

Article

University Hybrid Ecosystems: A Theory for Learning Based on the Interrelationships between Spaces with Contrasting Architectural Definitions

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Abstract: The rapid evolution of university education is accompanied by a multitude of very specific, but rarely interrelated, research. The importance of socialization, informal learning, virtuality, flexible furniture, and learning by doing are recurrent themes, but they are often analyzed in isolation. The great potential for understanding these concepts lies in the value of their gradients, thresholds, interstices, interconnections, and the multiple relationships between them. Interrelating the existing analyses defines the learning ecosystem where thresholds acquire didactic prominence. Since the beginning of this century, radical changes have been taking place in the way learning is understood and are accompanied by regulatory changes (e.g., the Bologna Plan), methodological shifts, and spatial changes. Teaching innovation and spatial innovation mutually enhance each other in the search for teaching quality. In this research work, the state of the art is organized and classified into five assumptions, each with a graphic analysis, so that different architectural styles, geographical locations, and periods are represented, all with didactic potentials. The result comprises five design criteria proposed to build the different gradients of each hybridization.

Keywords: hybrid learning spaces; learning spaces; higher education; learning environments; learning communities



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1. Introduction

As Figure 1 shows, the shadow of an oak tree has great didactic potential, and is a place that is conceptually opposed to the classroom: the paradigm of learning. The architectural definition of the intermediate situation between these opposites, i.e., their hybridization, is the objective of this research. There is an extensive state of the art on didactic spaces, initially focused on schools, but with a growing interest in higher education, particularly in universities.

The 1990s saw the launch of the Internet and the development of desktop computers. The development of new information technologies (hereinafter ICTs) since the establishment of the Internet in 1990 is one of the major drivers of change. This has led to a revolution in the way information is shared and accessed. The introduction of ICTs to teaching coincides with the signing of the Bologna Declaration in 1999, which promotes active and student-centered learning.

The change in teaching–learning strategies towards a more participative role of students and access to information, not only from the verbal exposition of the teacher, has led to teaching innovation and innovation in the physical space of universities. Bilandzic and

Foth [1] showed that learning communities are successful, in tune with modern society, which is increasingly pluralistic and connected.



Figure 1. First prize in the competition for the construction of the new CEU San Pablo Polytechnic School building in Madrid in the year 2022. Architect: Picado-deBlas. Photographer: Allberto Amores. Image courtesy of the author.

Research on how to improve the quality of learning has determined the importance of socialization, specifically interaction. As a result, the unidirectional focus (where students' attention is directed solely towards the teacher) has been changed into multidirectional engagement among many participants (students and teachers). The idea of socialization has been present in traditional universities in a physical form for centuries. However, in the mid-20th century, as classrooms became larger, the level of social interaction decreased within the classroom, creating spaces that promoted mass production, and the role of the student became more and more that of a scribe.

As a consequence of understanding that learning occurs through interaction, not necessarily through the presence of a teacher who transmits knowledge, the space (physical or virtual) outside traditional classrooms acquires didactic value. These spaces of non-formal learning have been defined as informal spaces. The interest lies in the "in-between space" [2].

This article delves into the spatial characteristics of didactic places in response to, among others, the statement: "A hybrid pedagogy fundamentally rethinks our conception of place. Hybridity is multidimensional: it is about the interweaving of formal forms and informal social structures of learning, the combination of physical and digital tools that mediate the individual's interaction with the world and society, and more" [3]. Trentin [4] defines hybrid learning spaces in their pedagogical, informal, planning, sociocultural, infrastructural, managerial, content, and professional dimensions. This research shares this same vocation to find a definition and ecosystem of hybridization.

The increasing use of ICTs and their rapid development are generating countless new forms of learning, becoming richer and more complex [5,6]. Online learning provides new possibilities to complement face-to-face classrooms [7].

The maximum exponent of the use of these technologies is the virtuality of teaching, i.e., the non-presential nature. There has been extensive discussion about the possibility of the disappearance of the physical space of the university as a place of learning, being

replaced by virtual space. Despite the claims in scientific publications regarding the importance of physical space, the ultimate demonstration of the need for face-to-face learning was given by the COVID-19 crisis. The confinement imposed by the COVID-19 pandemic turned teaching into an exclusively virtual undertaking. “We now have the opportunity to restructure and revitalize schools and education to look very different from the place where we all learned with rows and rows of classrooms, each with a teacher struggling valiantly to impart ‘knowledge’ to an increasingly uninterested audience” [8].

This article vindicates the proven necessity of face-to-face learning, in contrast to Sutton and Jorge [9], who claim that, as a consequence of the adaptation of teaching due to confinement, it was shown that the traditional method of teaching in higher education had to disappear immediately in favor of online game-based learning.

Leaving aside the human tragedy of the pandemic, the crisis led to an accelerated development of ICTs and, at the same time, bolstered the value of face-to-face learning by the acknowledgement that virtuality can add value to teaching methodologies. Nevertheless, the quality of teaching and the feeling of belonging can only be assured through the social contact in a physical setting. “The COVID-19 pandemic has heightened our awareness of how we learn and teach and expanded the meaning of ‘where’” [10].

The return to ‘the new normal’ involves introducing the evolutions developed in the crisis period (technology) and evolving systems that have become obsolete (physical space) due to changes in teaching methodologies, media or technologies, and society.

Higher education institutions today retain and perpetuate the once-valuable and relevant industrial model, which is now obsolete because of the divergence in the alignment between learning practice and the design of the traditional learning space.

The concept of hybridity has gained special relevance to respond to new learning patterns. Hilli [11] claims the need to explore the characteristics of Hybrid Learning Spaces, with hybridity being understood as an intermediate situation between opposites. There is a lot of literature, e.g., Kohls [12], about hybrid learning in contexts such as virtual and face-to-face; formal and informal; and individual and collective, but it is hard to find reflections on its impact on physical space or on composite hybridizations between several concepts.

Scott-Webber, an author with a long track of research on learning spaces, argues that hybrid spatial patterns can support a collaborative culture with participatory creativity [10], and opens the door to creating criteria for the design of physical spaces for this new teaching strategy. Bülow [13] also analyses hybrid spaces, but does not discuss their spatial implications.

Cook and Holley [14] define two dimensions of hybridity in learning spaces (“Hybrid Learning Spaces (HLS)”): the interweaving of formal and informal social structures in an activity system, and the combination of physical and digital tools that mediate the interaction of an individual with the world and the society.

This article develops this avenue of research on the hybridization of learning, i.e., the architectural context of the possible combinations of opposing situations, using the degree of social interaction as a system of relations. It is part, in turn, of a more extensive research developed in the PhD thesis: “University learning as social space. Didactic places for teaching activities and their different degrees of sociability. Architectural criteria for learning enhancers” [15].

2. Materials and Methods

Research on the spatial innovation of universities has been in full development with a large scientific production since the 2000s, being a current and universal topic nowadays. There is, therefore, a lot of research that tends to be attributed to a single line of investigation. However, there is a lack of research that seeks to relate all those issues that influence the quality of learning and the built space where it takes place.

To relate is to look for interactions between elements after identifying a common system of analysis. As Gourlay and Oliver [16] enunciated, instead of understanding the didactic space in quantitative terms, it should be considered as the place where certain social

practices take place, in a “simultaneous multiplicity of spaces”. Interrelation, interaction, communication, socialization, etc., are concepts that define the working method and the system of analysis of this research. The following opposites are extracted and defined from the analyzed bibliography:

- Individual—collective;
- Physical—virtual;
- Formal—informal;
- Academic—professional;
- Movable—immovable.

In the bibliography consulted, these situations are developed in isolation. In order to establish a relationship between them, the following methodology is used in each of the hybridizations:

- The state of the art;
- Analysis of their capacity to create interactions between learning actors;
- Graphic analyses (conceptual scheme in plan, section, and spatialization) of a university academic example.

It will then be possible to state that the university is an ecosystem of dualities, formed by habitats that offer different gradients of combined hybridization. As a result, the EHU—Hybrid University Ecosystem will be defined, and design criteria will be proposed for each of the above-mentioned opposites:

- Individual—collective: social matter;
- Physical—virtual: spatial matter;
- Formal—informal: matter of control;
- Academic—professional: professional matter;
- Movable—immovable: movable matter.

The bibliographic review of the relationship between the quality of learning and the physical space in the university determines that there is a large but unconnected scientific production. The main lines of research are detailed in the following sections.

2.1. Defining the Paradigm Shift from Passive and Individual Learning to Active and Social Learning; Individual–Collective Duality

A change in the teaching and learning paradigm is underway, moving from a transmission paradigm to a knowledge construction paradigm based on active learning, through “an individual’s ability to assimilate new knowledge into his or her own unique understanding through activity” [17]. Learning, at present, is therefore active, and this activity can be developed individually or through interaction, as the social environment has been shown to have a strong influence on learning.

Crook and Mitchell [18] stated that the current learning space design suggests four lines of social engagement: focused collaboration, intermittent exchange, chance encounter, and social environment.

An example of an individual–collective hybrid space is “Rudolph Hall” at the Yale School of Architecture in the United States (Figure 2). Despite being a space designed in 1963, the learning environment it contains responds to the current needs to offer different states of individualization and socialization. It is structured with a perimeter space of individual ‘student-owned’ workstations from which an atrium of exhibition, group, and display activities is visible. It is an example of a learning environment that encourages the contagion of activity through visual contact and ease of switching from one activity to another, due to the permeability of the space.

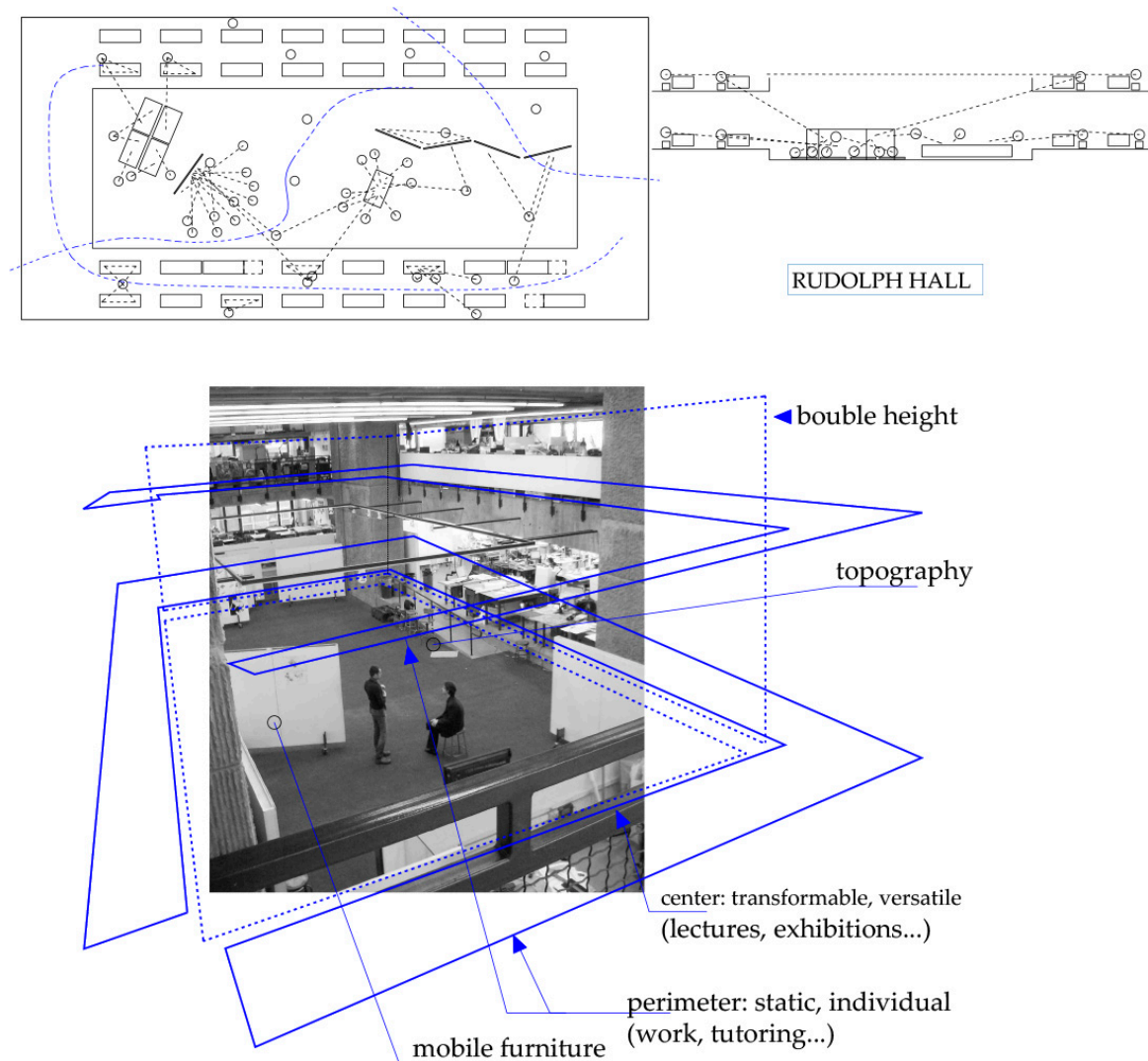


Figure 2. Analysis of the individual-collective duality in Paul Rudolph's Rudolph Hall. Own elaboration.

2.2. Establishing the Repercussions of the Introduction of ICTs in Teaching; Duality of the Physical and the Virtual

The introduction of the World Wide Web in 1993 changed the way we access information and, consequently, the learning experience. Adapting the use of ICTs as a complement to learning allows it to take place anywhere and at any time.

The technologies used in learning are altering the experiences and aspirations of students, and the use of technology in itself does not guarantee effective teaching or learning, but it can expand the scope and flexibility of what the institution offers. The development of virtual teaching and learning environments raises questions about the relationship between the physical environment and the student's learning experience [5].

New technologies have the capacity to replace the didactic expository activity, but it is more interesting to consider how they can participate in the transmission of information during a face-to-face activity, hence favoring the interaction among the actors and, finally, creating multiple foci of attention (teacher, students, and information).

A technologically rich space, and therefore an example of a physical-virtual hybrid space, is "Evans Hall" (Figure 3) at Yale, USA. Foster and Partners designed a series of drums with different spatial configurations, in order to offer a variety of opportunities for formal teaching activities using ICT as a means of transmitting information.

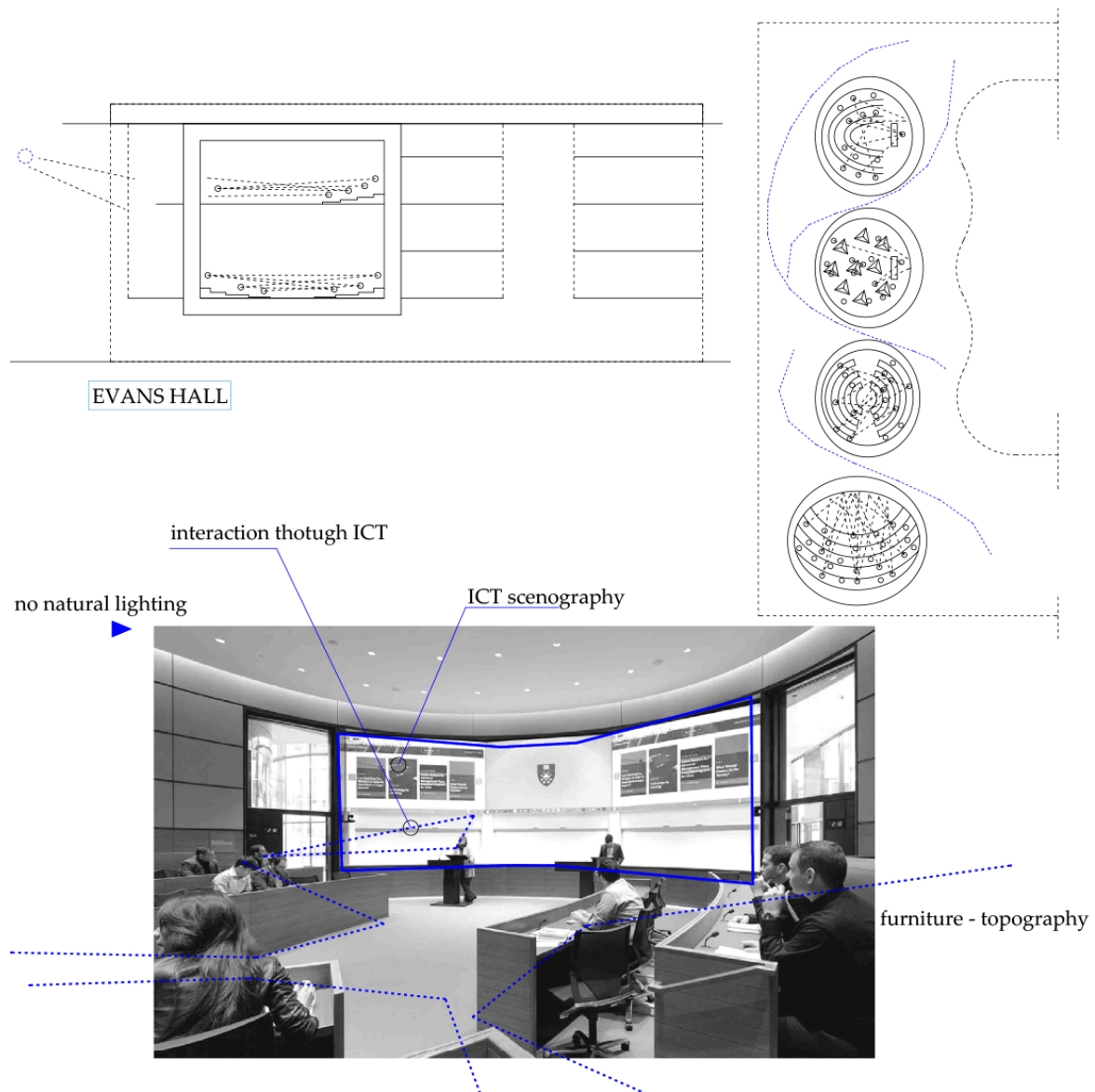


Figure 3. Analysis of the physical–virtual duality in Evans Hall by Foster and Partners. Own elaboration.

2.3. Developing the Concept of Learner-Centered Focus; Discussing the Duality of Teacher Presence or Absence in Localized Activities at the University

Formal learning spaces are places where learning is provided while informal learning spaces include the spectrum of places outside the classroom where knowledge and studies are shared, ranging from libraries and computer centers to cafeterias, lounges, or residence halls, among others [6].

Much of the work currently underway at universities involves the creation of informal learning spaces intended to make the campus a more attractive place to spend time, rather than being designed in ways that are tightly integrated with defined curricular purposes [19].

The McCormick Building at IIT Chicago (Figure 4) in the United States is a Rem Koolhaas project intended for informal learning, generated by the flows of students between formal spaces at that point on campus, exemplifying the formal–informal hybrid space. It creates spaces for social interaction and individual or group work by inhabiting, widening, and slowing down the circulation space. This building is an inhabited interstitial space, a container of didactic activity where the teacher becomes a visitor of the space.

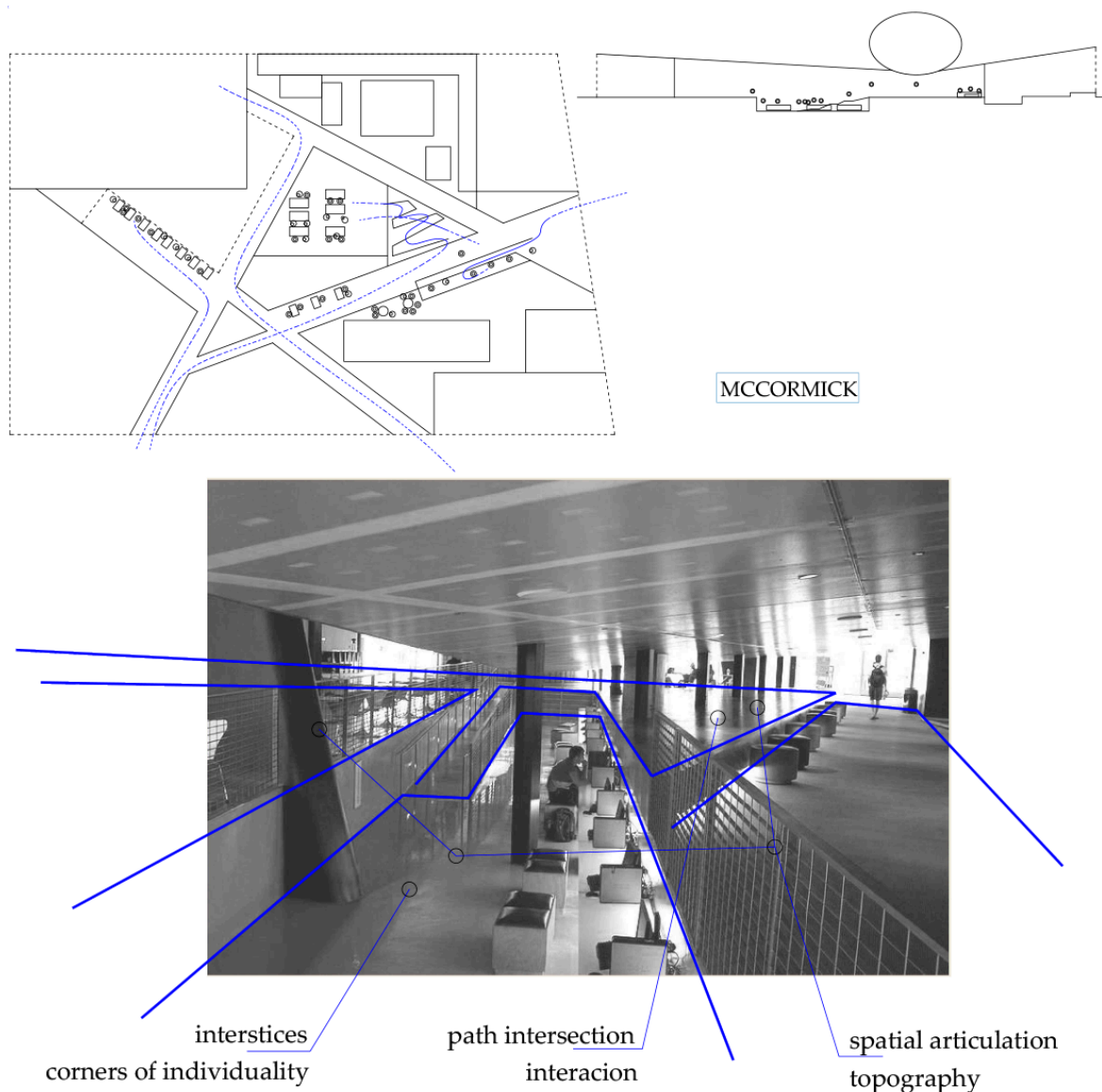


Figure 4. Analysis of the formal–informal duality in Koolhaas’ McCormick. Own elaboration.

2.4. Innovating the Design of Furniture, Taking into Account New Activities and Groupings of Students and Teachers; Duality between Architectural Furniture and Mobile Furniture

In the 1970s [20], Unzurrunzaga already proposed alternatives to the traditional classroom layout by rearranging the furniture and even proposing new types of tables to facilitate different group compositions (half hexagons). Scott-Webber [21] also suggested furniture variables for traditional containers, and Cuenca Márquez [22] listed some of the most common organizations for current pedagogies in his thesis. In addition, Yeoman and Willson [23] proposed a furniture–real estate (“micro”) scale, a U-shaped table for fluid interaction between students, the teacher, and technology.

Sometimes, the furniture has great didactic potential, even when it is not understood as a mobile element, but as part of the architectural project and the topography of the space. The large space of Harvard University’s “Gund Hall” (Figure 5) is an expressive container of a topography of grouping individual workstations. In addition to the architectural quality, the building–classroom and the furnishings form a harmonious whole, allowing mobility and customization of the vertical elements, where students control the degree of isolation and exposure of information. It is an example of an hybrid space–fixed–mobile setting.

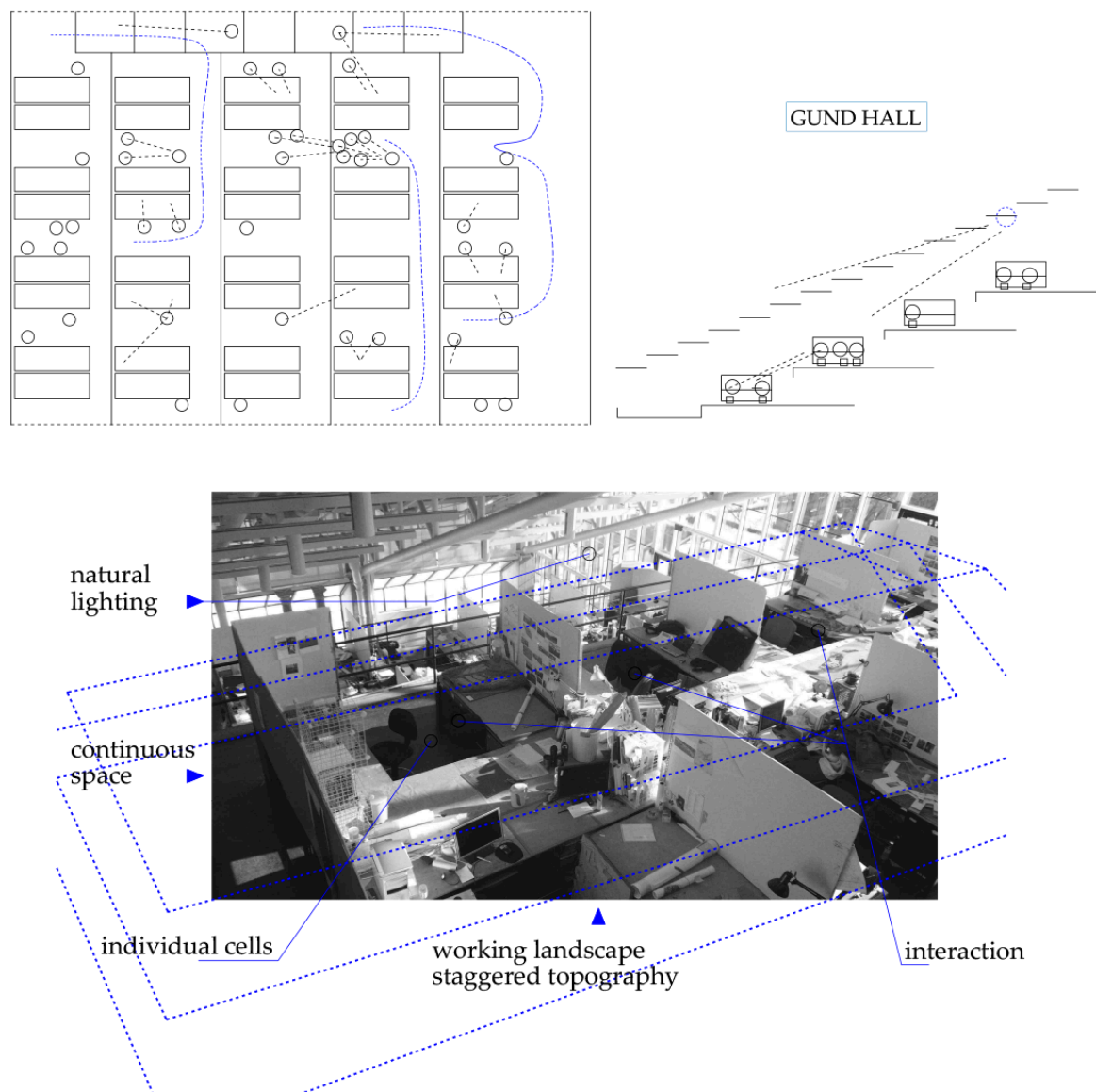


Figure 5. Analysis of the furniture–real estate duality in John Adrews' Gund Hall. Own elaboration.

2.5. Fostering the University's Connections with Its Social and Urban Context; Duality between Academic Training and Professional Practice

The university has synergies with the city, and if these are intense and of high quality, we are talking about a smart city. The flows of students, professors, and professionals between the city and the university enrich them. The university must provide the city with specific places that favor interaction between the academic community and the local community, through the promotion of R+D+i, cultural spaces, and sports facilities.

According to Heijer [24] the campus has become a knowledge market. Dugdale [6] claimed that campuses should plan networks of places for interdisciplinary teams to collaborate.

Campuses must have physical spaces where academic and professional realities interact. In Kanagawa, Tokyo (Figure 6), Ishigami projected a physically and conceptually permeable building where he creates a forest of workshops, of hybrid didactic–professional spaces.

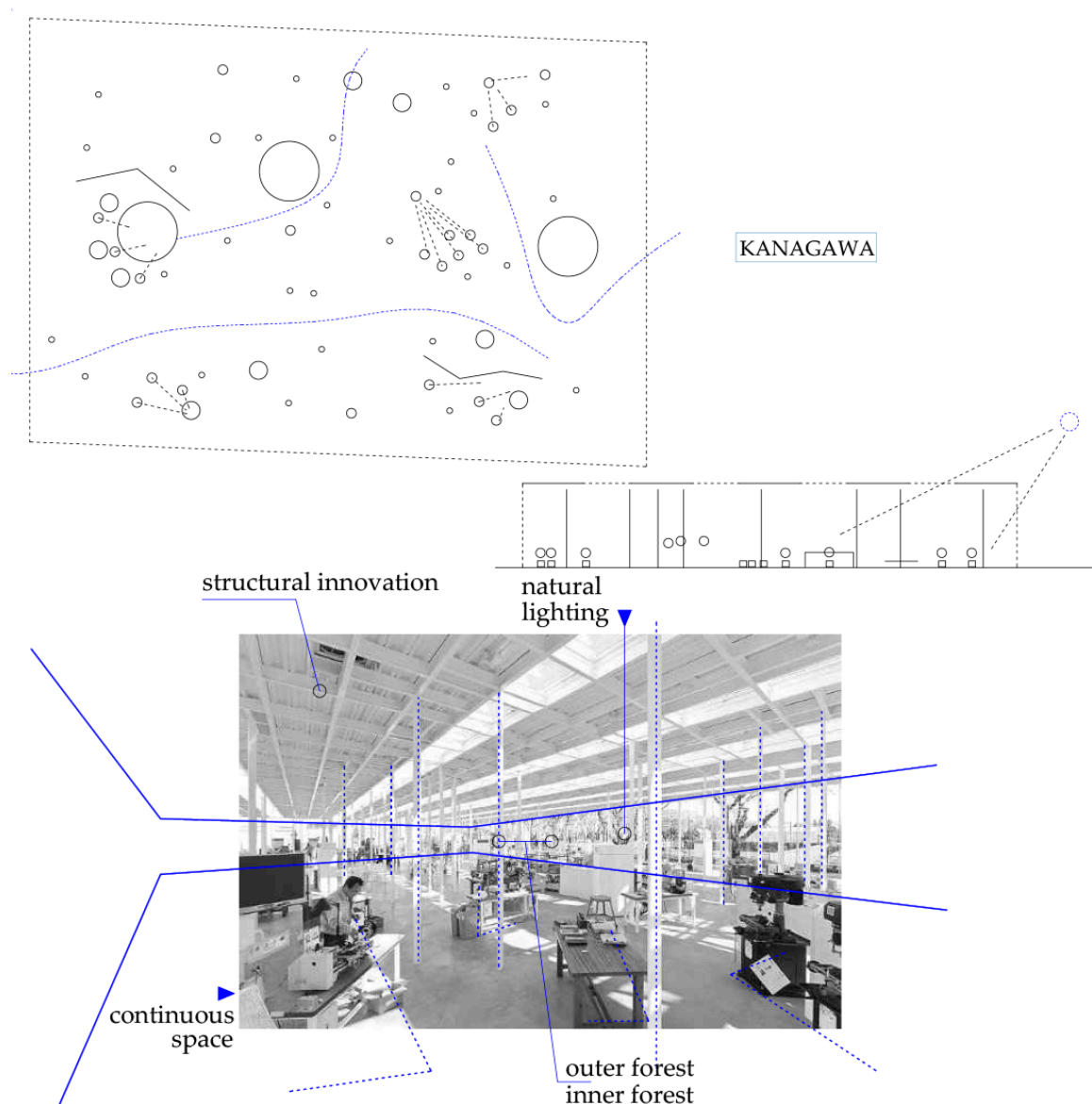


Figure 6. Analysis of the academic-professional duality in Kanagawa de Ishigami. Own elaboration.

3. Results

3.1. An Ecosystem of Dualities

Interaction is socialization, and the metaphor of the “Learning Ecosystem” is used [25] to explain the system of elements, their edges, and their relationships. It is a holistic methodology that aims to explain the system of networks that relate, connect, and allow the interaction of all the predominant themes in the learning environment. The concept that articulates and relates all of them is the same as that which defines interrelation, i.e., socialization.

All theoretical scientific reflections, analyzed from the point of view of the sociability of learning spaces, are related to constructed spaces.

- Socialization gradients are directly related to and dependent on presentality–virtuality;
- Socialization gradients will be conditioned by the teacher’s presence and the teaching methodology;
- Socialization gradients are groupings that are materialized in the organization of the furniture;
- Socialization gradients bring non-academic actors into the learning processes of the university.

In order to analyze a system of relationships between the different elements of a university, it is necessary to identify who participates in the learning process, where they develop their activity, how they access the space, and how they move through it. The “learning ecosystem” is defined by:

- Learning actors: teachers, students, non-teaching staff, technology, architecture;
- Habitats: containers of the activity, environmental scenarios;
- Membranes: visual filters, sound filters, connecting openings;
- Interstices: containers of flows, containers of activity.

For Ellis and Goodyear [7] campus learning involves a mixture of physical and digital, as well as activities distributed in physical space and across the Internet, by means of a combination of university-provided and personal tools and resources. Souter [26] spoke of hybrid spaces as reconfigurable areas and furniture to facilitate either individual or group work, as well as socialization, with multiple lines of sight to facilitate learner interaction. “Formal’ and ‘informal’ learning should be seen as a continuum of “learning” rather than contrasting modes” [5]. The potential of the hybrid concept that combines two opposites has typically been analyzed by focusing on only one of the above lines of research.

The results of this research comprise a network of interactions between the different gradients, thresholds, or hybridizations of learning environments. Consequently, the EHU–Hybrid University Ecosystem is defined, and design criteria are proposed for each of the above-mentioned opposites:

- Individual—collective: social matter;
- Physical—virtual: spatial matter;
- Formal—informal: matter of control;
- Academic—professional: professional matter;
- Movable—immovable: movable matter.

3.1.1. Spatial Matter

The hybrid space (Figure 7) integrates physical space and technology in such a way that the physical space is the container of the transmitter and/or receiver and the scenario of the transmitter, and the technology is the transmitting actor of the information.

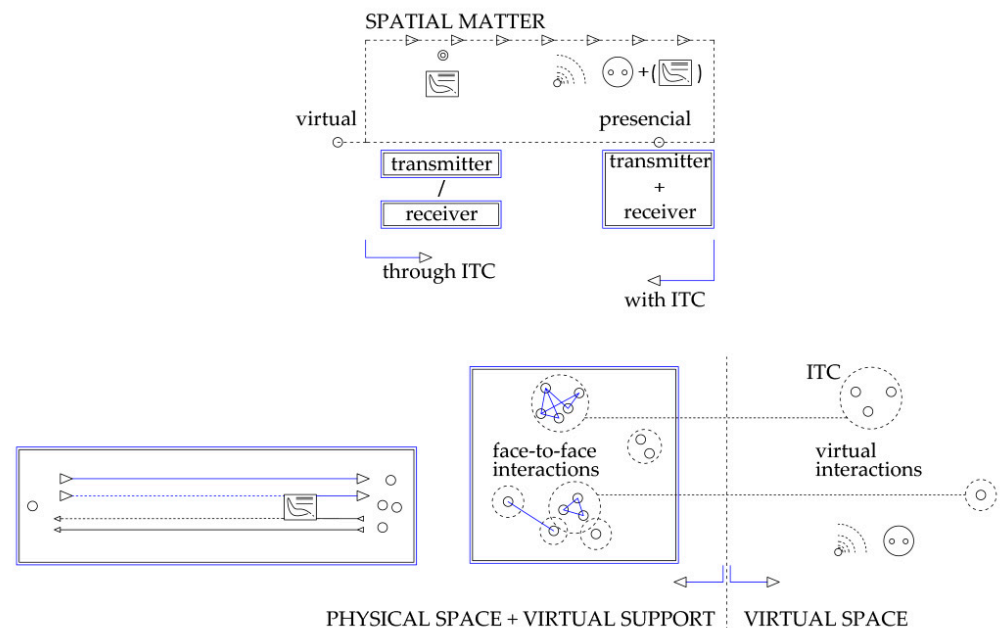


Figure 7. Spatial matter. Own elaboration.

ICT-supported spaces have a didactic vocation that is not linked to the use of ICTs. Nowadays, it is crucial that all university spaces offer the possibility of accessing and using technologies. Also, network access for charging portable devices and wireless connection are essential in every space, regardless of the type of didactic activity being developed. It has as many foci and directions as number of students.

ICT learning spaces are designed according to the needs of use of a precise technology. The focus is 'directed to' and 'part of' the technological element, materialized on a screen. A screen encompasses any technology for transmitting information, such as a projector or a whiteboard. It is a medium emitted by a student or teacher through the screen to a series of attendees, who receive the information either face-to-face or virtually. These spaces can be:

- **Receivers:** The sender of the information is not present and, in this space, one or more receivers access the information. These are spaces designed for a predominantly passive attitude of the receiver.
- **Emitters:** The receiver of the information is not present. It must be a space equipped with broadcasting technologies: cameras, microphones and specific lighting. The projected image of the architectural environment that can be visible on the receiver's screen is a scenography that must be considered. This scenography, depending on the message to be transmitted, can be neutral, digital, environmental or natural. These are spaces designed for a predominantly active attitude of the sender.
- **Containers:** All participants in the transmission of information are present. The information is transmitted through the screen with communicative support from the sender. They can be containers with a balanced participation vocation or giving prominence to a few senders.
- **Satellites:** Several receiver spaces associated with a single transmitter or multiple transmitters/receivers interacting through technology can be combined. The receivers can be one or several participants.

3.1.2. Social Matter

The hybrid social learning space (Figure 8) aims to seek the student's motivation through the contagion of the learning environment generated by the presence of other students in equivalent learning activities.

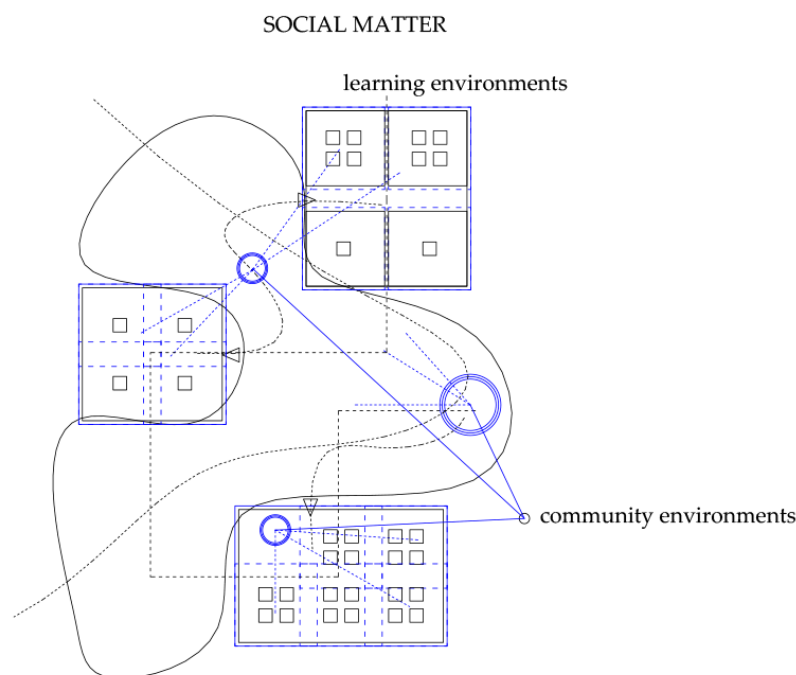


Figure 8. Social matter. Own elaboration.

The physical space intended for learning must take into consideration its social character. It must strike a balance between quiet and isolation, as well as seeing and being seen. Different balances to cater for different preferences. The physical space for group learning is a workplace. Therefore, the conditions must be equal to those in the individual work.

It is imperative to design it with the aim of enhancing the sense of belonging to the location, as these are spaces that are chosen by the student to develop their activities. They must offer the most suitable conditions for the student.

- Furniture: Different options to meet different needs, from individual tables to large tables to be shared for individual work. Intended for reading/studying, writing/drawing, or computer work. Furniture for group learning should ensure interaction (round tables).
- Scale and density: as the sociability of the activity increases, so do the scale and density.
- Storage: The proximity of a place to store personal belongings. Individual booths may be associated with permanent personal storage, while more communal booths should have a space to deposit material during the activity.
- Distraction: it is important to differentiate between spaces that protect from outside distraction from spaces that protect the outside from distraction generated inside.

Community environments are rest spaces, constituted of comfortable furniture, interaction furniture (round tables, either high or low, with several chairs), and service machines (food and/or stationery). These social nodes encourage rest from intellectual activity thanks to the services provided, but also because the social encounters boost rest.

The social encounters generated here may also have a vocation of possible academic contact with subsequent benefits, depending on their location (Figure 7).

- Indoor: encounters take place between people who are engaged in the same activity;
- Threshold: the social node can be used to connect people performing activities in adjacent spaces;
- Interstice: communication spaces become interstices of passage and rest thanks to the location of these social nodes.

3.1.3. Matter of Control

The hybrid structured space (Figure 9) would include all those places intended for non-casual learning that may or may not have the presence of the teacher, but that are controlled by the learner.

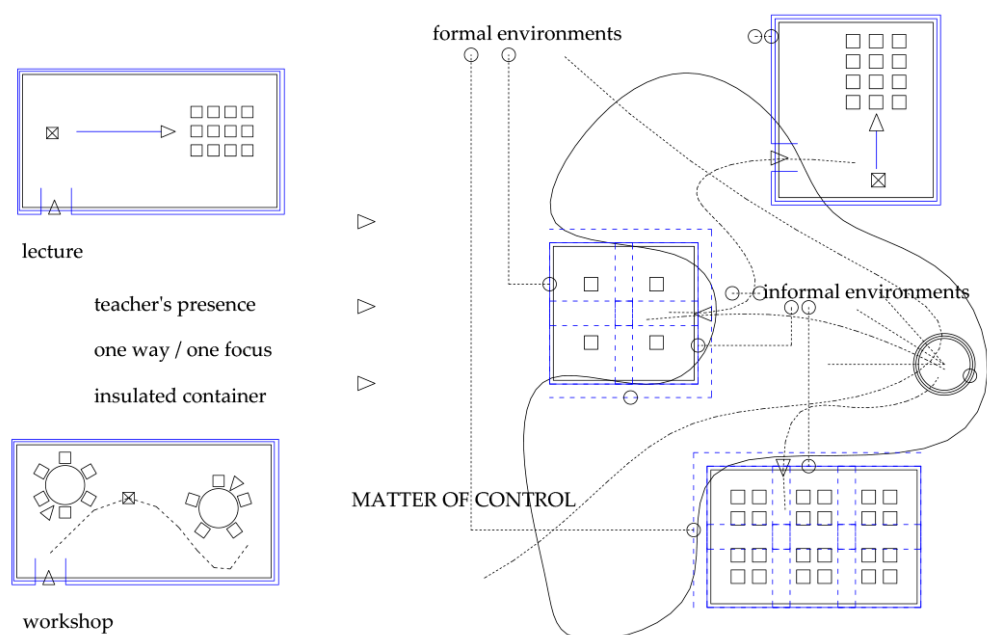


Figure 9. Matter of control. Own elaboration.

The use of structured environments responds to a schedule for a teacher-directed activity. The teaching methodology used will determine the level of interaction between the teacher and the students, and among the students themselves. They are expository methodologies (practically unidirectional) or seminar methodologies, where the teacher circulates around the tables (greater interaction).

The use of unstructured environments corresponds to the rest of the available time with no teacher-directed activities. They must be close to the structured environments so that they can be used during the time between controlled lectures.

- Casual encounters: Staying longer at the university can allow contact with other members of the academic community, with positive learning outcomes. The spatial resource for this to occur is the intentional design of service and recreational spaces (photocopiers, food machines) associated with small breakout spaces. Intentionally dispersed.
- Spaces where the student develops his activity (individually or in groups) and can receive visits from the teacher for tutorials. It allows the student to attend tutorials with classmates as well. Access to the teacher is also facilitated, because it is the teacher who goes to the place of the pupil and not the other way round.
- Universities should provide spaces that, although not essential from an organizational point of view, are essential as an academic offer. These places could be located in the students' own residences, in libraries, or in external cafeterias, but it is relevant that universities offer them, as they will be designed with the best conditions for academic activity.
- Student-only learning: Spaces that allow for varying degrees of association between the individual and groups of different sizes. The space is used to carry out an academic activity where only students are involved.
- Spaces that are chosen by the student to carry out a learning activity controlled by the teacher in the virtual space.

These circumstances allow universities to have these spaces and to offer them to the outside world. Thus, a student could use these spaces near his residence when he does not have structured face-to-face activities to avoid traveling to the university itself, which may be a long distance. This will also favor contact and interaction with a much broader academic community. It also promotes academic sustainability derived from sharing spaces.

3.1.4. Mobile Matter

The hybrid furniture space is one that offers both specific situations for very specific uses, enabling the adaptability of the scenario created, as well as free containers for the realization of different modular furniture organizations that allow multiple configurations (Figure 10).

When the furniture is fixed, architecture and furniture are designed together, since a fixed piece of furniture becomes an architectural element that permanently configures the space. Even if the furniture is immovable architecture, it should offer the possibility of customizing its use.

- Individual permanent workstations are, themselves, motivational decorations for the individual to whom they belong;
- The individual ICT learning stations are, themselves, the scenario transmitted virtually. The personalization of this scenario is also a message that is conveyed;
- Group stations for one-time use should allow for minimal movement to encourage interaction, e.g., swivel chairs;
- Social booths located in the circulations will have topography elements that generate meeting corners (to generate comfort and restful atmosphere by reducing the scale of the space). These corners may have some mobile furniture to adapt to each moment, but their range of movement will be determined by the architectural furniture;

- Desks: in some universities, students are given their own desks so they can go and do as they please in their own work area.

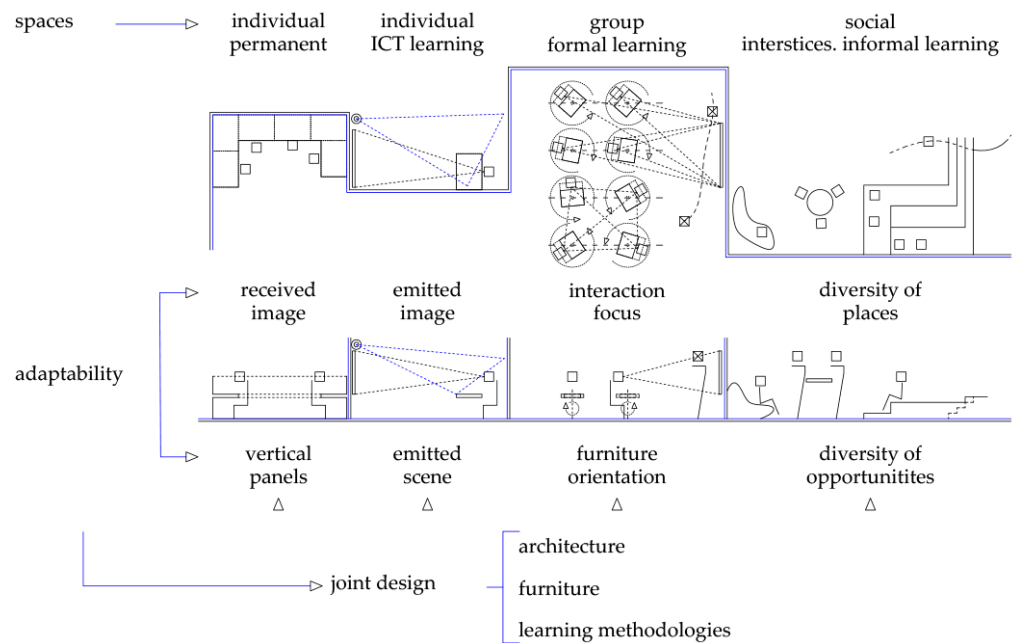


Figure 10. Mobile matter. Own elaboration.

When the furniture is mobile, the structured activities are located in a limited space (and within the teacher's reach), and must offer learning environments in all degrees of interaction between the teacher and the students and among the students themselves, according to the chosen methodology.

The didactic activities linked to a variety of learning environments require that the architectural container is not limiting or determining the content. There will be open plan spaces of different scales whose learning environment will be determined mainly by the organization of the furniture.

In addition to an "empty" container, it is essential to have furniture designed to allow multiple configurations that guarantee a great variability of compositions. An active participation of the student in the organization of the furniture creates a sense of belonging to the activity and, thus, to the learning community.

3.1.5. Professional Matter

A hybrid academic–professional space is one that blurs the boundaries between study and work in a physical place that is a meeting and exchange point (Figure 11).

In borrowed environments, the traditional professional practice format allows for total immersion. It is an extramural experience, but allows for some exchange between university and urban environment.

The simulated environments move on a gradient of practical reality and academic experimentation. It is also a gradient from a physical point of view, as it inhabits the edge and it is the threshold of transition between the university and its urban context.

- Simulated practices. This is a strict academic environment in which professional life is experienced through a real architectural scenario, in which all learning actors belong to the academic community.
- Early career. This is a professional environment for recent or soon-to-be graduates, where they are engaged in productive activity. Untenured students (academic world), recently graduated students (professional world), teachers (academic world), and experienced professionals (professional world) coexist in the same physical space. In

this way, a multitude of enriching interactions are developed, both for the university and for its urban environment. They are favorable environments for R+D+i.

- Loan to the city. The infrastructure needed on the university campus to train future professionals are very useful for their urban context, avoiding duplication.

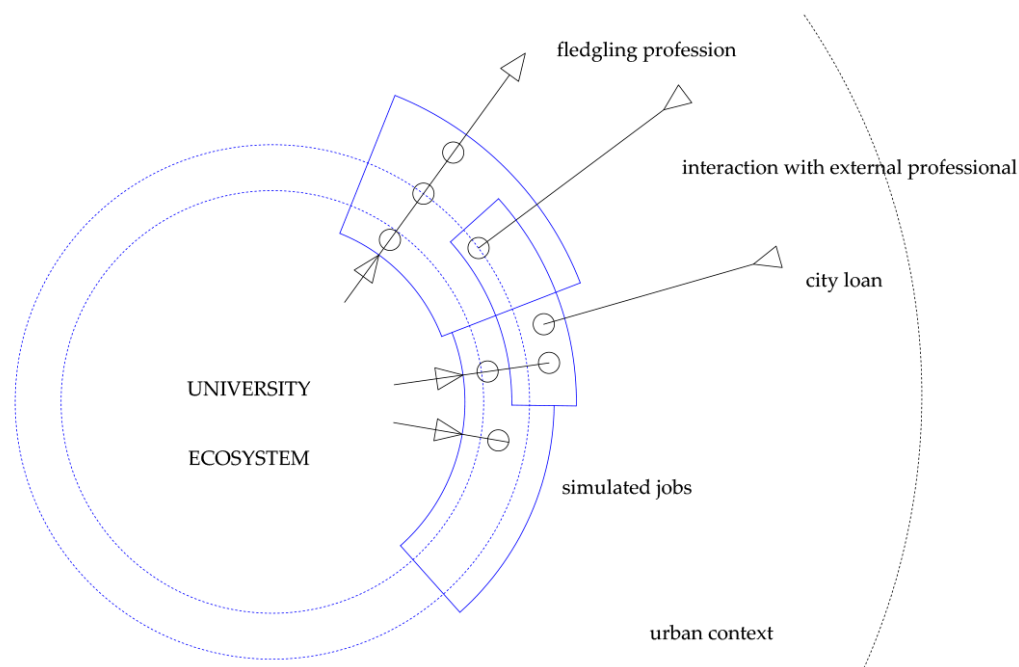


Figure 11. Professional matter. Own elaboration.

These threshold environments are crucial for any type of professional space, as they support academic–professional interactions, social interactions, and the mutual and symbiotic of spaces and materials. The classification of professional spaces according to the simulated space they represent allows for new threshold spaces:

- Office professions. It can be a co-working and business incubator;
- Health professions. Medical, veterinary, dental, rehabilitation, etc. facilities. This type of professional space on the academic campus already exists, but it is not conceived as a physical as well as a training threshold;
- Laboratory professions. The unification of academic and professional laboratories has a great potential for development and innovation;
- Professions associated with factories. They can have associated prototyping and innovation workshops at the university;
- Mobile professions. The threshold understood as a meeting and resting point but, above all, as a place for interaction with other professionals and students.

4. Discussion

All subjects constitute the perspective from which the system is defined. Nonetheless, the design potential of spaces arises from the amalgamation of criteria to provide as many learning environments as necessary.

For instance, a space hosting an exhibition through technology (spatial matter) must have foreseen levels of interaction between the actors of the receiving habitat (social matter), which will be translated into a concrete or customizable arrangement of the furniture (mobile matter), depending on the participation of a teacher (control matter) or a professional (simulated matter).

It is important to comprehend and study the university environment as an ecosystem where the networks of interconnection between physical spaces and individuals through

the activities that take place, define the learning environment. The design of the university architecture should be approached as a diagram of flows, relationships, and activities.

Each of the elements analyzed influences the others from the point of view of sociability. The architecture is the container where learning activities take place, and its spatial characteristics are determined by the gradients of social interaction, participation of technologies, grouping of furniture, teacher participation, and treatment of its edges and thresholds. Hybridization between the opposites of each of these characteristics has a didactic potential of much higher quality than the opposites. Hybridization has the virtue of flexibility and adaptability, features mandatory for didactic activities and, therefore, for the spaces where they take place. If the built space is flexible, adaptable, hybrid, innovative, and interconnected, the activities developed in it and the attitude sought in the student will also be.

An ecosystem is a living system (in continuous evolution), comprised of physical spaces (habitats) that relate to each other by exchanging people and knowledge. The quality of the system lies in the thresholds, interstices, and exchange flows. The system functions insofar as it generates, constructs, and transmits the knowledge generated.

The transversal analysis of the sociability of the diverse subjects involved in learning has yielded a series of suggestions for the spatial and environmental organization of the university, which are adaptable to the continuous evolution of the university ecosystem. The importance of holistic research, not focused on a single line of research, is noted in order to provide useful resources for the design of innovative teaching spaces.

As a conclusion of this research, it can be inferred that a hybrid learning space is that which flows in the interstice, in the constructed threshold of sociability gradients. The objective of the establishment of spaces with the design materials proposed in this article is that they encourage and favor the creation, enrichment, and transmission of knowledge.

This article opens up the field for the development of each of the subjects and how they generate a catalog of design criteria, both architectural and teaching methodologies, when mutually combined. It proposes an in-depth study of the relationships between the different hybridizations, with the aim of specifying design proposals to be used by architects and university managers, who are responsible for the creation of the future physical spaces of universities.

5. Conclusions

The evolution of teaching in recent years has shown a great potential in the use of new technologies (ICTs), informal learning, the virtue of flexible spaces, and learning in a real professional environment. This article highlights the value of intermediate scenarios, where face-to-face learning is complemented by ICTs, the boundaries between formal and informal learning are blurred, architecture and furniture are a joint project, and the transition between academic and professional activity becomes an architectural edge. In the university ecosystem, these intermediate scenarios, or hybridizations between opposing didactic concepts, are translated here into architectural project resources. In this way, teaching innovation is evolving in parallel with the spatial innovation of the didactic places, in order to achieve the highest quality of learning.

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