

2024

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MELO DIAS**

**Designing physical learning spaces for effective
teaching & learning**

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Dissertação apresentada ao IADE - Faculdade de Design, Tecnologia e Comunicação da Universidade Europeia, para cumprimento dos requisitos necessários à obtenção do grau de Mestre em Gestão do Design realizada sob a orientação científica da Doutora Ana Sofia Coutinho de Almeida Dinis Esteves, professora auxiliar convidada da IADE-EU.

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Keywords

Learning ; Learning Spaces; Design; physical learning spaces; Learning Environment; learning process; functional efficiency of classrooms; Informal learning spaces; community space;

Abstract

The study of learning spaces has mostly been conducted from a financial and quantitative perspective, primarily to support planning and management. However, these studies fail to link essential features that learning environments should have to increase the effectiveness and efficiency of learning experiences, leading to fruitful learning activities, enjoyable learning experiences, and beneficial learning outcomes. Essentially, this research is conducted through interviews and online questionnaires, applied in two higher education institutions in Lisbon, to understand whether these institutions apply established criteria for designing physical learning spaces in order to achieve functional efficiency of classrooms thus meeting the needs of teachers and students in achieving effective teaching and learning goals. The study concluded that, despite some challenges, managers in these institutions are aware of, and to a reasonable extent apply, criteria for designing physical learning spaces that achieve functional efficiency in classrooms. The study confirmed that these institutions have been striving for the satisfaction of psychological, physiological, and sociological determinants at their physical learning spaces as well as meeting some of the conditions that enable informal learning. The classroom facilities also enable teachers to achieve some of the teaching and learning goals, such as availability of technologies to create and share knowledge, the ability of teachers to switch quickly between different types of instruction, such as lectures, projects, and debates.

Palavras-chave

Aprendizagem; espaços de aprendizagem; conceção; espaços físicos de aprendizagem; ambiente de aprendizagem; processo de aprendizagem; eficiência funcional das salas de aula; espaços i de aprendizagem; espaço comunitário;

Resumo

O estudo dos espaços de aprendizagem tem sido realizado, na sua maioria, numa perspetiva financeira e quantitativa, principalmente para apoiar o planeamento e a gestão. No entanto, estes estudos não relacionam as características essenciais que os ambientes de aprendizagem devem ter para aumentar a eficácia e a eficiência das experiências de aprendizagem, conduzindo a atividades de aprendizagem frutíferas, experiências de aprendizagem agradáveis e resultados de aprendizagem benéficos. Essencialmente, esta investigação é conduzida através de entrevistas e questionários online, aplicados em duas instituições de ensino superior em Lisboa, para compreender se estas instituições aplicam critérios estabelecidos para a conceção de espaços físicos de aprendizagem, a fim de alcançar a eficiência funcional das salas de aula, satisfazendo assim as necessidades de professores e alunos na consecução de objetivos de ensino e aprendizagem eficazes. O estudo concluiu que, apesar de alguns desafios, os gestores destas instituições conhecem e aplicam, de forma razoável, critérios para a conceção de espaços físicos de aprendizagem que permitam alcançar a eficiência funcional das salas de aula. O estudo confirmou que estas instituições têm-se esforçado por satisfazer os determinantes psicológicos, fisiológicos e sociológicos nos seus espaços físicos de aprendizagem, bem como por satisfazer algumas das condições que permitem a aprendizagem informal. As instalações das salas de aula também permitem que os professores atinjam alguns dos objetivos de ensino e aprendizagem, tais como a disponibilidade de tecnologias para criar e partilhar conhecimentos, a capacidade de os professores alternarem rapidamente entre diferentes tipos de instrução, tais como palestras, projetos e debates.

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1. Introduction

Strange & Banning (2001, as cited in Ellis & Goodyear, 2016) state that the use of space in higher education is an under-researched and under-theorized topic, despite the fact that many billions of dollars are spent every year on building and maintenance and that buildings have long played significant practical, emotional and symbolic roles in university life. Associated with the current poor (in quantity) research in this area, this lack of research has resulted in a serious gap in conceptualizations of university space, where one viewpoint is purely financial and quantitative and primarily aims to support planning and management. In contrast, the opposing viewpoint, which is not always taken into consideration, misses the opportunity to connect important characteristics of specific learning environments to successful learning activities, enjoyable learning experiences, and beneficial learning outcomes. Such links between environment and education can be both complex and potent (Strange & Banning, 2001, as cited in Ellis & Goodyear, 2016). This research aims to focus on the second viewpoint, which is to better understand the specific characteristics that learning environments should have in order to increase the efficacy and efficiency of learning experiences.

At this point, it would be pointless to suggest a single, all-encompassing model of learning spaces. In fact, this might never be conceivable. A model's usefulness is not about its accuracy, but what makes it valuable. No single model is likely to meet all contemporary needs due to the wide differences in the working methods of the key stakeholders—students, teachers, architects, managers of the campus infrastructure, etc. However, there is a strong case to be made for why everyone who works at a university should be concerned with the creation, management, and user experience of learning spaces. This is due to the fact that it is a shared responsibility which may be beneficial to all participants. The pursuit of unifying models can then go forward with the development of more collaborative, self-managing, and participatory systems. Hence, this process of conceptualization, research, and management is made more challenging while also becoming more urgent due to five main trends that are becoming consolidated in contemporary higher education (Ellis & Goodyear, 2016):

1. The student body is diversifying across several nations, reflecting a wider range of expectations and demands.

2. In a similar manner, when graduate's attributes expectations are highly increasing, academic success per se, is no longer a sole desirable result. Universities are being "forced" to provide a wider variety of educational experiences to assist students in becoming effective workers and engaged citizens.
3. Working with knowledge in new ways is now possible thanks to the usage of new digital technologies. Students are using digital technology to find and create knowledge that is important to them, despite the differences in their learning styles and levels of digital literacy. Additionally, they are beginning to anticipate broader, occasionally universal access to educational resources.
4. Physical and virtual "boundaries" are becoming less distinct and more permeable. This enables and encourages the redistribution of study activities in both location and time, with many students requesting more flexibility to fit studying around other responsibilities such as working and taking care of others.
5. This flexibility comes with risks of fragmentation when learning experiences are dispersed across short periods of time, many locations, a variety of media and devices, and interactions with various social groups. To help students (re)connect what they are learning, such as concepts to ideas, principles to issues, theory to practice, learning to life, etc., educators must therefore encourage "connected learning."

In other words, if universities want to manage space to support learning, then they must find ways to conceptualize spaces that guarantee there may be significant linkages between financial and higher education institutions (HEI) decision-level and the main activities of learning and teaching. Additionally, to avoid unacceptably high levels of volatility, uncertainty, and risk brought on by technological advancement and its related shifts in study methods and expectations, these links must be strong. Knowing how to manage the physical estate without damaging educational processes, when use is intensifying, costs are rising, and buildings are crumbling, needs robust methods for linking attributes of the physical space to pedagogy and learning outcomes. Currently, research struggles to offer such foundations for practice.

1.1. Problem Definition

As we go through the state of the art, we can understand more deeply the concept of learning, as discussed by modern and past researchers from relevant disciplines, that is, pedagogy and

psychology, and although there are different arguments among them, we can see consensus about the critical elements involved in the learning process, which are: Acquisition of new information, experience and changes in behavior.

Additionally, the state of the art has also led us to realize that the design of physical spaces can influence the quality of learning, especially in HEI (which was our specific scope of study). We realize, however, that there will not be a one-size-fits-all, especially due to inequalities of varying nature. Nevertheless, as we also learned in the state of the art, we can use established criteria to evaluate the functional efficiency of learning spaces on how they can accommodate the teacher and student needs to meet effective teaching and learning goals.

1.2. Research object and objectives.

As we have been learning along the way, scientists argue that it is critical that learning environments foster a sense of community, collaboration among learners, and social interaction. It is also hoped that, in addition to meeting basic operational and pedagogical needs, the design of learning spaces will produce learning environments that respond more adequately to the challenges of today and the future by producing more flexible learning spaces (to allow for multifunctionality) that enable active learning and that are prepared to respond effectively to the technological demands of modern students and instructors in terms of accessing, producing, and sharing knowledge. Thus, we conducted a case study to evaluate the practical application of these principles and to get an idea of their results in terms of the motivation and behavior of students and teachers.

1.3. Document Structure

This paper is structured in 4 chapters, which are also split into several sub-chapters:

1. Introduction.
2. Literature Review.
3. Methodology.
4. Analysis and Discussion of Results.

In this chapter, we introduce the topic of space use in higher education and the perspectives of the research field in this area. We also present the problem definition and the research objectives. Next, we present the literature by exploring the concept of learning, the principles that support a well-designed learning environment, and the future of learning spaces. The third chapter is about

the methodology, where we present the research question, the research strategy, and the hypotheses, and then we conclude with the analysis and discussion of the results as well as the conclusion of this study.

2. Literature Review

In the literature review, it seemed essential to examine the word 'learning' in the light of psychology and pedagogy and to see how this concept is discussed and viewed by some of the scholars in these disciplines, before delving deeper into the concept of physical learning spaces.

When it comes to physical learning spaces, authors introduce the concept of informal learning spaces, where they argue that, unlike traditional classroom learning spaces, learning can also take place in other spaces of the institution without the presence of instructors. As we delve deeper into the literature, we begin to learn about other elements of the physical spaces that are quite critical to the learning process, such as promoting community building as a goal, a sense of place, and collaboration among students. The criteria for a well-designed learning environment have been debated for more than 20 years, but the ideas range from pedagogical requirements to people, place, and technology. Authors, such as Torres (2014), identify three determinants to be considered in this process: psychological, physiological and sociological determinants. However, Br et al (2021) support the introduction of criteria to assess the functional efficiency of classrooms and how well they can meet the needs of teachers and pupils. Looking at the future, the authors acknowledge that traditional lecture-based learning environments are ineffective because they actively discourage social interaction and productive responses. Institutions should therefore look at learning trends in order to meet the needs of twenty-first century students.

2.1. The Concept of “Learning” in the Psychology and Pedagogy space

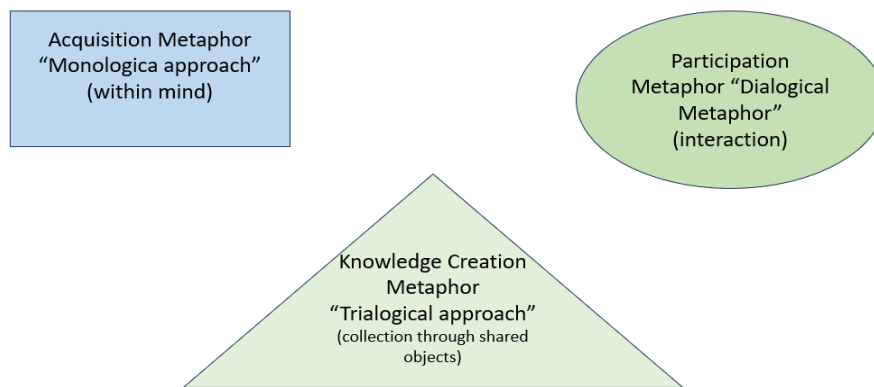
According to De Houwer et al. (2013) there is a lack of consensus about the definition of learning amongst researchers in the psychology arena and makes some contributions to the debate by defining learning “as ontogenetic adaptation, that is, as changes in the behavior of an organism that results from regularities in the environment of the organism”. Researchers who study cognitive learning contend that only the formation, modification, and activation of mental representations within the organism may cause environmental regularities to affect behavior. Hence, it is claimed that mental processes serve as required, intervening causal agents that offer continuous causes of

behavior (De Houwer et al., 2013). On the other hand, from a student-centered theory perspective, Learning is an active, participatory, immersive, and collaborative activity (Estes, 2004). Yet, for Percy (1989) “learning is acquiring knowledge, skill, and awareness of a subject or field. The process by which we learn involves study, instruction, practice, and experience in some combination with one another”. Percy (1989) continues by saying that although memorizing helps with learning, Memorization does not, by itself, produce learning. Learning is more than merely being able to repeat ideas and information precisely. It's also important to comprehend the subject, comprehend the context, and be able to integrate the information.

From a pedagogy perspective, Zogla (2018) already makes an association of learning process and students' surroundings when he explains that a pedagogical process is "a process for living". A structured process of education has to link the learning and growth of people with their surroundings because it is a planned method of targeted teaching and learning; based on specific routines and theoretical hypotheses (Zogla, 2018). Actually, it is impossible to limit pedagogy to instruction alone due to the nature of human development. Here, we have reached the point where the purpose of the science of pedagogy is the constant interactions between the learner, the teacher, and the activities' or lessons' content in frequently carefully organized environments (Zogla, 2018). However, Braungart & Braungart (2015) defined “Learning as a relatively permanent change in mental processing, emotional functioning, and/or behavior as a result of experience. It is the lifelong, dynamic process by which individuals acquire new knowledge or skills and alter their thoughts, feelings, attitudes, and actions”. Finally, Sharkey & Weimer (2003), described the learning process as "an activity or process of acquiring knowledge or skills through the study, practice, teaching or experience of something."

Sfard (1998, as cited in Br et al., 2021) “explained the complex phenomenon of the teaching and learning process using three metaphors, which can be expressed as "acquisition", "participation", and "knowledge creation".

Figure 1 - The three metaphors of learning



Source: Adapted from Paralic & Paralic (2007)

In general, we can say that all cited authors agree that learning involves acquisition of new information, experience and changes in behavior. However, for the sake of this paper we'll consider the position of Ivegard and Hunt (2004) when they explain that “Learning is a set of mental processes driven by a proactive interaction between individuals, and between individuals and their environment. Environment includes resources focused on learning (such as technology, teaching-learning tools and the expertise of others). Environment also encompasses formal and informal social settings such as the workplace and educational institutions”. Both actors also emphasize the importance of experience in this process, as well as the role of iteration, which allows students to refine their inputs. Social interactions with other students are also essential for meaning making. Thus, the learning process is not necessarily a sequential process, but rather a dynamic process that is not tied to a specific linear process.

According to Ivegard and Hunt (2004) the dynamism of this process leads to the creation of new knowledge, skills, abilities, and competences. Similarly, the experiential part of this process leads the individual to seek new alternatives. All these elements contribute significantly to the acquisition of knowledge.

2.2. Physical Learning Spaces

When we talk about Learning Spaces, people tend to think immediately about classrooms, which in fact is correct, especially if we look at it from the formal learning perspective, however, if we consider the concept of Informal learning, physical learning spaces can be extended to other spaces such as libraries, laboratories, workshops, studios and so on (Cox, 2018). Matthews et al. (2011)

defined informal learning as the “student learning outside of designated class time”, Jamieson (2009) goes even further referring to informal learning as “course-related activity undertaken individually and collaboratively on campus that occurs outside the classroom and does not directly involve the classroom teacher”. Hence, following Jamieson’s concept, one of these places where learning occurs outside the classroom is the library (or learning resource centers, or information commons) which are among the key categories of university specialist learning spaces that have gotten the greatest attention in the literature in terms of their evolving functions in promoting learning. The library is frequently located in the center of a campus because it is usually thought of as being there. Contrary to certain expectations, the demand for physical libraries is still growing despite the growth of online services (King, 2000, as cited in Wilson & Cotgrave, 2020). The learning resource center, in particular in teaching-oriented universities in the UK, emphasizes "space and computer-based access, rather than on books and shelves... the aim is to offer a fascinating and flexible space in which students can study at their preferred pace, in their own time, using a variety of learning styles" (Edwards, 2000, as cited in Temple, 2008). One of the most obvious changes to the space is the one, which reflects the demands of students who may be using innovative teaching techniques to pursue courses that aren't conventional. Giving students the option to work in groups while simultaneously providing a quiet area for individual study is a design problem unique to these types of facilities. The JISC study demonstrates how a learning resource center might aim to accomplish this (Edwards 2000, as cited in Wilson & Cotgrave, 2020).

Current research demonstrates how traditional academic libraries can also be modified to adapt to new learning methodologies, as seen at Monash University in Australia (Jamieson, 2003).

Besides libraries there are other types of learning spaces that can fall into this category of informal learning spaces, such as laboratories, cafeteria, lounge and other social learning spaces. Matthews et al. (2011) advocates that social learning spaces may promote student social interaction by giving students a platform to form relationships with their peers, which can increase their participation in active and collaborative learning and make it easier for them to share their knowledge in order to tackle academic challenges.

2.3. Learning Spaces in Higher Education

Marmot (2006) explains that there are seven different types of learning spaces in higher education and further education. These areas were intended for:

1. Group teaching and learning, which required changeable furniture configurations to accommodate groups of various sizes and different layouts, particularly in square rather than rectangular rooms (the former being more versatile).
2. Simulated environments, which requires both observation and carrying out the work at hand and allow for the practical learning of, for example, technological subjects or nursing.
3. Immersive environments, such as "HIVEs," highly interactive virtual environments with cutting-edge information and communications technology, which are possible in many areas but are more likely to be found in those relating to science or technology.
4. Peer-to-peer environments, such as those seen at cybercafés, where informal learning can occur.
5. Clusters where students can collaborate in groups, like in learning centers.
6. Individual work, in a peaceful setting.
7. External group - Spaces outside the building that are suited for small-group work. These usually take place in external areas where people from different institutions come together for reflective learning on topics of common interest.

However, it is important to note that most of these types of learning spaces proposed by Marmot (2006) are mostly aligned with the concept of informal learning spaces introduced earlier.

According to Temple (2008), there is a small amount of data supporting the idea that campus design and building design both assist student learning. Yet, since learning is a social activity, campuses must be designed to foster warm, informal areas where people may gather, chat, and possibly work in small groups. Strange & Banning (2001, as cited in Temple, 2008) even corroborate saying that learning is aided by giving students access to a "third place" that is "socially stimulating," i.e., a spot that is neither home nor work, where relationships can be explored and expanded.

According to Whisnant (1971, as cited in Wilson & Cotgrave, 2020), inquiring about how the physical layout of the campus affects learning is made possible by a critical analysis of American campuses, which makes the provocative claim that campuses are actually built to exacerbate

"division, tension, alienation, and strife"—though these remarks primarily apply to intra-departmental rivalries. Despite Whisnant's support for giving students more freedom in how they structure their learning, his recommendations for physical changes to enhance learning center on removing barriers between the campus and the "uncampus" outside and fusing teaching, research, administrative, and social spaces within it to foster a stronger sense of community (Whisnant, 1971, as cited in Wilson & Cotgrave, 2020). The founding vice chancellor of the University of Kent had a similar perspective, saying that each college should be "a microcosm of the overall University". While other institutions used alternative planning strategies in the 1960s, they were all guided by what is now known as a model of teaching and learning, which had an impact on campus layout and space utilization (Martin, 1990, as cited in Temple, 2008).

2.4. A community space

HEIs are more than just classrooms. The Robbins Report (Committee on Higher Education 1963, 193) asserted that campuses are communities, and several campus designs have included community-building as a goal (Wilson & Cotgrave, 2020). What connections exist between teaching and learning, as well as space, and concepts of community and participatory governance in higher education? Understudied yet possibly significant, this field needs more study. It has been suggested that the physical form of the university plays a significant role in fostering its intellectual and social integration and that institutional effectiveness is supported by "the preservation and development of this integrated form, with its dense network of connections". By the operation of social networks, physical space and intellectual space may be connected (Temple and Barnett, 2007, as cited in Wilson & Cotgrave, 2020). According to Kuh et al. (2005, as cited in Wilson & Cotgrave, 2020), "the physical and the emotional become inextricably intertwined to form an almost palpable "sense of place," one that has profound, if not always clearly understood meaning to many members of the campus community," campuses and specific buildings may have significance in supporting learning (Wilson & Cotgrave, 2020).

We may also point out that it is unquestionably true that most university buildings around the world are merely standard functional units built to the same designs and specifications as other comparable structures at the same time; they don't have any significant symbolic purpose (Wilson & Cotgrave, 2020).

The necessity of developing human-scale learning environments is highlighted in the literature. 'The physical environment communicates messages that influence students' sentiments of well-being, belonging, and identity,' according to a study, and hence promotes learning (Kuh et al., 2005, as cited Wilson & Cotgrave, 2020)

It is well acknowledged in the literature that places like labs, workshops, and studios should be viewed as having significant social dimensions, and that their designs should encourage social interaction in addition to satisfying basic operational needs. It is possible to create "an island of reflection" in a central atrium or create an internal "street" that connects related spaces to encourage social interaction in newly constructed or renovated buildings (Edwards, 2000, as cited in Wilson & Cotgrave, 2020). Having close places to eat and semi-private meeting spaces could further boost the likelihood that "serendipity and story-telling" will occur (Edwards 2000, cited in Wilson & Cotgrave, 2020). Another suggestion for promoting this kind of connection is to switch to larger, open-plan laboratories with common facilities rather than smaller labs for each research team with nearby clustering staff offices (Wilson & Cotgrave, 2020).

Barrett et al.(2017); Suraini & Aziz (2023), have demonstrated that although the direct effects of the physical learning environment are difficult to measure, many institutions experience the benefits of their investment through students' motivation and behavior as well as those of the teachers.

2.5. Flexibility in the design of learning spaces

More recent ideas on "flexible" learning spaces - places where various groups may be engaged in various activities simultaneously and which lend themselves to a variety of uses (Chism 2006; Joint Information Systems Committee, 2006) - have suggested how campus and building design can be used to support learning, particularly informal learning. Since interactions between students are crucial to effective learning, designs must offer a variety of areas for them to collaborate and socialize (Kuh et al. 2005, as cited in Wilson & Cotgrave, 2020).

There is a resurgence of interest in the impact of space on learning behaviors and instruction as the paradigm in education evolves from teacher to student and from passive to active learning (Chism and Bickford, 2002 as cited in Neill & Etheridge, 2008). The inflexible layout of the traditional classroom limits learning and teaching to one-way, linear flows. Several educational institutions are exploring flexible, networked classrooms to address this relationship between space and learning (Classrooms, N.D, as cited in Neill & Etheridge, 2008).

Flexible learning spaces are areas with a variety of furniture alternatives that may be arranged in many different ways to support a variety of teaching and learning activities. They are an abrupt contrast to traditional classrooms, which are made up of rows of desks and chairs facing a teacher who mostly uses didactic teaching methods in the front. These traditional settings are increasingly viewed as insufficient for educating students in 21st-century skills (Kariippanon et al., 2019).

Hoodless et al (ND, as cited in Br et al., 2021) defined this term as referring to the provision of multi-functional spaces that can respond to different user needs and individual goals that change over time, providing the right mix of open spaces with split or grid configurations that allow teachers to create layouts consistent with the educational goals of an institution's curriculum.

The design of these areas is strongly tied to the type of learning behavior that is desired of students in each area. Consequently, the design of this area should enable one to set up various workspaces and carry out many tasks at once (Duthilleul et al., 2019).

An environment that encourages exploration by both instructor and student is necessary for innovative pedagogy. This environment needs to support a variety of teaching and learning modalities in order to be effective. A flexible learning environment is created with pedagogical, architectural, and information technology considerations in mind (Neill & Etheridge, 2008).

Figure 2 – Active-learning classroom.



Source: <https://dcs.rutgers.edu/active-learning/active-learning-spaces>

In this experimental project to redesign an existing classroom into a flexible learning space the following learning space layouts were determined prior to implementation, based on professional experience and conversations with professors:

- Cluster: Small Group Discussion and Activities
- Horizontal: Class Conversation
- Linear: Lecture, Presentation, and Video
- Network: Decentralized Instruction

The results of these experiments were analyzed according to the following criteria:

Room Functionality and Features: The instructor/student computers and moveable furniture were the features of the room that were most commonly used (Neill & Etheridge, 2008).

Room Efficacy: The adaptability of the space, according to faculty and student evaluations, improved participants' teaching and learning styles and increased student involvement. It also

fostered collaborative learning (Neill & Etheridge, 2008). While the pedagogy is the same, the results show that students perceive the flexible learning environment as being more conducive to engagement, collaboration, flexibility, and learning (Neill & Etheridge, 2008).

The effectiveness of more student-centered methods is constrained by a conservative traditional environment as faculty members deploy alternative teaching and learning tactics. (Neill & Etheridge, 2008).

The study concluded that, flexible space is necessary for active, interactive, immersive, and cooperative learning. This perspective sees physical space as a force for transformation (Oblinger 2006, as cited in Neill & Etheridge, 2008). It is believed that a flexible learning environment enhances student involvement, collaboration, flexibility, and learning (Neill & Etheridge, 2008). This study also showed that students are actively engaged in learning when the environment is changed to accommodate the manner of instruction, for instance U-shape (Neill & Etheridge, 2008).

2.6. Criteria of a Well-designed Learning Environment

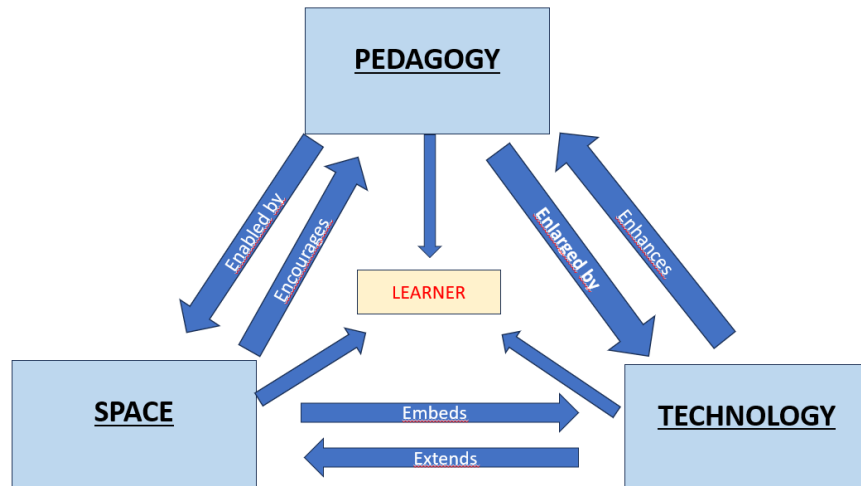
The criteria about what determines a well-designed learning environment have been discussed for 20 years plus, and proposals seem not to be static throughout this period.

Positive trends can be observed in the criteria that people consider to be important for well-designed learning environments, which are shifting away from simple technical design components to more complex ones that are pertinent to learning spaces. From 2001 to 2010, there was an increased emphasis on "pedagogy" in terms of what constitutes a well-designed learning space (Suraini & Aziz, 2023).

Both Bovey et al. (2003) and Graetz (2006), concur that setting up the physical environment can promote student collaboration. For instance, pupils can develop their social skills in environments that are planned to promote peer interaction, and teachers can use team teaching and interdisciplinary topics.

Between 2011 and 2021, talks on learning space designs have gotten increasingly complex as they take into account "technology" in addition to "people," "pedagogy," and "place" in order to determine whether a given learning space is well-designed (Suraini & Aziz, 2023).

Figure 3 - The interrelationships between space, pedagogy and technology



Source: Adapted from European Journal of Engineering Science & Technology, 4(3): 1-14, 2021

Technical elements like classroom colors, lighting, furniture placement, acoustics, and many others were discussed in relation to the incorporation of technology for a meaningful learning experience (Ramli et al., 2013).

Figure 4 - Active learning classroom.



Source: <https://dcs.rutgers.edu/active-learning/active-learning-spaces>

For instance, according to some, a suitable design for learning spaces should take into account power outlets and internet connectivity that students can use whenever and wherever they need (Suraini & Aziz, 2023). On the other hand, through his analysis of teachers' movement inside the classroom, discovers that in addition to influencing their movement, the classroom environment also affects instructors' productivity and performance when delivering lessons (Suraini & Aziz, 2023).

Figure 5 - Active learning classroom.



Source: <https://dcs.rutgers.edu/active-learning/active-learning-spaces>

Establishing a precise checklist of requirements for the "ideal design" of a learning environment may not be feasible in this situation, particularly when education inequality is involved. Instead, we should use the guiding concepts behind these criteria (which include the visual aesthetics, availability of effective facility functions, communal spaces, movable furniture, adaptive spaces, and affordances for new digital technologies) to help us create schools that are conducive to learning. To do this, we must first understand the learners of the future (Suraini & Aziz, 2023). Nair et al. (2020) declares that “despite our best efforts, our best ideas produce highly variable results in different contexts, depending on the capabilities, preferences, and conditions under which real people try to adapt them”. This is further confirmed by a study conducted at two Finnish schools. The results implied that there are no ready-made models that can easily adapt to a new situation. Instead, practices are built in actual physical locations through active negotiations and meaning-making, in three cyclical interaction processes, i.e., interaction between teachers,

interaction between students and teachers, and interaction between students (Kokko & Hirsto, 2021).

2.7. Specific needs of physical spaces

Torres (2014) discussed the determinants that should be considered in learning spaces in order to increase productivity and satisfy human requirements, as the following:

2.7.1. Psychological Determinants:

Torres (2014) explains that people typically congregate in environments with some degree of restriction and visual privacy. Walls, partitions, and furniture can be used to achieve this.

In terms of acoustic privacy in an interior environment, it can be achieved by combining a number of interrelated elements such as the presence of the ceiling, walls, floor, and furniture. However, for appreciating aesthetic it depends on the surroundings. Depending on the occasion, location, goal, and context, aesthetics can be achieved by the experience that the design itself provides to the human senses, in addition to functionality, structural integrity, and physical beauty.

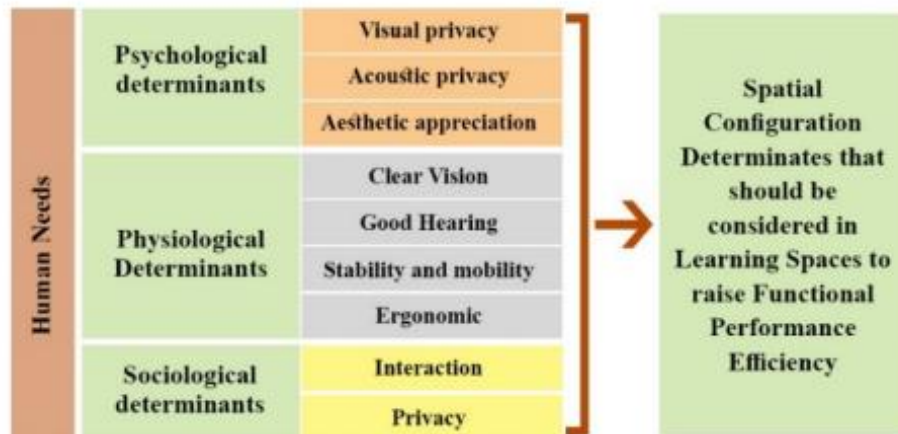
2.7.2. Physiological Determinants:

According to Torres (2014), the physiological determinants to be considered are vision, hearing, mobility, and ergonomic design. Torres (2014) explains that vision is fundamental for an individual to carry out tasks as far as there is visibility, legibility, and recognition. As for hearing, it is a critical element of communication which entails intelligibility, audibility, signal-to-noise ratio, and noise disturbance as crucial hearing factors. When it comes to mobility and stability it refers to the factors that enable individuals to carry out their functional activities. The incline of the ceilings, the width of the hallways, the depth of the stairs, the location of the handrails, and other factors should all be taken into account from the perspective of mobility. Lastly, Ergonomic Design: In response to the user's environmental needs, ergonomics incorporates human measuring data, physiology, and psychology. Designers use this information to produce interiors that are specially adapted to the human body.

2.7.3. Sociological Determinants:

For Torres (2014), sociological determinants address the social needs and concerns of the occupants. Hence, the physical distance at which people and tasks might interact is a critical factor to consider when designing interior spaces. Not less important, is the size of the room in relation to its occupants since it has an impact on how far away a conversation takes place; it is noticeable that people tend to sit together when the room is smaller.

Figure 6 - Functional performance efficiency standards.



Source: Adapted from European Journal of Engineering Science and Technology (2021)

Interior environments (learning spaces) must satisfy the basic functional needs of human beings - sight, hearing, stability, and mobility - in order to achieve comfort and efficiency. Therefore, these needs are of primary importance in relation to the others and it is essential that these needs receive a special attention (Torres, 2014).

Br et al. (2021) advocates that to evaluate the functional efficiency of classrooms and how well they can accommodate teacher and student needs, a set of criteria has been established. These criteria are based on the ability of learning environments to accomplish efficient teaching and learning goals. For Br et al. (2021), the effective teaching and learning goals can be summarized in how classrooms enable the following:

- Individual, peer, and collaborative learning.
- Use various teaching strategies for content interaction.
- Foster shared leadership between instructor and student.
- Enables the instructor to acknowledge and consider students' individual differences.

Br et al. (2021) specifies the requirements for teachers to meet Effective Teaching and Learning Goals (ETLG) as the following:

- The instructor has unrestricted movement to reach all students equally.
- Instructor is able to visually scan assess the progress of pupils and identify those in need.
- Ability for the instructor to switch between various instruction types.

- The learning space is acentric or polycentric, hence, there is no clearly defined front of the room, Instructor is able to move around the space and promote motivation.
- Availability of a variety of technologies that facilitate collaboration and knowledge advancement.

Adaptability of the learning space allows for diverse learning styles, activities, and technology. Br et al. (2021) further adds that in order to meet the Effective Teaching and Learning Goals (ETLG), the student needs that should be met in the classroom can also be summarized as follows:

- The ability to support various learning strategies for individual, group, or peer application. Allows students to develop different learning styles.
- Provides the ability to display interaction results for teacher and peers' review.
- Allows varied engagement with learning material.
- Provides ample room for diverse activities.
- Free space in classroom facilitates easy interaction with teachers and peers.
- Availability of various technologies for collaboration, knowledge sharing, and building.

2.8. The need for new design approaches

By their very nature, debates about a student-centered approach to university architecture have tended to focus more on pedagogical and curriculum concerns than on the actual physical environment. Some authors have emphasized that in addition to new approaches to teaching and learning, there should also be new approaches to design in order to meet the needs of students from a broader spectrum of social and educational backgrounds, for instance. They specifically pointed out that design should be driven by teaching and learning as opposed to the other way around (Jamieson et al., 2000, as cited in Temple, 2008)

Suraini & Aziz (2023) align in the same direction when they affirm that architecture and design theories shouldn't stand on their own when it comes to understanding the design of learning environments without being connected to pedagogical theories, and vice versa.

The standard non-specialist teaching setting in higher education continues to be a room with tables and chairs and a way of displaying material so that everyone can view it. While acknowledging that large-group teaching may in fact require this "sage on a stage" layout, in some cases, a simple adjustment to the arrangement of the chairs and tables in the room is suggested to facilitate a group discussion rather than the ex-cathedra layout of a lecturer at the front with ranks of students laid out before her or him. Both professors and students appear to have similar preferences: cozy seats,

practical furniture arrangements, temperature control, and lovely outdoor vistas are all prominent features (Douglas and Gifford 2001, as cited in Wilson & Cotgrave, 2020). There is more room for the introduction of fresh ideas when a new building or an existing one is remodeled. This is already evident in the design of modern lecture halls, where curved rooms can draw the audience and lecturer closer together and swiveling seats can enable the lecturer to transition from a big-group session to several small-group sessions and back to the large group. Particularly in quantitative subjects, furniture with computer facilities might enable students to work on exercises provided by the instructor and receive immediate feedback on their work (Joint Information Systems Committee 2006, as cited in Wilson & Cotgrave, 2020). A more appealing environment and more usable space can be created by simply opening up separate, uncomfortable rooms (Wilson & Cotgrave, 2020). Micro-design must be taken into consideration in both newly constructed and preexisting learning environments: "The proxemics associated with seating arrangements in a lounge area can either stimulate or impede social interaction. A sense of belonging, as well as a sense of purpose, worth, and value, can be signaled by physical artifact signals of support or unsupported, which can take many different forms. such messages improve or hinder students' capacity to handle the stress of college (Strange & Banning 2001, as cited in Wilson & Cotgrave, 2020) and hence their capacity to learn.

2.9. Potential Role of the Users in the Design Process

Participatory research between educational professionals and designers would enable teachers to communicate their goals and needs to those who could create the ideal physical environment, thereby benefiting the pupils. While the "learning environment research" sector is expanding quickly, as stated by Barret, the UNESCO Institute for Statistics 2012 also noted that its findings are frequently difficult to apply outside of affluent countries.

According to Suraini & Aziz (2023), future discussions about physical learning spaces should go beyond the ideal design ideas for learning spaces that only apply to individuals with higher status. Instead, in order to provide a workable and sustainable design strategy for learning spaces, especially in poor nations with much less funding available, the stakeholders' opinions must be heard by involving them in the design process (Suraini & Aziz, 2023).

What is considered to be the standards of a well-designed learning space may change due to the complexity of educational space design. It spans from technical aspects like heat management,

lighting, color, and acoustics to the socio-psychological effects a space may have through defining identity, fostering community, or incorporating technology (Suraini & Aziz, 2023). In terms of public-school building designs, Suraini & Aziz (2023) support that its constrained governance and the changing nature of teaching and learning in the Education 4.0 era should be seen as opportunities for a committed scholarship between various internal and external stakeholders to bring about change in the physical environment of educational institutions (Suraini & Aziz, 2023). Given the rapidly evolving trends in education, it is crucial for experts from various fields to collaborate and exercise vision in order to design physical learning environments that will function effectively both now and, in the future (Suraini & Aziz, 2023).

2.10. Future Learning Spaces: Space, Technology and Pedagogy

In order to satisfy the demands of students in the twenty-first century, new, cutting-edge schools are being built. These facilities encourage collaboration, critical thinking, and flexibility in teaching and learning, among other things (Benade, 2017).

Several studies have shown that traditional lecture-oriented learning environments are ineffective because they actively discourage social interaction and productive responses (Br et al., 2021).

Recent studies have shown that making students active participants in the curriculum can enhance, deepen, and enhance the learning experience (Oblinger, 2006 as cited Br et al., 2021). Research is pointing to the following learning trend gears:

Active Learning Classrooms (ALCs) – For Br et al. (2021) Active learning is observed in learning processes that encourage pupils to perform some activity and think about what they are doing" as active learning, i.e. technology-rich, learner-centered activities that emphasize constructive innovation and collaboration.

Flexible Learning Spaces (FLSs) – Br et al. (2021) explains FLS as “the provision of multi-functional spaces that can respond to different user needs and individual goals that change over time,” i.e., these spaces provide the correct balance of open areas with split or grid arrangements that enable teachers to build layouts congruent with the instructional goals of an institution's curriculum.

Innovative Learning Environments (ILEs) – Earp (2019) refers to ILE's as “a product of innovative space design, teaching practice and innovative learning that can evolve and adapt in the future”. Earp (2019) believes that its mission is to provide physical education facilities that combine

outstanding collaboration, flexibility in teaching and curriculum, and flexible use of space, technology, and furniture.

Br et al. (2021), have come up with following features of the Next Generation of Learning space:

- The rooms have movable furniture that is simple to rearrange.
- Because the front of the room is unclear, the rooms have a "acentric" or "polycentric" design.
- Instead, the teacher walks around to stimulate collaboration among the students.
- Spaces make it simple to use online learning resources.
- Spaces are changeable because they are a spatial characteristic that denotes the potential to alter the site's layout based on various actions.

3. Methodology

3.1. Research Question

To address the research problem and the objectives, the present work proposed to answer the following research question:

RQ: What criteria do higher education institutions consider when designing physical learning spaces and how do they relate with the known requirements of effective teaching and learning?

3.2. Hypothesis formulation

In light of the state-of-the-art takeaways, the following hypotheses are conceivable:

H1 – HEI are not applying established criteria for designing physical learning spaces that achieve functional efficiency of classrooms that meet the needs of teachers and students in accomplishing effective teaching and learning goals.

H2- HEI managers are not aware of any established criteria for designing physical learning spaces that achieve functional efficiency of classrooms that meet the needs of teachers and students in attaining effective teaching and learning goals.

3.3. Research Strategy

In this research, we focus on two higher education institutions in Portugal, specifically in Lisbon due to logistical constraints. Secondly, it is essential to be cognizant that there are HEIs in Portugal that are very old in terms of year of construction, and some are even centennial universities, such as Universidade de Lisboa, as well as in terms of when the campus was last renovated, which

makes it very difficult if not impossible to have access to the decision-makers and participants of the design process of the physical learning spaces at the time. Hence, this research will be centered on HEIs whose campuses were built or renovated in the last 10 years. Furthermore, this research will concentrate on faculties related to the creative industries more generically, which is my area of interest and operation in design management.

This research is primarily aimed at the students and faculty members of the above-mentioned institutions, as well as the staff of the governing bodies of these institutions. In this context, we use two research methods, namely qualitative and quantitative research.

3.4. Structuring of the Interviews with Pedagogical and administrative Staff

Qualitative research will be conducted through interviews with Pedagogical and administrative management staff. Below are the main questions to be addressed:

Table 1 - Qualitative Research Questions

Categories	Questions	Supporting Bibliography
	1. Position/Role at the institution	
	2. In what year was the university built and started operating?	
	3. When was the last renovation done? What was it about and what was the reason for the last renovation?	
Evaluation of classroom requirements to meet Student's effective teaching and learning goals	4. Did the architectural or design process of the learning spaces take into account modern established criteria to meet effective teaching and learning requirements?	Characteristics of New Generation of Learning Spaces: • The rooms have movable furniture that is simple to rearrange.

		• Because the front of the room is unclear, the rooms have a "eccentric" or "polycentric" design. • The teacher walks around to stimulate collaboration among the students. • Spaces make it simple to use online learning resources. • Spaces are changeable because they are a spatial characteristic that denotes the potential to alter the site's layout based on various actions. (Br et al., 2021) These spaces help motivate social interactions, meetings and conversations that foster personal and professional development (Br et al., 2021)
	5. Is the institution's management aware of established criteria for designing learning spaces that meet effective teaching and learning requirements?	we should see the principles behind these criteria to guide us in school. designing where learners of the future need to first be understood in order to

		provide a conducive space for their learning process. As Nair et al. (2020, p. 187)
	6. Does classrooms offer the ability to rearrange mobile furniture that supports various learning strategies, whether applied individually, in groups, or with peers	Flexible space is necessary for active, interactive, immersive, and cooperative learning. (Neill & Etheridge, 2008). While the pedagogy is the same, the results show that students perceive the flexible learning environment as being more conducive to engagement, collaboration, flexibility, and learning (Neill & Etheridge, 2008).
	7. Does classroom offer a variety of technologies such as internet points (cable and or wireless), collaboration tools such as teams, and digital presentation devices, that supports efficient teacher and student collaboration, knowledge sharing, and building?	To meet the effective teaching and learning goals the facility offers a variety of technologies that enable teacher and student collaboration, knowledge sharing, and building (Br et al., 2021).
	8. Does the classroom design and furniture enable the teacher to quickly shift	The space's adaptability allows it to offer a variety of learning styles, activities,

	between various types of instruction, such as lectures, project work, and discussions.	and technology to take into account the specific peculiarities of each student (Br et al., 2021).
	9. Has the institution's management implemented or intends to implement these principles?	
	a) In case it has, are there any noticeable outcomes?	-The teacher can quickly switch between various types of instruction, such as lectures, project work, and discussions.
	b) In case it hasn't, what are the main challenges that hinder such implementation?	- As there is no clearly defined front of the room, the space has a (acentric) or (polycentric) design. Instead, to motivate students to work, the teacher moves from one place to another. -The place offers a variety of technologies that allow teachers and students to collaborate, share, and advance their knowledge with one another. -Students having the ability to rearrange mobile furniture that supports various learning strategies, whether

		applied individually, in groups, or with peers. - Students with the freedom to maneuver and develop various learning styles. - Students can display the results of their interactions for the teacher, other students to view and discuss. - Students are allowed to engage with the learning material in a variety of ways, either individually or in groups. - Students have enough room to conduct a variety of activities. - Based on the interaction distance, students can easily interact with the teacher and each other. (Br et al., 2021).
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3.5. Student's Online Questionnaire

The quantitative research will be carried out through an online questionnaire and will target the students and teachers of these institutions.

Table 2 - Online Questionnaire

Categories	Question	Supporting Bibliography
	1. Gender	
	2. Age	
	3. Nationality	
	4. Student/Teacher	
Participant Identification	5. Course	
Evaluation of the psychological determinants of spatial elements	6. How do you rate the classrooms of the institution where you study in terms of visual privacy and restriction from people that do not belong to the class, being 1 - no privacy and 5 - all necessary privacy?	Visual privacy: People tend to be in places with some degree of restraint and visual privacy. This can be achieved with furniture, partitions and walls (Br et al., 2021).
	7. How do you rate the classrooms of the institution where you study in terms of privacy and acoustic restriction, being 1 - no privacy and 5 - all necessary privacy?	Acoustic privacy: It is an effective treatment of the acoustic environment in rooms that are affected by connecting elements: ceiling, walls, floor and furniture (Br et al., 2021).
	8. Do you agree that the visual aesthetics of the institution's classrooms promote a sense of well-being? 1 - strongly disagree and 5 - strongly agree?	Aesthetic appreciation: It is influenced by the environment. It depends on the time, place, purpose and context. Aesthetics can be achieved not only

		functionally, structurally and physically, but also through the experience that the design itself gives to the human senses (Br et al., 2021).
Evaluation of the physiological determinants of spatial elements	9. Do you agree that the institution's classrooms have and facilitate good and sufficient visibility for the performance of classroom activities, with 1- strongly disagree and 5- strongly agree?	Vision: The ability to perform the tasks by providing good & clear vision (Br et al., 2021)
	10. Do you agree that the institution's classrooms have and facilitate good and sufficient audibility and noise freedom for conducting classroom activities? 1- Strongly disagree and 5- Strongly agree?	Hearing: The critical variables in human hearing are intelligibility, audibility, signal-to noise ratio, and noise disturbance (Br et al., 2021).
	11. Do you agree that the institution's classrooms have the ergonomic conditions, such as adjustable desks necessary to carry out the teaching activities, 1 - I totally disagree and 5 - I totally agree?	Ergonomics integrates human measurement data, physiology and psychology in response to the user's environmental needs. This data is used by the designer to create interiors tailored to the human body (Br et al., 2021).
	12. Do you consider that the size of classrooms is proportional to the number of students attending a particular class (for example, huge classrooms for a limited number of students that allow students to be scattered around the classroom, thus hindering interaction and collaboration between them and the teachers)? 1 - I totally disagree and 5 - I totally agree	The scale of the room in relation to its inhabitants also affects the distance of the conversation. When the room size decreases, people tend to sit together (Br et al., 2021).

	13. Do you consider that the overall physical spaces in the institution help promote student socialization and interaction? Yes/No	setting up physical environment can promote student collaboration (Wilson & Cotgrave, 2020) setting up the physical environment can promote student collaboration (Wilson & Cotgrave, 2020).
	14. Do you consider that the physical environment at your institution promotes collaborations and a sense of community amongst colleagues? If yes, please give an example at your institution_____	These spaces help motivate social interactions, meetings, and conversations that foster personal and professional development (Br et al., 2021)
Evaluation of the crucial elements that the classroom should enable.	17. Does the classrooms allow the use of various teaching and learning strategies to encourage interaction with content, such as: Student – Activities and Presentation, Lectures, and Teacher- Led interactive.	The effective teaching and learning goals can be summarized in how classrooms enable the following: - the use of various teaching and learning strategies to encourage interaction with content, such as: Student – Activities and Presentation, Lectures, and Teacher- Led interactive. - The teacher can visually scan the class to keep an eye on the

		pupils, assess their progress, and spot any who might need help. - The teacher can quickly switch between various types of instruction, such as lectures, project work, and discussions. (Br et al., 2021).
Evaluation of classroom requirements to meet Instructors' effective teaching and learning goals.	18. As an instructor (in case subject selected "Teacher" in point 4), does the room design allow you to have unrestricted movement and reach every student equally, whether they are working individually, in small groups, or as a class. (Yes/No)	
	19. As an instructor (in case subject selected "Teacher" in point 4), does the room design allow you to visually scan the class, keep an eye on the pupils, assess their progress, and spot any who might need help?	
	20. Does the classroom allows the teacher to quickly switch between various types of instruction, such as lectures, project work, and discussions. (Yes/No)	
	21. Are the classrooms designed in acentric or polycentric way so that teacher can motivate students to work, as he moves from one place to another? (Yes/No)	As there is no clearly defined front of the room, the space has a (acentric) or (polycentric) design. Instead, to motivate students to work,

		the teacher moves from one place to another (Br et al., 2021).
	22. Does the facilities offers a variety of technologies that enable teacher and student collaboration, knowledge sharing, and building? (Yes/No)	The facility offers a variety of technologies that enable teacher and student collaboration, knowledge sharing, and building (Br et al., 2021).
	23. Does the learning environment convey adaptability to support a variety of learning styles, activities, and technology to take into account the specific peculiarities of each student? (Yes/No)	The adaptability of the space, according to faculty and student evaluations, improved participants' teaching and learning styles and increased student involvement. It also fostered collaborative learning (Neill & Etheridge, 2008)
Evaluation of classroom requirements to meet Student's effective teaching and learning goals.	24. Does the classroom have movable furniture that is simple to rearrange in order to support various learning strategies, whether applied individually, in groups, or with peers? (Yes/No)	Students can rearrange mobile furniture that supports various learning strategies, whether applied individually, in groups, or with peers. (Br et al., 2021) with peers. (Br et al., 2021).
	25. Does the room allow students to display the results of their interactions for the teacher, and other students to view and discuss. (Yes/No)	Students can display the results of their interactions for the teacher, and other students to view and discuss (Br et al., 2021).

4. Analysis and Discussion of the Results

This chapter introduces the analysis of the results derived from the application of the methodology, which aims to present and discuss the results through the data collection methods, namely the interviews with staff responsible for pedagogical/administrative tasks at IPAM and, secondly, the use of online questionnaires aimed at students and lecturers at the IADE campus, and the Quinta do bom nome (QBN) campus. Firstly, the results obtained from the interviews will be analyzed and, later, the same exercise will be carried out on the data obtained from the online survey, including a characterization of the profile of the sample.

4.1. Interviews with Pedagogical and administrative management staff

4.1.1. Brief presentation of the participants

Subject 1 is a member of the IADE Management Committee and the coordinator of pedagogical practices at IADE and IPAM. She is in charge of tasks such as semester planning, academic coordination, planning the distribution of teaching workload, etc.

Subject 2 is a coordinator of pedagogical practices at IADE and IPAM.

Subject 3 is a coordinator of the Faculty of Science and Technology and Health Sciences at the QBN.

4.1.2. Analysis of the Content of the Interviews

As most of the universities were built more than 50 years ago and most of the managers and decision-makers of these institutions are no longer present or accessible, the interviews focused more on aspects such as the last renovation of the campus facilities and the reasons for it, the reasons for structuring the classrooms and the campus in general, other spaces on the campus and the awareness of campus design principles that support learning.

4.1.3. Last Renovation

Subject 1 explained that the last major renovation at IADE took place in 2020 when the Hiflex system was installed in most of the classrooms. The installation of this system was motivated by the period of confinement due to the COVID pandemic, when everyone had to be at home and classes had to continue online, so large screens with internet access were installed to make online classes and the general presentation of content more intuitive and interactive. Subject 1 added that general maintenance is carried out every summer.

Subject 2 corroborates with Subject 1 about the motivations for the last renovation at IADE, carried out in 2020, and adds that in addition to Hiflex, other technologies such as database systems, software, and other platforms have been introduced to facilitate online classes and the general presentation of content in a more comprehensible and interactive way. Subject 2 also adds that some rooms in the middle of the floors have been modified and the wall separating the two rooms has been broken down and a mobile partition has been installed between the two rooms, providing the flexibility to make the room larger, thus respecting the social distancing needs imposed by the pandemic, or to divide it into two when it was necessary to divide it into two classes, but which was maintained after the pandemic for practical subjects such as design.

Subject 3 confirms that the same has happened at the QBN campus, where a similar investment in Hiflex technology has been made for the same reason as at IADE.

4.1.4. The structuring of the classroom

The principles of modern classroom design recommend, among other things, the use of flexible furniture that supports different approaches to teaching than the traditional classroom arrangement in which the lecturer is at the front and the students are arranged in rows at the back. Subject 1 acknowledges the existence of similar features at IADE, as the furniture in the Hyflex classrooms is all mobile (tables and chairs), so they are mobile chairs in order to adapt the configuration of the room according to the different teaching methodologies that the lecturer intends to follow. In addition, spaces such as the 3D laboratory have been created to encourage interactivity and sharing among students.

Subject 2 mentions the teachers' concern to create a class dynamic that is different from the traditional style. According to Subject 2, "the rooms on the third floor are the most versatile. This is where the factory is located and where you can create many different spaces, from large creative tables to conversation circles".

Subject 3 explains that whenever she talks to lecturers, she takes this component into account because this one of the elements through which Universidade Europeia stands out from the rest. After all, it has this experiential learning model. Depending on certain learning scenarios, such as challenge-based learning, problem-based learning, and simulation-based learning, in order to apply these methodologies, one has to adapt them to the place where they are. For example, in QBN, whenever there is a need for discussion, the class goes to rooms without tables and with

chairs on wheels (there is only one room) that allow the students to move around, and the students are placed in a circle with the teacher in the middle to allow for face-to-face discussion. In addition, for problem-based learning, i.e. discussion of practical cases, they often have to adapt the room to facilitate learning in two ways: If the classes are small, 10-15 students, they organize the rooms in a U-shape and the teacher stays in the open part of the U-shape to facilitate discussion. If the class is larger, they divide the class into groups, creating islands where the groups discuss within the group and elect a spokesperson who then presents and discusses with other spokespersons and the teacher. This choice is made to achieve the learning objectives but adapted to the constraints of the size of the room. However, not all rooms are equipped with movable furniture.

Nowadays, technology also plays a very important role in building knowledge, sharing, and collaboration between students, which is also key to student engagement that contributes to learning. Subject 1 guarantees the availability of wired and wireless internet, Hyflex technology, and collaboration tools such as Miro, FIGMA, Discord, Slack, Teams (for online lessons and class recordings), and Canvas, where material is made available to students as well as grades, etc. Subject 2 concurs, adding that this has made it much easier to have access to teachers in other geographical locations, as well as other rooms where there are laboratories with more specific software according to the curriculum unit.

4.1.5. Other spaces on campus

As we have learned in the literature review, informal learning is also essential and takes place in other spaces on the university campus than the classrooms and without a teacher. These spaces can promote socialization among students, the sharing of their struggles, and their knowledge.

Subject 1 recognizes that despite some limitations in terms of space at IADE, they have some spaces that enable student socialization such as the lounge and the Factory, which allows them to work on group projects. However, there is a lack of outdoor spaces for students to socialize more, and in a recent exercise, some students recommended the creation of a Zen room for relaxation, a panic room, bouncy balls, healthier food, green spaces, excursions, and study visits would also help to integrate students and share knowledge. Subject 1 advocates that when IADE moves to another location, all these aspects will be taken into consideration. Subject 2 agrees and adds that this is a big challenge for IADE today, as the building itself is not small per se, but it is small compared to the population it houses. Subject 2 agrees that students don't just learn in the classroom, but also through academic interaction and personal and professional growth. For

subject 2, unfortunately, there are few such spaces at IADE, only the lounge, the tables, the bar, the library and the possibility of reserving the laboratory for specific work. However, for Subject 2, there is still a lack of spaces that are university spaces, but in a more relaxed atmosphere. Subject 2 insists that students feel the need to be in an academic environment but at the same time in a more relaxed space to develop some collaborative work. Subject 3 argues that QBN is very pleasant and has green areas with plastic sofas. In addition, subject 3 commented that next to the library there is a study room where you can set up tables and chat while you work. Students also meet in the bar where they buy lunch and work. Students often prefer to be in the bar tent than in the library. The time of year and the weather have a big influence on whether the students are outside or inside. Subject 3 also believes that there are plans for a future campus that will meet the needs of operationalizing this academic model and creating other study spaces.

4.1.6. Awareness of campus design principles

University administration and pedagogical staff should be aware of some classroom design principles that support student learning.

Subject 1 states that a significant investment has been made in IADE to support this concept, such as mobile furniture, 3D labs, and space for games for the computer science degree course. However, additional free space is still a challenge. Subject 2 commented about a project for a new structure, and therefore it has been discussed that IADE has different needs, especially in terms of labs, as one of IADE's flags is learning by doing and creative collaboration. Subject 3 advocates that especially for the future campus plan classrooms will be conceived to support Simulation-based learning, problem-based learning, and challenged-based learning which differ considerably from traditional teaching and hence require a different type of classroom architecture and furniture. Subject 3 added that at present, the existing classroom type is not appropriate for the teaching methods they wish to implement, however, the new campus is very much in line with what is needed to operationalize these modern academic models.

4.1.7. Conclusions from the analyses of the interviews

From this analysis, we can conclude that the latest renovations on both campuses have been more technological, motivated by the pandemic situation, where various technological tools for collaborating and sharing content online have been implemented, such as Hyflex, Miro, and others. In terms of how the classrooms are structured, we have noticed that there are some rooms with

mobile furniture that allow various teaching dynamics to be carried out that are different from the traditional teaching style and that allow for greater collaboration and sharing between teachers and students. Regarding other spaces on campuses that allow informal learning, through socializing, sharing and collaboration between students, we noticed the existence of some spaces other than libraries, such as the lounge, the bar, among others.

We also found that the pedagogical staff is aware of other modern teaching methodologies such as problem-based learning, simulation-based learning, and challenge-based learning, although it is not always possible to implement them due to the fact that not all classrooms are properly equipped.

Both campuses face some limitations in terms of free space available for more radical physical changes that meet the requirements of the most modern principles of designing physical learning spaces. However, the administration and pedagogical leaders of these campuses are aware of the current shortcomings and in this context some investments have already been made in this direction, such as obtaining mobile furniture for some rooms, a 3D laboratory, and others. Additionally, the pedagogical and administrative leaders are already planning the migration of the campus to new infrastructures where many of these concepts should be effectively applied.

In this chapter, we have summarized our interpretation of the extent to which the pedagogical leaders of the institutions under study are aware of the criteria to be considered when designing or even renovating physical learning spaces. In the next chapter, we will look at the results from the online questionnaire to analyze the perceptions of teachers and students (as the main users of physical learning spaces) to see if their learning spaces meet the human requirements that influence increased productivity and, consequently, learning, which we were introduced to earlier in the literature review, namely:

- Psychological Determinants: Entails aesthetics, visual and acoustic privacy.
- Physiological Determinants: Includes vision, mobility and ergonomic design
- Sociological Determinants: covers the social needs of the occupants.

In addition, we will also assess the functional efficiency of classrooms and their ability to respond to the needs of teachers and students. This criterion is based on the ability of learning environments to achieve effective teaching and learning objectives.

4.2. Online Survey

The second part of the research was carried out following a quantitative methodology by means of an online questionnaire answered by higher education students and lecturers who attend IADE and Quinta do Bom Nome. In total, the survey received replies of 55 respondents.

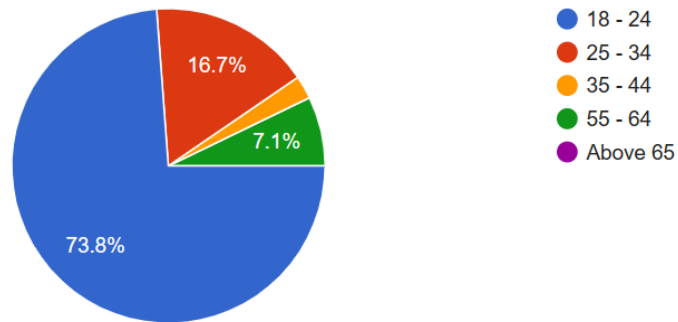


Figure 7- Student respondents' distribution by age group.

In terms of the age of the respondents (Figure 7), we can see a higher percentage of younger age groups of which 18-24 year old account for 73.8%, 25-34 year old for 16.7% 35-44 year old age group and, to a lesser extent, the 55-64 year old age group. When we visit these institutions, we can see with the naked eye that most of the student population is quite young, especially in the undergraduate programs. Hence, these proportions are a fair reflection of the age distribution in these institutions, as well as indicating that most of the data in the study comes from the most representative age range.

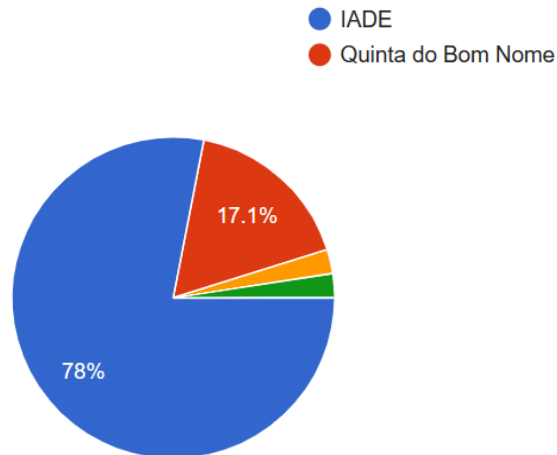


Figure 8 - Distribution by campus.

In terms of participants by campus, a big discrepancy was noted as 78% of the participants were from IADE whilst the remaining participants were from QBN.

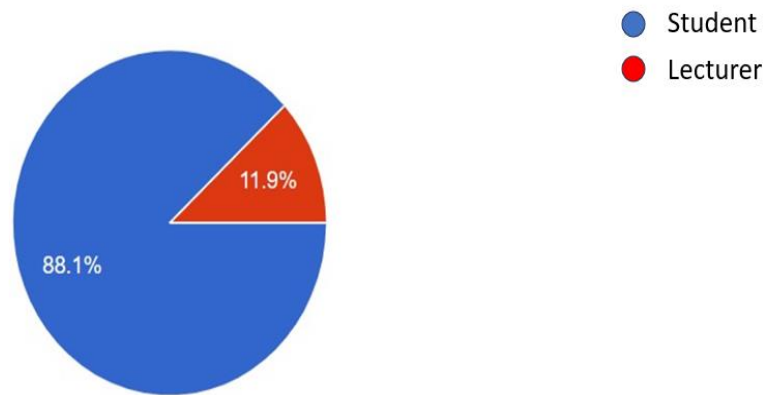


Figure 9 - Distribution by participant type.

88.1% of the participants were students and only 11.9% of the participants were lecturers.

4.3. Analysis of the main results

First of all, it is important to point out that we considered it opportune to combine the results of the student survey from IADE and QBN. This was because no significant differences were found between the results from the two institutions obtained during the interviews.

The aim of this phase is to analyze the data obtained in relation to the proposed questions on the condition of classrooms and physical spaces on campus in general. In most cases the questions could be answered using a linear scale from 1 (meaning “Totally Disagree” or “Very Bad”) to 5 (meaning “Totally Agree” or “Very Good”).

The second part of the questionnaire validates the teachers' perception of the composition of the classrooms and how their layout allows for the transmission of didactic content and the application of different methodologies.

Figure 10 reflects the fact that the majority of students agree that the structure of the classrooms at the institution they attend allows for visual privacy and restriction of people who don't belong to the class. Visual privacy is one of the psychological determinants that contribute to increasing productivity and satisfying human needs in physical learning spaces. These figures therefore indicate that this principle is well met in both the IADE and the QBN. It is important to refer that the results obtained through the students' surveys in IADE and QBN are actually combined, since there were no significant differences identified from the results obtained during the interviews.

4.4. Student's Feedback

This session will explain the feedback from the students' responses to the online questionnaire.

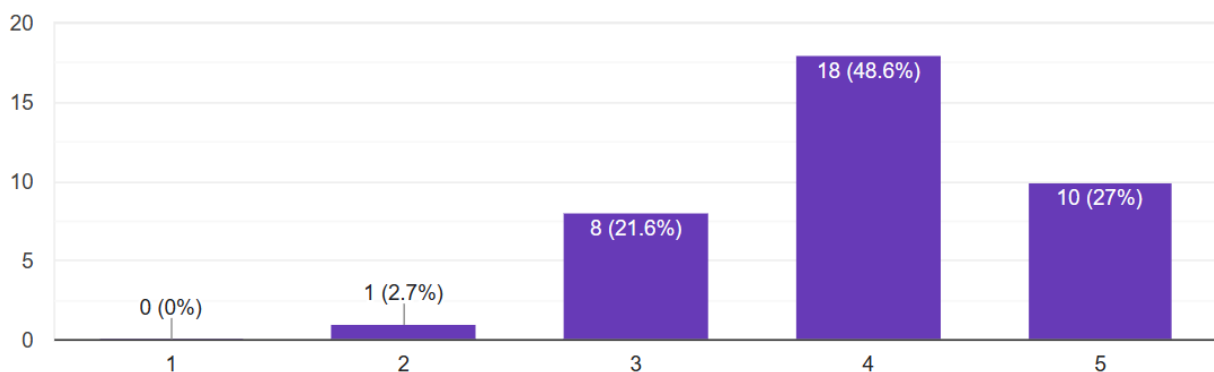


Figure 10 - Assessment of the visual privacy premises of the classrooms.

Figure 10 shows that most students agree that the visual privacy of the institution's classrooms promote a sense of well-being. The percentage of those who disagree is less than 10 percent. This is another psychological determinant which, if we look at the figures, is also well met in both

institutions.

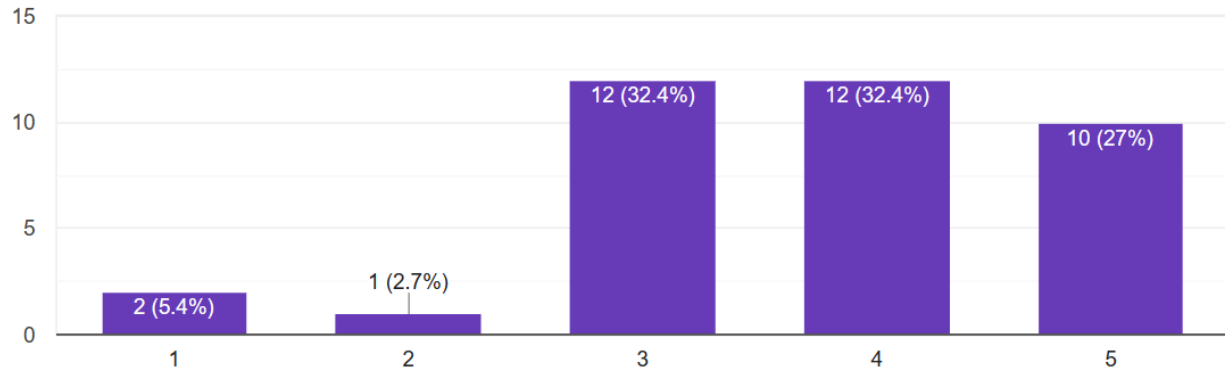


Figure 11 - Assessment visual aesthetics of the institution's classrooms.

Figure 11 indicates that most student are satisfied with the visual aesthetics of the institution's classrooms, as the percentage of students who think otherwise are less than 10%.

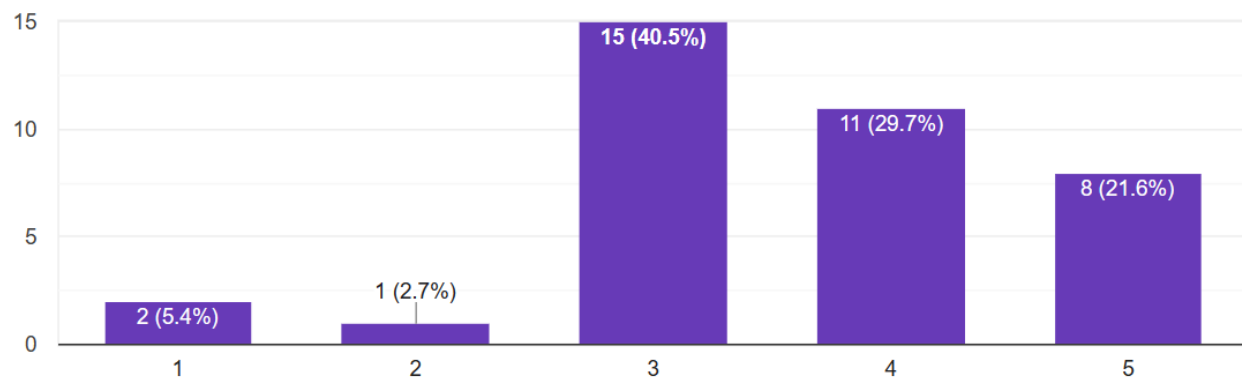


Figure 12 - Acoustic restriction of the institution's classrooms.

In terms of privacy and acoustic restriction, 40% of the students were not fully satisfied or dissatisfied, but still we had more students satisfied with acoustics restriction than dissatisfied students which made less than 10%. This is the third psychological determinant which, according to the figures, has also not been ignored by the institutions surveyed.

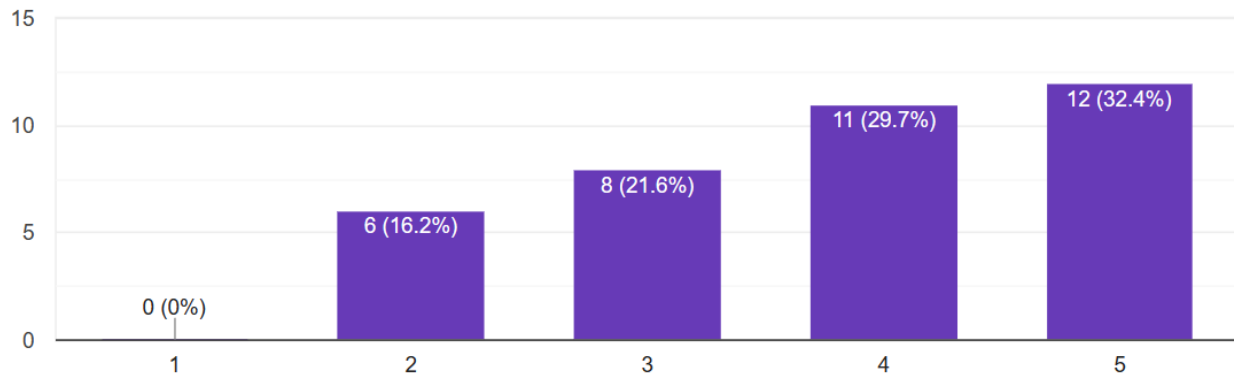


Figure 13 - Assessment of visibility in the institution's classrooms.

Regarding visibility in classrooms, more than 60% of students agree that the institution's classrooms provide good and sufficient visibility for teaching activities, whereas only 16% would disagree. Visibility in the classroom is one of the physiological determinants that must also be considered in order to increase productivity in the classroom and to meet human needs. In this respect, the figures also show that this psychological determinant has been taken into account by the institutions surveyed.

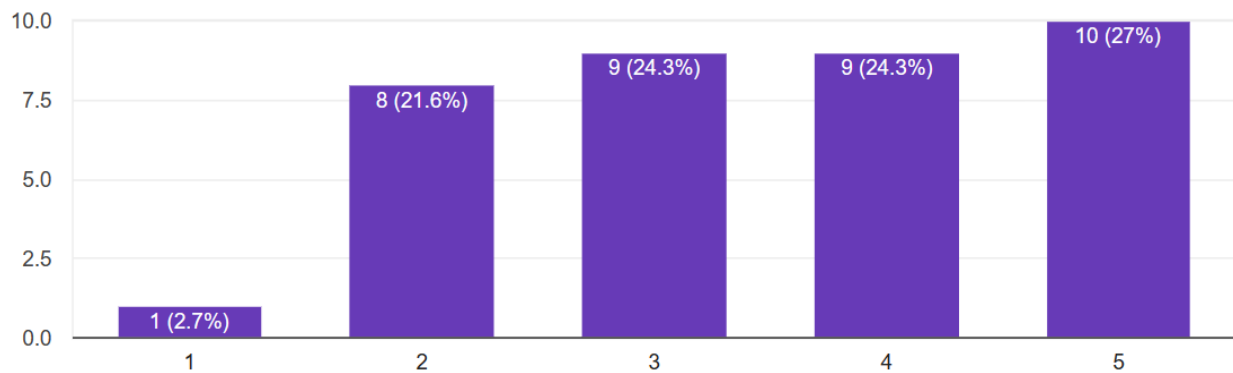


Figure 14 - Assessment of some ergonomic conditions of the classrooms.

Now, only about 51 percent of the students agree that the institution's classrooms have the ergonomic conditions, such as adjustable desks, needed to carry out teaching activities. The figures show that both institutions have room for improvement in this physiological determinant.

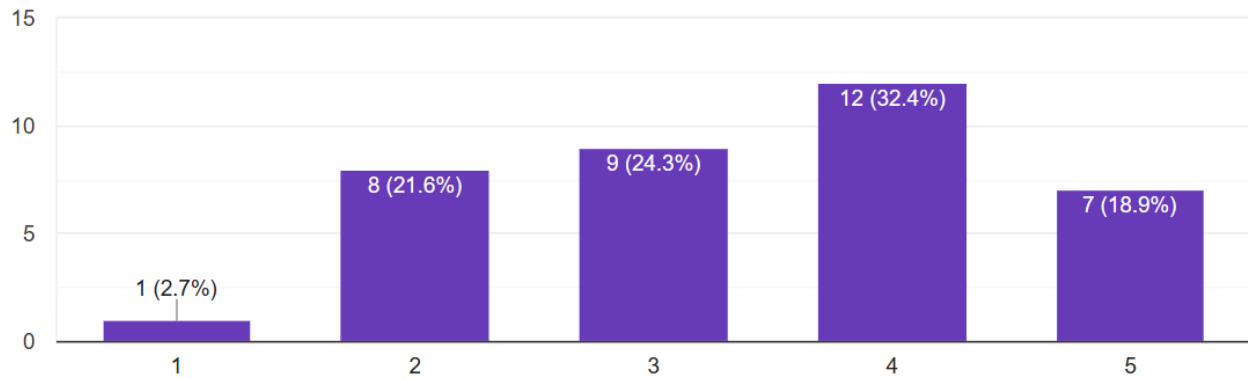


Figure 15 - Assessment of suitability of the classrooms for the number of students.

With regard to the suitability of the classrooms for the number of students in the class, the sample of opinions was fairly evenly distributed, as exhibited above. This sociological determinant assesses the size of the room in relation to its occupants, as it affects the distance at which a conversation can take place, which can also promote socialization. This almost even distribution of opinions suggests that things are not so bad in these institutions, but that there is room for improvement.

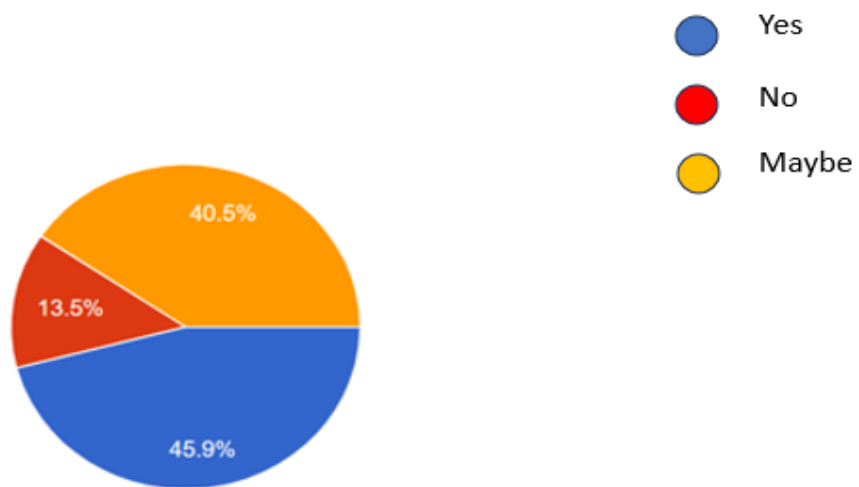


Figure 16 - How campus spaces promote socialization and collaboration.

When asked whether the physical spaces of the institution generally help to promote socialization, interaction and collaboration between students, 45% of students agreed, 40.5% were uncertain and only 13.5% disagreed. Students who agreed cited spaces such as the cafeteria, library, laboratories, factory, lounge, design rooms, and tents. According to this feedback, although there are some informal learning spaces in these institutions, these figures point to some shortcomings in this respect, indicating some room for improvement. However, we should not forget some of the limitations that prevent this increase in the short term, as we learned from the interviews with the pedagogical managers of the 2 institutions.

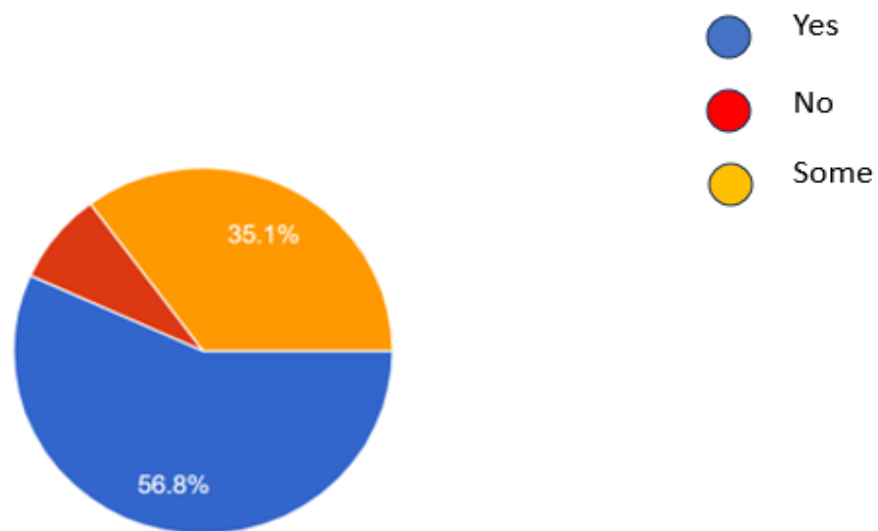


Figure 17 - Classroom premises for versatility.

Inquiring whether classrooms allow the use of different teaching and learning strategies to encourage interaction with the content, such as student activities and presentations, lectures and interactive teacher-led lessons, 58.8 percent agreed, while 8.1 percent disagreed and 35.1 per cent said that only some classrooms had such conditions. This evaluation of classroom functional efficiency shows that these specific need for learning environments to accomplish efficient teaching and learning goals are not so well fulfilled in both institutions.

4.5. Lecturer's Feedback

This session will explain the feedback from the lecturers' responses to the online questionnaire.

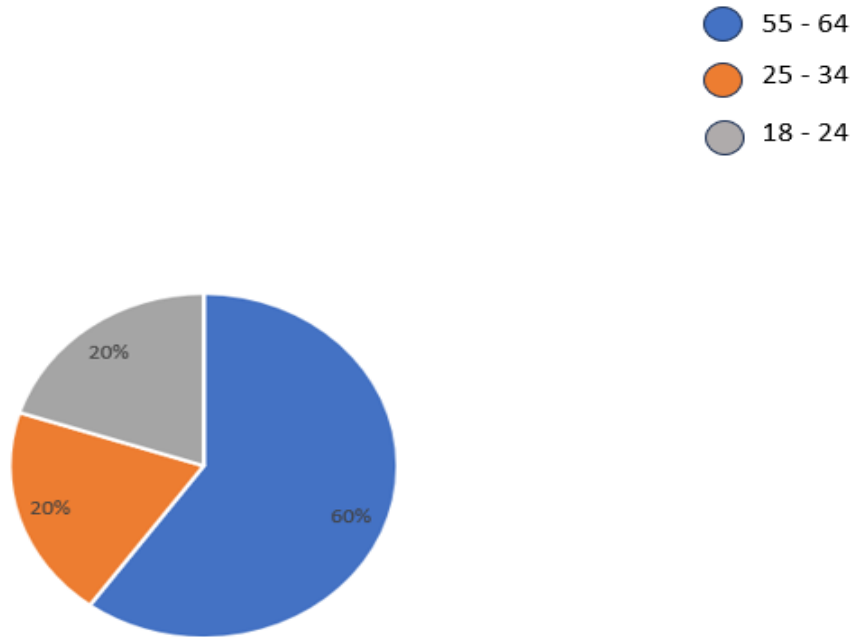


Figure 18 - Lecturers respondents' distribution by age group.

In terms of the age range of the population of teachers who responded to this online survey, 60 per cent of respondents are between 55 and 64 years old, while 20 per cent of respondents are between 25 and 34 years old, and the remaining 20 per cent are up to 24 years old. These percentages also felt quite proportional to what we can assess visually as most of the lecturers are indeed above fifties.

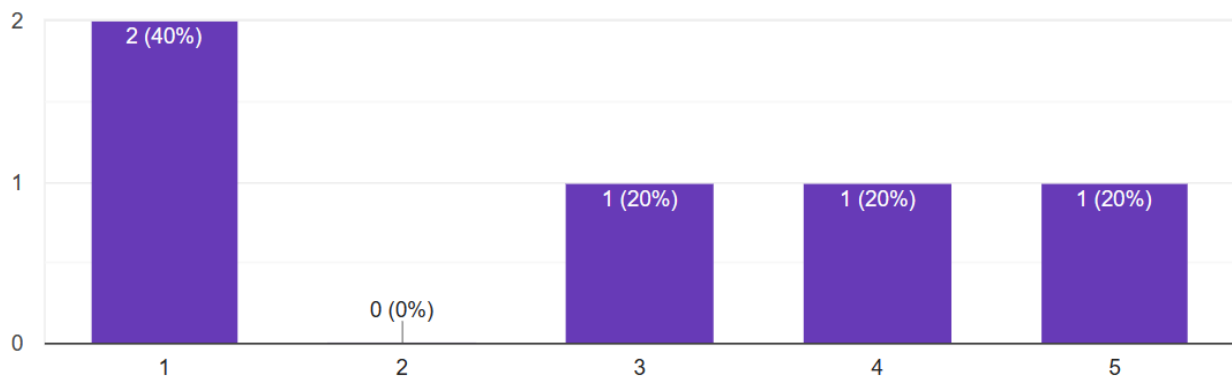


Figure 19 - Assessment of free space to move around and reach all students.

Responding whether the layout of the learning space allows a teacher, to move around freely and reach all students in the learning are applied in these institutions. Same way (whether they are working individually, in small groups or as a class), we see a fairly balanced distribution of opinions. The figures indicate some challenges in how these requirements for teachers to meet the objectives of effective teaching and learning.

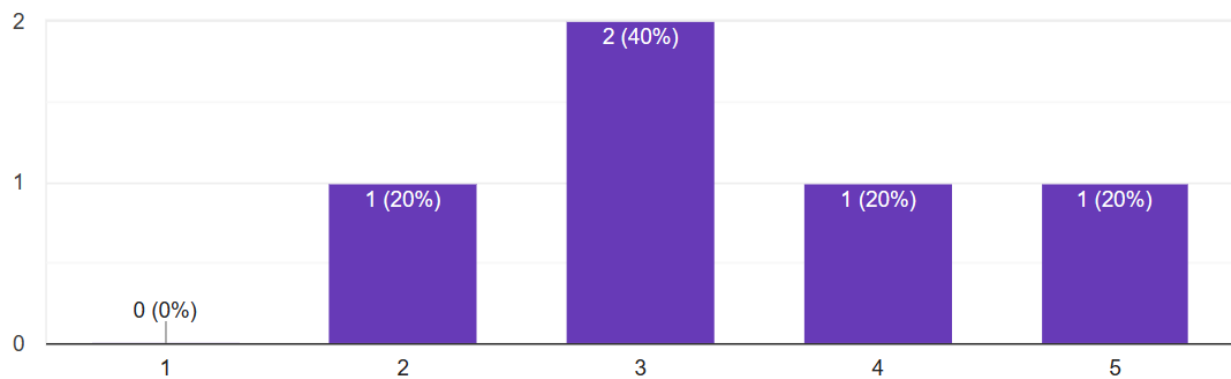


Figure 20 - Assessment of visibility across the classroom.

Questioned whether the layout of the learning space allows them to visualize the lesson, monitor students, assess their progress, and identify those who need help, 20% of lecturers disagreed, 40% were unsure and 40% agreed. Once again, in this specific aspect that also contributes to teachers meeting the objectives of effective teaching and learning in these institutions, we also see some room for improvement.

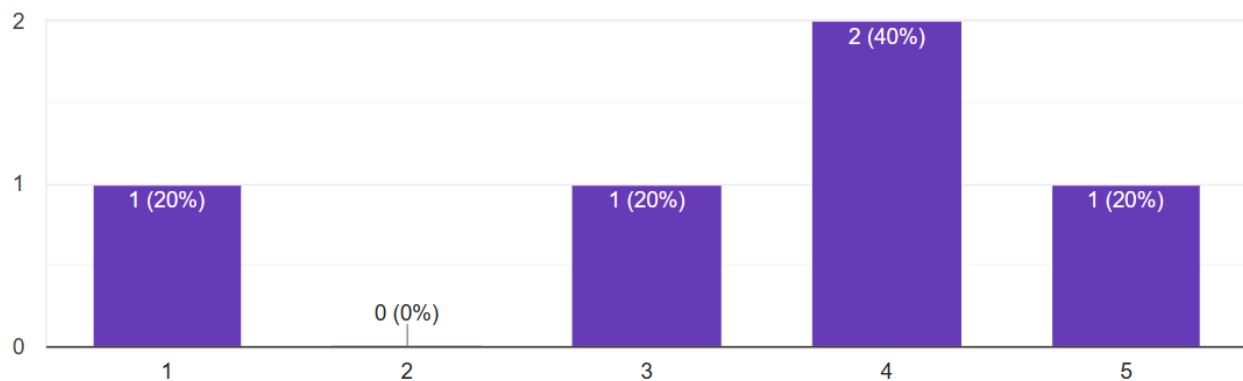


Figure 21- Assessment of the ability to implement different dynamics.

When asked if the configuration of the learning space allows the teacher to switch easily between different types of sessions, such as lectures, project work and debates, 60 per cent agreed, 20 per cent were unsure and 20 per cent disagreed. At this point, the figures are much better in this specific aspect that positively influences the achievement of effective teaching and learning objectives.

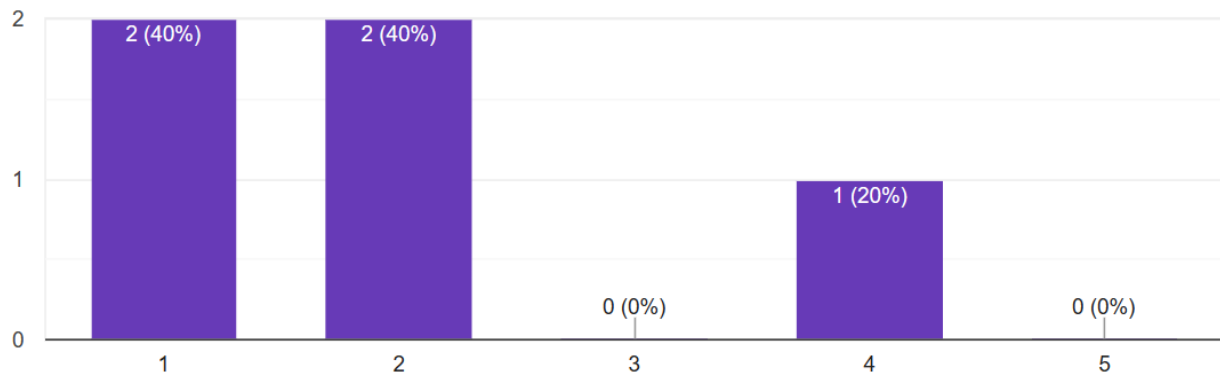


Figure 22 - Assessment of the centrality and polycentrism of the classroom.

When questioned whether learning spaces are designed to be acentric or polycentric, so that the teacher can motivate students to work by moving from one place to another, 80% of the lecturers disagreed while only 20% agreed. This is definitely an area that needs additional effort if these institutions are to meet this specific need for teachers to meet the Effective Teaching and Learning Goals.

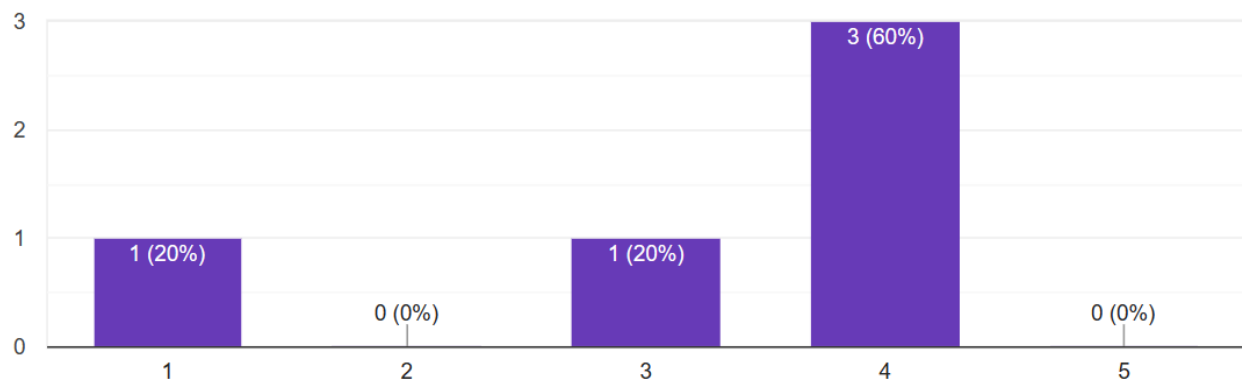


Figure 23 - Evaluation of the technological means in the classroom.

When evaluating whether the facilities offer a variety of technologies that allow for collaboration between teachers and students, knowledge building, and sharing, 60 percent of lecturers agreed,

while 20 percent disagreed and a further 20 percent were unsure. As we have already learned, technology is now also an essential element of the physical learning environment and the figures show that both institutions are responding appropriately to this need of their students, which contributes to the effective achievement of teaching and learning objectives.

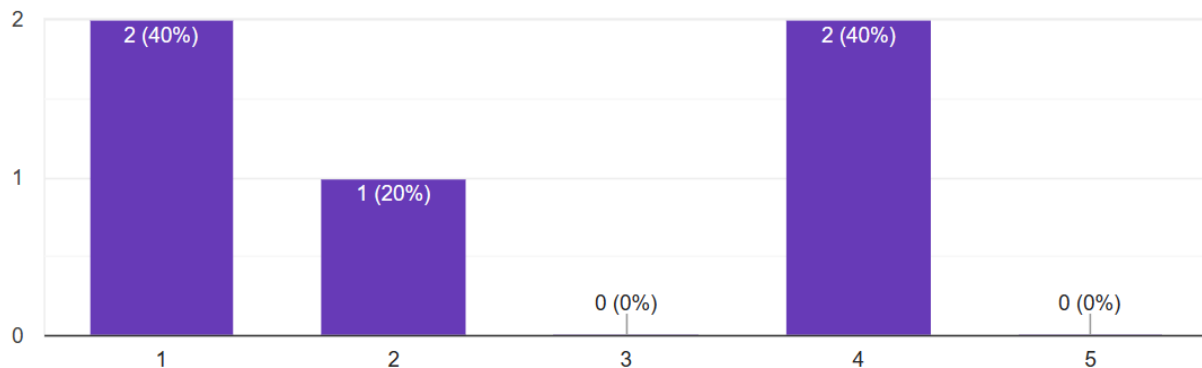


Figure 24 - Evaluating the adaptability of the classroom.

When asked if the learning space allows for adaptability to support a variety of learning styles, activities and technologies to meet the specific needs of each student, 60% of the lecturers disagreed, while 40% of the lecturers agreed. In this respect, the figures show that these institutions need to do a much better job when it comes to this element, which also contributes to the achievement of teachers' objectives for effective teaching and learning.

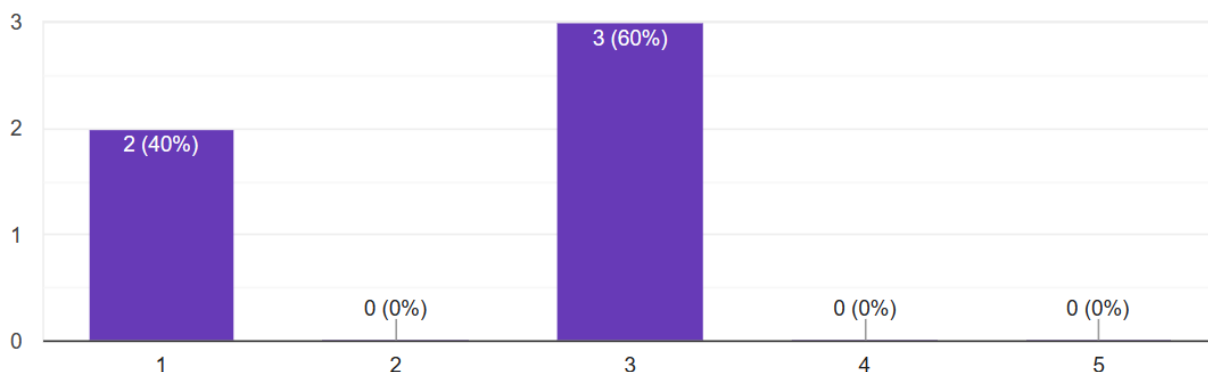


Figure 25 - Evaluating the furniture and versatility in the classroom.

Asked whether classrooms have movable furniture that can be easily rearranged to support different learning strategies, whether individual, group or peer, 40% of the lecturers totally disagreed while 60% were not so certain. The figures suggest that this is another area where much improvement is needed if these institutions are to effectively meet the needs of teachers to achieve teaching and learning objectives.

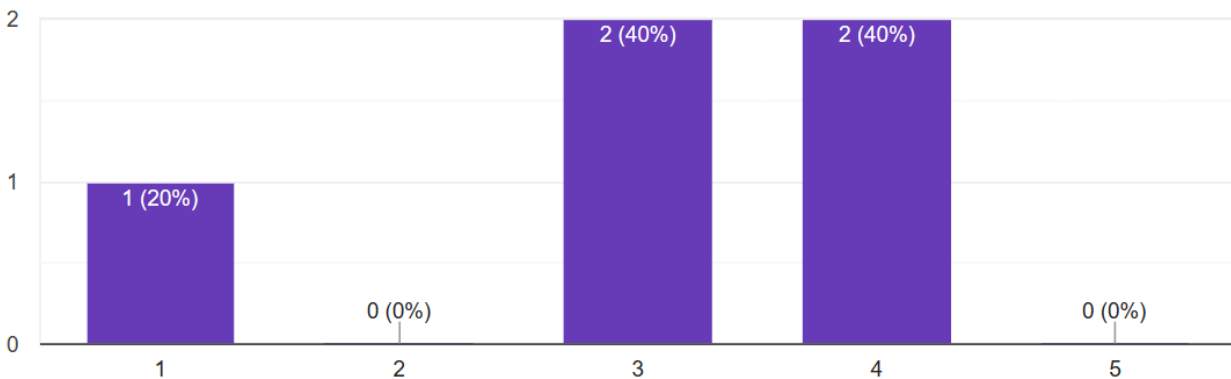


Figure 26 - Evaluation of classroom means to share and discuss results.

When asked whether the classroom allows students to present the results of their interactions for the teacher and other students to see and discuss, 40 percent of teachers agreed, 20 percent disagreed and 40 percent were unsure. The figures aren't excellent but are also not bad.

5. Conclusions

Therefore, after analyzing this survey, we can conclude that IADE and QBN can be positively assessed in terms of the following requirements and criteria for well-designed physical learning spaces:

- The psychological, and physiological determinants that contribute to increasing productivity and satisfying human needs.
 - Visual and acoustic restrictions are well implemented in both institutions.
 - Classrooms provide good and sufficient visibility for teaching activities.
- We can also conclude that classrooms meet some conditions for teachers to achieve effective teaching and learning goals, namely
 - Teachers' ability to switch quickly between different types of instruction, such as lectures, projects and discussions.

- Availability of technologies to create and share knowledge.
- Classroom's means to share and discuss results.

However, we can also conclude that some elements, while not bad, deserve attention as they show some room for improvement:

- Ergonomic conditions in the classrooms can be further enhanced as these physiological determinants influence increased productivity.
- The room adequacy in relation to its occupants is also an essential sociological determinant that needs to be met.
- The number of physical spaces that promote community-building, socialization and collaboration thus contributing to learning can also be improved.
- In terms of classrooms providing the necessary premises for students and teachers to achieve effective teaching and learning goals the following elements were found to have room for improvement:
 - Ability of classrooms to enable versatility in the use of different learning strategies.
 - Classrooms space allowing the teacher to move around freely or to reach all the students in the classroom.
 - The classroom's configuration allowing the teacher to easily switch to another type of methodology such as project work or debates.
 - Availability of mobile furniture to support flexibility.

On a different note, some other elements, and criteria for improving learning and achieving effective learning and teaching goals were rated negatively, as follows:

- Existence of acentric or polycentric classrooms
- Adaptability of the classrooms to support a variety of learning styles and activities.

Hence, recalling our research question here:

RQ1: What criteria do higher education institutions in Lisbon consider when designing physical learning spaces?

- RQ1a: Do these criteria include the requirements of effective teaching and learning?

We can conclude that although there has been no new construction of physical learning spaces or even more radical physical changes in recent years, and based purely on the most recent

renovations these institutions have undergone, as well as investments in technology, furniture, and other related areas, we recognize that the following criteria are considered:

- Satisfaction of psychological, physiological and sociological determinants, although there is room for improvement.
- Conditions that are conducive to informal learning.
- The transition from the traditional teaching style to a more modern style that allows the implementation of other learning dynamics, such as challenge-based learning, problem-based learning and simulation-based learning.

Effectively, these criteria include the satisfaction of some requirements to meet effective teaching and learning such as:

- Classroom facilities for sharing and discussing results.
- Availability of technologies for creating and sharing knowledge.
- Teachers' ability to move quickly between different types of teaching, such as lectures, projects and discussions.

With regards to our hypothesis, that “HEI are not applying established criteria for designing physical learning spaces that achieve functional efficiency of classrooms that meet the needs of teachers and students in accomplishing effective teaching and learning goals” and the second hypothesis “HEI managers are not aware of any established criteria for designing physical learning spaces that achieve functional efficiency of classrooms that meet the needs of teachers and students in attaining effective teaching and learning goals”, the conclusions of the study lead us to reject both hypotheses. Starting from the second hypothesis, the study indicates that the HEIs selected are aware of some criteria for designing physical learning spaces that achieve functional efficiency of classrooms that meet the needs of teachers and students in achieving effective teaching and learning goals. We get this from the interviews with the pedagogical staff, which is later confirmed by some figures obtained in the online questionnaires.

For the first hypothesis, the study showed, that despite some constraints and limitations in terms of available space, the selected HEIs do apply some elements of an established set of criteria for designing physical learning spaces that attain functional efficiency of classrooms that meet the needs of teachers and students in achieving effective teaching and learning goals.

5.1. Recommendations

As a result of the practical study, we recommend the following actions, especially when both institutions plan the migration to the new physical learning spaces:

- 1 Additional investment to assure ergonomic requirements are met as this is one of the physiological determinants that influences productivity and satisfaction of humane needs.
- 2 Sociological determinants such as the size of the room in relation to its occupants, as this affects how far away conversations are.
- 3 Increasing the number of physical spaces that encourage community-building, socializing and working together, and thus contribute to learning, can also be improved.
- 4 Invest in modular classrooms to allow versatility in the use of different learning strategies.
- 5 Continue to invest in mobile furniture to support the flexibility of the classroom and to adapt quickly to the different dynamics of the teaching process.
- 6 Investment on at least a few acentric or polycentric classrooms in order to enable teachers to motivate students to work by moving from one place to another.

5.2. Limitations and future research

It would have been very interesting to extend this research to a few more universities in Lisbon and even throughout the country. However, logistical constraints prevented us from going any further. In this research, we also missed the opportunity to get the Ministry of Education's point of view on the existence of a set of criteria or guiding principles that they expect or recommend HEIs to follow when implementing renovations to their learning spaces or even when designing new learning spaces.

If the budget is available, a research project could also be carried out to better understand the qualitative and quantitative levels of improvement in terms of student achievement and learning outcomes in educational institutions that apply guiding principles or criteria for the design of physical learning spaces versus those institutions that do not apply any criteria and are still very much stuck in the traditional style of teaching in the geographical context of Lisbon and other cities in Portugal.

In addition, it would be vital for future work to consider the aspect of maintenance of physical learning spaces, as this is a key component for the sustainability of the learning process in higher education institutions. Furthermore, it is also recommended to explore the role that design can play in the contextual surroundings of the learner, such as cultural diversity, income inequality, age differences between students, climate of the country and religion, as all of these can be a barrier to the learning process of higher education students.

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Anexo 1

Carta de Apresentação as instituições do ensino superior em Portugal

Cordiais saudações,

Obtive o vosso contacto através do website institucional da vossa instituição. Gostaria de solicitar a vossa participação num projeto de investigação no âmbito do Mestrado de Gestão do Design do IADE, Faculdade de Design, Tecnologia e Comunicação da Universidade Europeia. A proposta de investigação pretende conduzir um estudo em torno do impacto do design dos espaços físicos das instituições do ensino superior no processo do aprendizado e compreender a implementação de alguns princípios guia no design dos espaços de aprendizado das instituições de ensino superior em Portugal e seus benefícios.

Considero importante a vossa participação e experiência para o desenvolvimento desta investigação, caso tenha disponibilidade e interesse para tal. Se for aplicável, e do vosso interesse, os resultados desta investigação poderão eventualmente trazer algum contributo para a vossa instituição à nível de recomendações para que os vossos espaços de aprendizado se tornem mais flexíveis e conseqüentemente, ambientes de aprendizagem que promovam melhor aprendizado através de uma maior colaboração e integração social entre os estudantes.

Em seguida poderá encontrar respostas a algumas questões pertinentes sobre a sua possível participação no estudo. Não hesite em contactar caso tenha alguma questão sobre esta carta ou qualquer informação que gostaria de ver aprofundada.

Título do Projeto: Designing physical learning spaces for effective teaching and learning.

Investigador: Moreno Dias

Objetivo deste Método de Pesquisa:

Em primeiro lugar, utilizar a pesquisa quantitativa via questionário, para compreender dos alunos e docentes o seu ponto de vista sobre o contributo dos espaços de aprendizado para promover a socialização e a partilha e como isso de facto contribui para um melhor aprendizado. Em segundo lugar, utilizar o método qualitativo para confrontar os resultados obtidos na pesquisa quantitativa e também auferir junto dos gestores através de uma entrevista, o seu posicionamento sobre os espaços de aprendizado da instituição em questão, desafios e benefícios. Em terceiro lugar gostaria também de realizar alguma observação, discreta e não invasiva, para permitir a coleta de mais dados pertinentes a este projeto de investigação.

Objetivos desta investigação:

- Compreender quais critérios são levados em consideração no processo de design e implementação dos espaços de aprendizado.
- Consultar as condições dos espaços de aprendizado para promoção do active learning?

- Entender as barreiras existentes no processo de design e implementação dos espaços físicos de aprendizagem.

Como será a vossa participação?

Este estudo consiste na realização de uma entrevista semiestruturada, questionário online, e algumas sessões de observação para recolher informações pertinentes a questões relacionadas aos espaços físico de aprendizagem e sua contribuição para o ensino e aprendizagem. Seria de grande interesse que você pudesse participar de uma entrevista no Google Meets, com uma duração aproximada de 30 minutos.

A minha participação será confidencial?

Sim. Os resultados obtidos serão utilizados apenas para fins académicos.

Informação de contacto:

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Agradeço desde já a vossa valiosa colaboração e aguardo o seu posicionamento.

Atenciosamente,

Moreno Dias