they fulfill their mission and communicate with society. From the answers, we were able to arrive at these two final categories: robust, continuous, and stable government support; renovation required: understand the crisis as an opportunity for Brazilian public universities to reflect on their "modus operandi".

The main concerns of interviewees with the future of the Brazilian public university are as follows: the need to establish broader and more intense relationships, partnerships, and dialogues with society; research agendas aimed at emerging societal problems; government support - more robust, continuous, and stable investments to finance teaching, research, and services (university extension, community engagement, outreach, for example); recovery of public university budgets; investments in digital technologies for teaching; valuing scientists and science; defense of academic freedom and autonomy; rethink classes and teaching methodologies.

Robust, continuous, and stable government support

All interviewees agreed that the future of the public university and of Brazilian science itself depends on robust and stable government support. Without this, the results can be severe, such as discontinuation of projects and programs, stagnation of the teaching career, scientific blackout, loss of talent ("brain drain"), among other deleterious effects. As mentioned by the former minister of education and current president of the Brazilian Society for the Progress of Science (SBPC, in Portuguese), Renato Janine Ribeiro, in an interview with Deutsche Welle Brazil, "the survival of science and innovation in the country is at stake" (Pontes, 2021). This situation occurs because the government and different segments of society

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still do not have a clear idea of the role of the public university, its importance, and the importance of science for the country's development.

Bureaucracy is also a worrying issue that significantly appears in the interviewees' statements. According to the interviewees, bureaucracy makes purchasing inputs for research more time-consuming, affecting the laboratories' productivity. Bureaucratic processes prevent Brazilian researchers, their teams, and laboratories from being competitive. In Brazil, the period between the purchase of inputs and their arrival at the laboratories can be six months, while in other countries, as pointed out by the interviewees, this period can be just a few hours (24 or 48 hours) or days. While abroad, it is common for universities to have instances specially designed for grants and funding management, in Brazil, on the other hand, the reality is different, as the researcher is responsible for practically every step of the process: managing resources, looking for suppliers, acquire inputs, render accounts (United States, England, Australia, Sweden are some of the countries mentioned by some interviewees). As several researchers mentioned, "a lot of time and energy is spent on bureaucratic and inflexible processes, time that could be used to conduct research."

Renovation required: understand the crisis as an opportunity for Brazilian public universities to reflect on their "modus operandi."

Interviewees believe that the structure created to face the pandemic and the experiences and lessons learned opened "windows of opportunity" for a more renewed university in the post-pandemic.

The relationship with society was a topic raised, and, in general, all interviewees understand that the university needs to be more present in people's daily lives so that it can be remembered, recognized, and valued.

All interviewees also understand that universities showed their value during the pandemic and that without the action of public universities, Brazilian society would be much more backward in facing

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COVID-19. However, this engagement with society's problems and urgencies must continue and intensify. Interviewees hope that in the post-pandemic, the academic community will balance its interests to establish research agendas that are more responsive to society's demands and problems.

The pandemic demonstrated how important inter and multidisciplinary interactions and conversations are for advancing knowledge. As one of the interviewees pointed out: "it is essential to overcome departmental and disciplinary barriers to see what others are doing, or what they know how to do, to see through the eyes of the other, to build multi/inter/transdisciplinary interactions.

Another point raised concerns about adopting technologies in teaching and hybrid forms of teacher-student interaction. It is necessary to learn more about the use of digital technologies in teaching and rethink the current classes and teaching model and the relationship between research and teaching. During the pandemic, many universities were not prepared for emergency remote teaching and were unable to meet the demands and needs of students, especially concerning access to equipment and Internet connection.

Conclusions and limitations of the work

The research findings allow us to conclude that academic scientists at public universities across Brazil have redirected their research agendas to work on issues ranging from epidemiological studies, virus sequencing, diagnostic tests, and robust and rapid production of knowledge on COVID-19, among other contributions. They also came out of their "ivory towers" (their labs) and communicated more actively with society, warning and informing about several topics related to the COVID-19 pandemic.

Although all interviewees agree that Brazilian universities have made significant contributions to society over time, they also understand that these contributions need to be made more evident. Thus, it is essential to maintain the communication channels and the same level of interaction established during the pandemic, when scientists went public to talk about their research and various topics of interest.

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Regarding the future of Brazilian public Universities and academic science, there was a consensus among the interviewees about the need for more robust, assertive, and stable public policies. Without a clear understanding from governments and society that education, science, and technology should be seen as investments, the future will be uncertain.

Considering that the research we carried out is exploratory and mapped a phenomenon still in progress, it is impossible to say that the learning and routines resulting from the new dynamics established during the pandemic - in laboratories, research groups, and teams, or, in broader terms, in the universities themselves - will or will not be converted in dynamic capabilities (in the future). As discussed in this article, dynamic capabilities represent a set of resources that allow the renewal of routines and operational capabilities of an institution/organization. These are new or renewed competencies and aptitudes relating to stakeholders, managing resources, responding quickly to challenges, and identifying opportunities.

However, we expected that the lessons learned and the legacies arising from the engagement of public universities in confronting the COVID-19 pandemic will produce positive results in the long term and help institutions to incorporate qualitative changes in several dimensions: administrative processes, teaching, research, university extension, as well as in all its relations with different sectors of society.

Finally, it is essential to highlight that Brazilian public teaching and research institutions carry out more than 90 percent of Brazilian Science. Furthermore, between 2013 and 2018, only fifteen public universities accounted for more than 60 percent of all Brazilian research production, according to data from the report "Research in Brazil: Funding excellence commissioned to Clarivate Analytics" by the Coordination for the Improvement of Higher Education Personnel (Capes, in Portuguese). (Clarivate Analytics, 2019).

Another relevant piece of information comes from a special report by the "United Nations Educational, Scientific and Cultural Organization (UNESCO)," according to which Brazilian Science has

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shown remarkable resilience, even in the face of adversities faced over the years. According to this report, between 2014 and 2018, the quality and quantity of Brazilian scientific production progressed considerably, even in the face of progressive and drastic budget reductions for the financing of science and technology in the country (Schneegans, Lewis, & Straza, 2021).

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