Should Disciplines Define Learning Spaces?

Luis Henrique Pavan, Federal University of Santa Catarina, Brazil
Camila Poeta Mangrich, Federal University of Santa Catarina, Brazil
Jose Ripper Kos, Federal University of Santa Catarina, Brazil

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Abstract
Brazil has a robust system of public higher education institutions in which funding always depends on the importance that governments give to universities. The organizational methods and premises implemented in Latin America and particularly in Brazilian universities in the 1960s still have critical consequences on the campus. The spatiality and location in the city result from a comprehensive university reform that took place during the military rule. While the multidisciplinary departments defined the division of the campus, through their disciplinary fragmentations, there was an intentional distancing from the neighborhood. However, the importance of interdisciplinarity in university spatial organization is present throughout the campus social infrastructures. These institutions' networks have a large and crucial role for Brazilian society, providing public health assistance, language courses, sports activities, and other services. We argue that social infrastructure connections can enhance the importance of disciplinary exchanges to strengthen the relationship between the university, society, and ecology. In this work, we use a Brazilian campus to explore how its social infrastructures can support in overcoming disciplinary segregation. By reassessing territorial organization, public universities can strengthen fundamental services for social cohesion, care, and city functioning, as the so-called hard and social infrastructures are parallel in terms of their importance. This study contributes to expanding the concept of social infrastructure and its role in transdisciplinary fields, framing the campus dynamics in a context marked by climate change, social segregation, and the lack of public services.

Keywords: Social Infrastructure, University Campus, Brazilian Public Universities

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Introduction

Focusing on the main campus of the Federal University of Santa Catarina (UFSC) in Florianópolis, Brazil, we argue that by reassessing territorial organization, public universities can reinforce a fruitful platform to overcome critical disciplinary segmentation. At the same time, these institutions can strengthen fundamental services for social cohesion, care, and city functioning, as the so-called hard and social infrastructures are parallel in terms of their importance. This study contributes to expanding the concept of social infrastructure and its role in transdisciplinary fields, framing the campus dynamics in a context marked by climate change, social segregation, and the lack of public services. We mapped the main social infrastructures provided by the university on campus to highlight proximity relationships and possible associative links between the different social infrastructures, identifying the layers of provided services that make up the campus. Our proposal acknowledges that the disciplinary divisions in campus planning remain a significant hindrance to fully utilizing the potential of social infrastructures and their integration. This study explores how social infrastructure can enhance human connections and grant necessary public services to promote efficient urban life, social harmony, and ecological balance in cities. These social infrastructures can prompt a reevaluation of academic practices, emphasizing interdisciplinary curricula to strengthen the relationship between society and ecology.

A university campus may profoundly vary depending on where it stands. The Brazilian public universities, for instance, incorporate crucial urban social infrastructures and its campuses are places of organized complexity of public services. At the same time, these institutions host multiple forms of sociability that include their surrounding communities. However, public universities are increasingly underfunded, and their role in addressing the country's social problems is often ignored or distorted. Brazilian recent experiences include the public universities in the eye of a cultural war promoted by conservative sectors that depicted the university community as an investment with no real return to society and even as enemies of morality.

Garcia (1994) establishes a connection between the initial restructuring of academic frameworks and the Enlightenment era, closely tied to the emergence of modern Western science. The schism between university practices and the Roman Catholic Church, a significant knowledge transmitter, yielded profound ramifications. This divergence not only brought about disciplinary and thematic compartmentalization within organizational and administrative dimensions but also instigated a spatial transformation necessitating specialized academic facilities (Temple, 2014). Furthermore, García (1994) contends that the dichotomy between natural and human sciences emerged as an endeavor to systematize the realms of knowledge. Moving forward, in the 20th century, neopositivists embarked on a reductionist quest for scientific cohesion, which gradually permeated university organizational principles and physical infrastructures.

Disciplines have engaged in a collaborative exploration of their depths, yet this endeavor has often been accompanied by skepticism regarding attempts to amalgamate disparate fields. Discussing the disintegrated nature of sciences and urban dynamics, Lefebvre (1996) highlights that throughout a substantial portion of the 19th century, the sciences focusing on social reality evolved in opposition to philosophical concepts aiming to encompass the entirety through rational systematization. The author underscores how these sciences segment reality into analytical fragments, each wielding its distinct methodologies, sectors, and domains. Consequently, the environment was approached and comprehended as a

comprehensive yet intricate concept, susceptible to fragmentation due to the specialized approaches and investigations pursued by disciplines such as geography, climatology, and botany. This division of labor led to a montage-like environment perception. Following this, a wealth of literature emerges, expanding the horizons of learning environments' capacities. This literature considers these environments from a wide-angle perspective, recognizing them not only as traditional centers of learning, but also as vibrant hubs and social focal points. Importantly, this perspective does not dilute the educational aspects; on the contrary, it enhances them. This assertion finds support in research, underscoring that this inclusive approach measurably contributes to improve the learning experience, nourishing more extensive spatial diversity, geographical flexibility, and enhanced resource accessibility are provided for both students and educators compared to conventional classrooms (Carvalho & Goodyear, 2018; Cleveland & Fisher, 2014; Young & Cleveland, 2022).

Urban university campuses form the landscapes of cities with other urban, sociocultural, and biophysical systems. The interaction between the processes and components of these territories affects the campus and cities directly (Goddard & Vallance, 2013). Understanding the campus requires knowledge of the institution's history it belongs to. In its expanded context, our object of study, UFSC's main campus, is a component that illustrates the growth of state and federal public agencies and tourism in Florianópolis since 1960. UFSC's establishment is part of the educational modernization debates that marked Brazil in the 1950s, aimed at strengthening the country’s affluent elites. Governmental resources have led to public interventions contributing to the city's territorial occupation, as in other parts of the country. At the same time, workforce qualification was a necessity for operating the new service provision and public administration sector in a remote area of the city.

Campus Context and Disciplinary Segmentations

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In 1960, the construction of the university complex in a non-urbanized area was the object of conflict, as evidenced by the opposition from the team of architects responsible for the city master plan and the proposal for the university's implementation in the center of Florianópolis. The state government advocated for the campus outside the city center, in the Trindade district. The reserved plot was previously a swampy farm, and its selection was due to a political plan to promote urban development directed toward the east and north of the city (Teixeira, 2009). The two first plans for the new campus included comprehensive architectural, road, and urban spheres. The actual construction, however, was limited to the road and drainage systems, which were vital to expanding the surrounding neighborhoods (Neckel & Küchler, 2010) (Figure 1). Infrastructures like these give rise to temporalities, thereby composing what is known as infrastructural time (Appel, 2018). After the Brazilian

military coup d'état, the University Reform of 1968 redefined organizational and administrative parameters of higher education institutions, with a significant impact on the UFSC's project. The Reform emphasized economic rationalization and influenced by productive university models, territorial compartmentalization, and hierarchy.

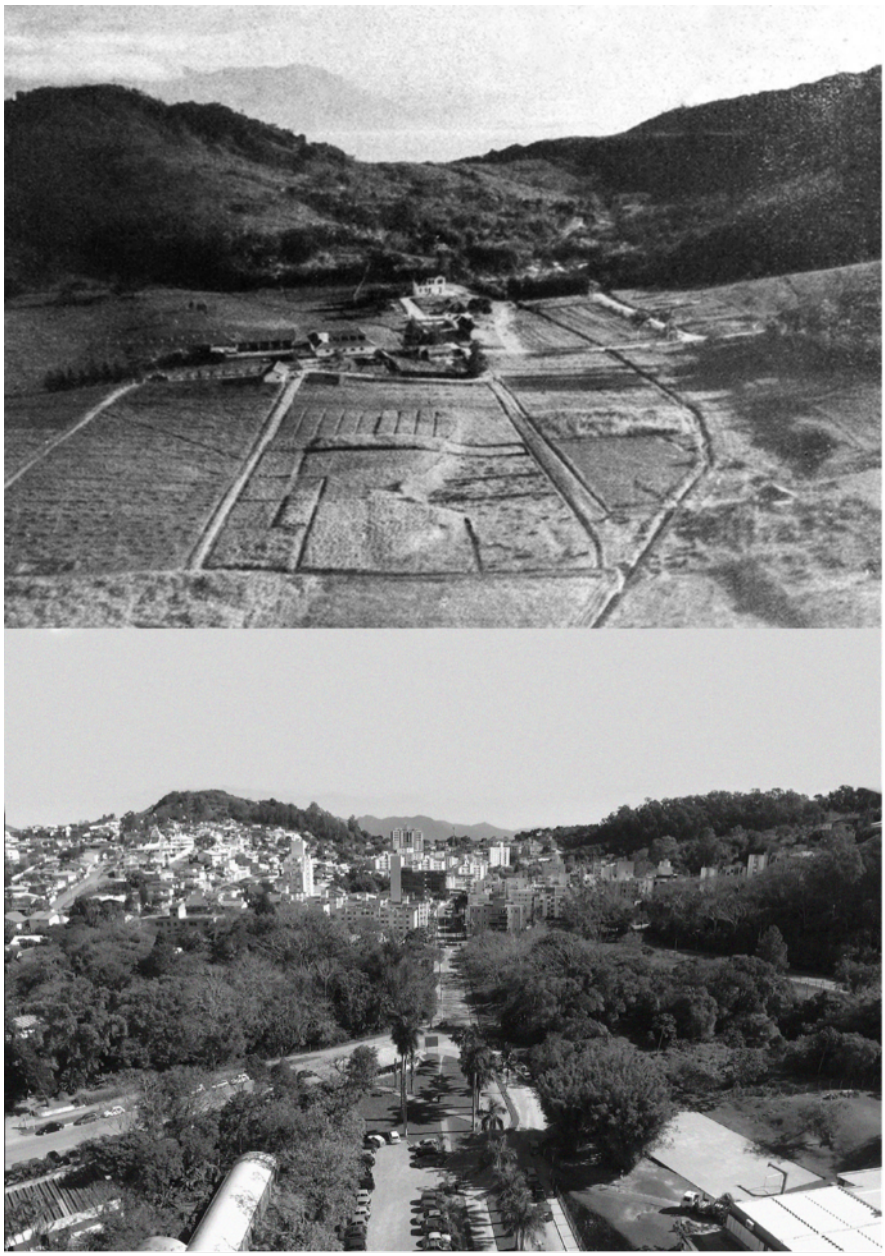

Figure 1. Above: taken in the 1950s, the plot where the campus now stands with part of the drainage system, viewed from the east. Source: UFSC Agecom. Below: Same region in 2016. The landscape formed by these infrastructures serves as a temporal reference for the campus and its environment. Source: authors.

The Manual for Integral Planning of the University Campus[1] by Rudolph Atcon (1970) guided a large part of the organization of Brazilian universities. It reflects a strict belief in post-Reformation pragmatic rationalism. Atcon established the division of universities into centers associated to large disciplinary fields, eliminated any duplicate infrastructure,

[1] From portuguese “Manual sobre o planejamento integral do campus universitário”, our translation.

hierarchically organized the rectory, disciplinary centers, and other collegiate bodies, and emphasized the vital role of departments over schools (Cunha, 1988; 2014). The United States acted in Latin America in the cultural and educational fields as part of the Cold War through bilateral agreements. Documents such as the Manual are part of a significant series of other legal provisions, academic exchanges, and other cultural and political actions guided by the US government. Atcon envisioned the connection between universities and society through fundamental infrastructure and services, the university hospital, and the sports facilities. However, these connections presented a contradiction as the community could only penetrate to a certain extent the campus domain through these social infrastructures.

The "Manual" segments knowledge into different disciplinary centers, a feature that was part of the university's initial plans but exacerbated by the Atcon documents. These segmentations reflect the current scientific understanding of natural laws and are evident in different disciplinary and spatial practices. Atcon used zoning to reinforce the spatial segregation of the hypothetical campus depicted in his Manual. He conceptualized this zoning based on areas of knowledge (Figure 2). Architecture is responsible for the ordering and maintenance of this concept, as it describes the protocols for space formatting (Easterling, 1999). Nonetheless, it is crucial to engage in a thorough and nuanced analysis of the significance of these reforms and the Manual's pivotal role in shaping administrative changes within the university. This examination should consistently acknowledge the overarching influence exerted by the Federal Government, without overlooking the diverse local contexts and political-regional distinctions. These documents represent a synthesis of both theoretical and practical endeavors, unfolding concurrently within the centralizing sphere of the federal government and the university staff. The varying degrees of importance and centralization attributed to the government further underscore the dynamic nature of this interplay.

The university campus mirrors these specialization procedures, highlighting the guidelines that govern them, and their ability to simplify and standardize infrastructure through modular protocols (Appel, 2012; Tsing et al., 2019). An approach to infrastructural space could prioritize the fundamental components of urban life and social care. Thus, social infrastructure encompasses quality urban spaces and their essential characteristics that can have a significant impact on everyday life and extreme weather events (Klinenberg, 2016; 2018). Quality urban spaces include sociability, physical provision, and programmatic-institutional organization, linked to the socio-spatial and community characteristics of the regions (Latham & Layton, 2019; 2022).

The UFSC campus area is over 400.000 sq. meters, comprising around 60 departments with almost 50.000 students, staff, and faculty. The university provides free of charge multiple and disconnected services and summarizing them is not straightforward. Nonetheless, we present some of the principal social infrastructures below. The campus boasts several social infrastructures related to health, including the University Hospital (HU) and teaching clinics. The HU is one of the largest hospitals in the State and is a significant provider of the Brazilian Unified Health System[2], which offers universal and free access to health services for all (Gelbcke et al., 2018). The HU caters to approximately 10,000 clinical admissions and 40,000 emergency cases annually. Additionally, the campus has various teaching clinics, such as Dentistry, Speech Therapy, and Psychology. The University School receives around 1,000 preliminary and high school students, becoming a recognized social education infrastructure for the metropolitan region. Other social facilities on campus include the Child

[2] From portuguese Sistema Único de Saúde, our translation.

Development Center, extracurricular courses in foreign languages, and academic events open to the community, which attract thousands of people. The Sports Center occupies a significant part of the southern section of the university complex and comprises several infrastructures such as sports courts, swimming pools, athletics track, soccer field, and gymnasiums with multipurpose courts. The Center for Elderly Studies fosters inclusion and collaboration with the elderly public on campus. These social infrastructures are scattered throughout the campus separated by the internal road system and the campus river network. Parking lots constitute a significant feature and barrier all over the campus, particularly between buildings and the riverbanks (Kos et al, 2017).

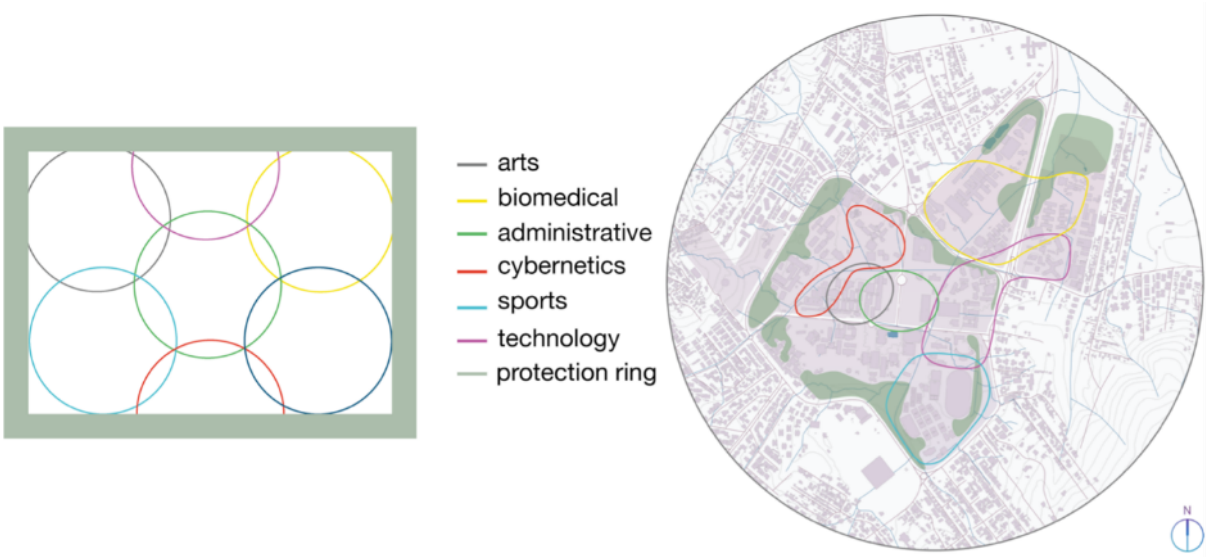

Figure 2. On the left, is the diagram of the Atcon Manual and its basic sectorization, while on the right, this schematic is superimposed onto the UFSC campus. Source: authors.

Reframing Divisions, Emphasizing Social Infrastructure

It is crucial to acknowledge the adaptability of the concept of social infrastructure, as its varying spatialities and sociability are different and specific to different regions worldwide, which requires different typologies of sociotechnical systems. We developed Latham and Layton's (2019; 2022) research categories to direct our study about the possibilities of integration and visualization of social infrastructures on campus. Additionally, we referred to the University Service Charter (UFSC), a document that outlines UFSC's primary services enhancing their capacity to meet the evolving needs of Brazilian society more efficiently and effectively. We centered on investigating these on-campus social infrastructures georeferencing them across thematic overlays, disregarding their departmental affiliations (Pavan, 2022). Our analysis of the campus's social infrastructures focused on the following themes: social health infrastructures, community education, leisure and sports, elderly care, culture, mobility, and open spaces as social infrastructure.

Part of the inspiration for building the visualization model came from an infrastructural inversion in which the substrate turns into a substance. Infrastructural inversion is an analytical concept involving an epistemological change in the studies of large-scale technological infrastructures, delineating its properties (Bowker, 1994; Star & Ruhleder, 1996). The representation option underscores the object-relational quality of infrastructures, establishing syntactic relationships with and connecting to other multilayered. This inversion introduces action and representation possibilities of the campus organization through

functional coexistence in its different social infrastructures, thus surpassing disciplines as the only possible division.

To assess the potential of the university, we developed diagrams of social infrastructures focusing on specific aspects of the infrastructural space. To ensure flexibility, we established a negotiable structure integrating existing experiences with emerging virtual relationships in the campus's infrastructural space. After conducting a thorough survey, we georeferenced the typologies in a Geoinformation System Software. With the obtained coordinates, we organized the actions into circuits using Kepler.gl, an online geospatial analysis tool. By connecting the social infrastructure in a network, the software interpolated the circuits using Delaunay's Triangulation. This approach maximizes the smallest angle of all triangles, avoiding those with a reduced internal angle, leading to circuits formed with greater flexibility (Figure 3). Together, these circuits form paths and directions that impact the campus's performance and social impact.

Figure 3. Different georeferenced points attached to social infrastructures generated the triangles, posteriorly employed to generate the circuits. Source: authors.

By visualizing each circuit based on its proximity relations, we can identify the layers of services that make up the campus (Figure 4). We are calling circuits the surface delimitation and the perimeter formed by uniting different social infrastructures. The overlapping distribution of these infrastructures highlights their ubiquitous and permeable nature throughout the campus. Each category, disseminated across the university, adds richness to the campus and is reinforced by the distributive terms of these circuits, which each compose a layer. Furthermore, we examined social infrastructures and typologies beyond discipline ties, recognizing that their management by different sectors within the same institution challenges the notion of a systemic view.

The interaction between the university and the external community is an essential part of university outreach and takes place through various educational and social activities, such as projects, courses, and cultural or leisure activities provided by the institution. A critical part of this process has been integrating activities currently not intricately connected concerning space or themes. For example, when we designed the social health infrastructure diagram, we considered locations such as clinics and the university hospital, sports facilities, and other buildings that play a significant role in intergenerational care, emphasizing their spatial

complexity. For the social education infrastructure circuit of the community, we considered locations whose educational activities are part of official programs and are central to the organization of the university's physical spaces.

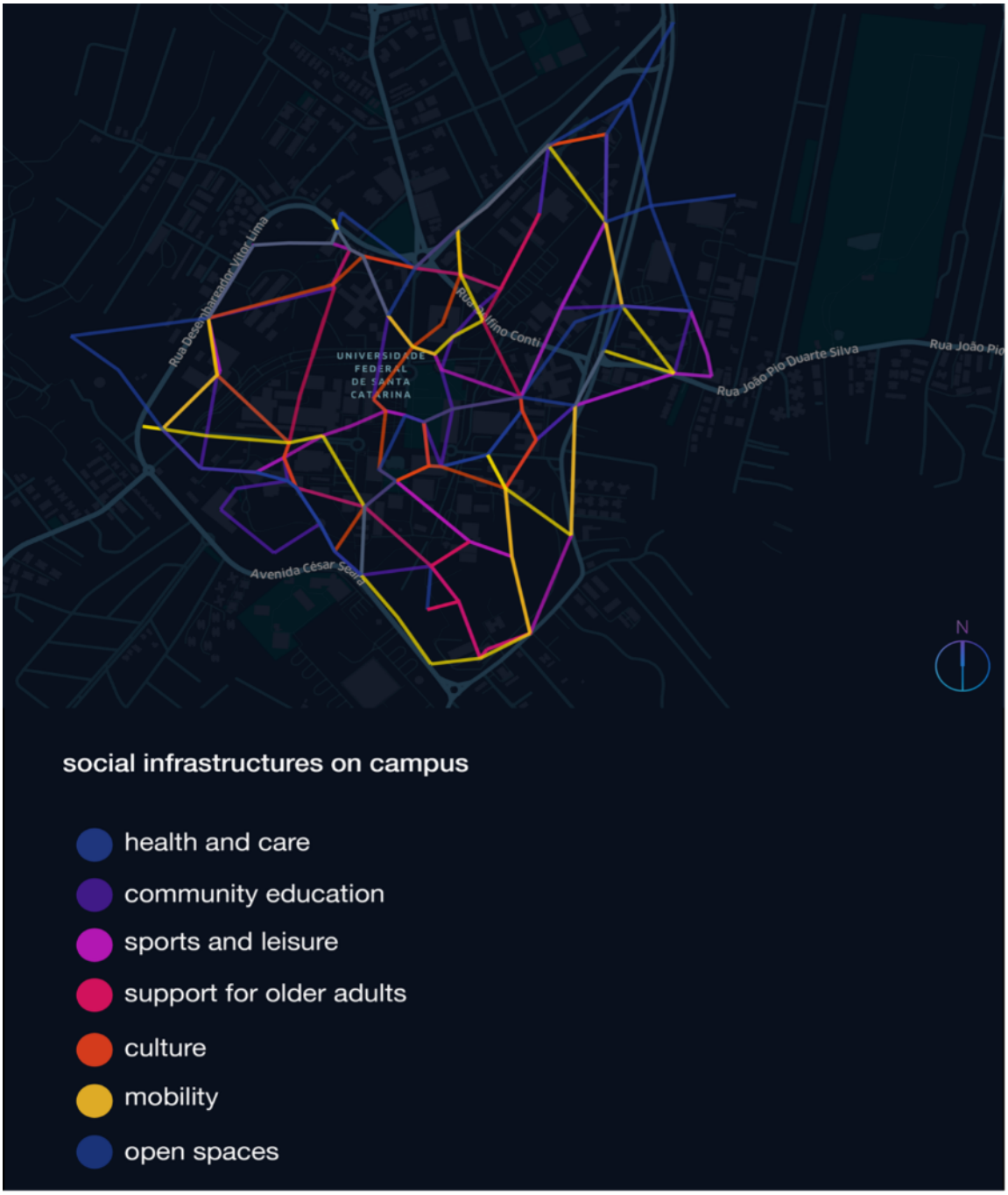

Figure 4. Diagram overlaying the social infrastructure circuits on the UFSC campus. Source: authors.

Working with social infrastructure requires flexibility beyond the end function of the spatialities we evaluate. Even in the case of the campus, whose primary focus is higher education, integrating schools and the community on the university campus effectively promotes education and socialization in the community. The University School presents an example of community interaction through parent-teacher associations, allowing for continuous dialogue and expanding the integration between schools and the city. This

network of social infrastructure aimed at education permeates most buildings of the university. However, the challenge is not only to integrate them, but integrate the open spaces to actively participate in this network.

Orr's hypothesis (2004) emphasizes that a campus is an object of learning and community education, as classes and lectures are. The social leisure and sports infrastructures are pivotal in this process. They offer collective activities in which interaction with the university's territory is crucial. In this sense, sports and leisure are social and cultural rights that energize public space. The diagram of social leisure and sports infrastructures reinforces these relationships, bringing the concept of social infrastructure closer to a space traditionally dedicated to research and study (Figure 5). Furthermore, they support the pedagogical potential of the university's territory, present in the mutual transfer of knowledge between scientific knowledge and other kinds of knowledge.

Figure 5. Public sports infrastructures on campus. Source: authors.

Among this new knowledge, we mention the inclusion of different perspectives about the public that occupies and attends the university. Population aging is an increasingly prevalent phenomenon worldwide and can lead to problems of a sedentary lifestyle, isolation, and mental and physical frailty. Social infrastructures concerning people over certain ages must consider generational particularities and avoid prejudices and ageism. The Center for Studies on Aging is the most prevalent and relevant social infrastructure in this domain. In addition to offering specific activities for the older adult population, the center serves as a gateway for older adults to learn about other activities developed on campus that are not related to the center's actions. It is necessary to be constantly updated and attentive to the senior population's substantial dynamics, considering their diverse needs, such as difficulty with mobility and other physical restrictions. Social connections and networks of sociability are fundamental to meeting the needs of this increasingly large population group and the consequential need for integrated health and social care. Another relevant issue is campus

diversity. The university is mostly a young community and placing them with older people opens their worldviews to different society's needs.

Mobility on campus raises concerns about transportation dynamics in the metropolitan region of Florianópolis. This is also the case for most students who live in the city's peripheral neighborhoods of the island, who depend on the campus's public transportation. Controversially, this reality results in pressure for parking spaces on campus that, together with the original road infrastructure, defines an urban design that fragments opportunities for exchange between the disciplinary centers. The extensive infrastructure for private vehicles, however, is a facility offered primarily to a specific class that resides in the surrounding neighborhoods, coupled with the argument that pedestrian access is limited and precarious, making it uninviting for walking. Nonetheless, reframing the quality and permeability of pedestrian sidewalks is one of the most potent acts to ensure its social infrastructure qualities in the campus context, favoring encounters and vital interaction for society's dynamics.

We consider the diagram of free space systems as a valuable tool for understanding the social infrastructure present on the university campus and its relationship with the surroundings. These spaces should orient the development of dynamics related to the biophysical matrix, visual perception, and accessibility. Part of its ecological complexity derives from the intersection of several ecosystems such as mangroves, rivers, and hilltops. Additionally, its topographic position places it as a link between these ecosystems and the ocean downstream. The circuit of free space systems illustrates a green and blue infrastructure, addressing water dynamics processes, not just the logic of efficient drainage. It is essential to recognize these free spaces as areas of opportunity for intervention in the territory, promoting life quality of its inhabitants and sustaining new sociabilities. In this sense, it is crucial to consider these free spaces in urban planning and recognize their importance in the structuring of the city.

By highlighting the social infrastructures through the circuits our intention is not to limit the possibilities of interaction through design. This model offers an alternative method to visualize the thematic areas that make up the campus infrastructure. By emphasizing social infrastructure, we provide an alternative perspective on the campus organization. What is at the core is the possibility of overcoming the fragmented multidisciplinary model that rules university planning in the Brazilian public university system since Atcon, separating it from the city. Acknowledging these complex infrastructure systems that the university support subverts the disciplinary ruptures of the administrative structure and the campus segregation from its neighbors.

Conclusion

The social infrastructure is responsible for delivering care and preserving the "life-worlds" of individuals (Hall, 2020; Lathan & Layton, 2022). It encompasses a multitude of systems that are often ignored and undervalued, yet crucial to the proper functioning and sustainability of society. In the context of exploring the infrastructural space, it became evident that sociotechnical systems possess underlying political and material implications that are not always apparent upon initial observation. We can make an analogy with a library. It would be reductive to assume that the biggest potential of such a place is restrained to the dynamics to access the collection traditionally organized by corridors of knowledge areas. In an era where accessing collections is increasingly detached from physical libraries, these spaces are evolving to become hubs of diverse services. These services not only redefine the purpose of libraries but also have the potential to significantly enhance various facets of visitors' lives.

This study, thus, embarks on a comprehensive exploration of multifaceted approaches rooted in the domains of science and technology studies. These approaches provide valuable insights for scrutinizing social infrastructures as pivotal cornerstones within the intricate spatial tapestry of a university campus.

When campus maps are limited to displaying the primary activities of educational environments, simplified into academic buildings associated with specific disciplines, they may not accurately represent the connections of services provided by the university. However, diagrams considering the social infrastructures interconnected by the different departments may encourage society's participation in scientific work through transdisciplinary interaction. Many infrastructures appear more than once in the circuits, which allows for identifying interdisciplinary encounters and their flexibility and multiplicity of purposes, following Latham and Layton (2019). Understanding the social impacts of these often-undervalued infrastructures is crucial as they serve various purposes. Placing them at the forefront is significant for both the university and society's awareness. Furthermore, it creates meaningful bridges to connect the various worldviews separated by the disciplinary fields on campus, as well as with the outside community.

Infrastructure systems are essential to society, and their interdependence is an imperative aspect of their functionality. Even when these subsystems work well independently, their interruption or absence impacts the activities and services of the totality. The social potential of the UFSC campus and other infrastructures in the city is complex and may be difficult to grasp. However, it is critical to recognize their importance and prioritize their enhancement as a permanent objective of political forces. We believe this will contribute to the success of the university's values of being an inclusive and interdisciplinary institution, and that society can adapt actively to changing times based on community cohesion.

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Contact email: luis.henrique.pavan@posgrad.ufsc.br