

LTSHE

Learning and teaching space in higher education



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Exploration of Policy and Practice: Learning and Teaching Space in Portuguese Higher Education

“National Report” by **University of Aveiro** about policy and practice of designing L&T spaces in Portugal higher education including institutional levels

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Executive Summary

The first report resulting from the work developed by the Portuguese team within the LTSHE project aims to explore the policy and practice of designing and implementing learning and teaching (L&T) spaces in Portuguese higher education at national and institutional levels. Although challenging, mainly because there is not much official information on the design or implementation of L&T spaces in Portuguese higher education, this lack of information showed to be also one of the reasons why it is relevant to work on this specific output considering that the project aims to develop a set of comprehensive design principles that institutions can draw on to inform the development of new learning spaces (NLS). Thus, and despite challenging, it was possible to find some NLS in seven Portuguese higher education institutions and also some national guidelines regarding new learning spaces by drawing a parallel between the Portuguese higher education system and the non-higher education system, where such guidelines are at a more developed stage.

Output 1 herein presented was developed within the LTSHE – Learning and Teaching Spaces in Higher Education, an Erasmus + project that arose from the need felt for the development of a set of core principles that may be useful to institutions to help them design and build new learning and teaching spaces, along with the increasing quality assurance concerns regarding the inclusion of aspects concerned with buildings and built L&T spaces. The final output – that of developing a set of core principles that help institutions design NLS – needs to build upon data collected from national exploration of policy and practice in that regard, in each member state involved in the project.

Both the strategic framework for European cooperation in education and training (ET 2020) and the renewed EU agenda for higher education (2017) set up as a priority the promotion of research-based teaching, supporting inter-disciplinary education and research, and bringing pedagogical innovation into the classroom. Furthermore, there is strong evidence claiming for the efficacy of active learning strategies, such as collaborative, problem-based, inquiry-based and challenge-based learning. Within this context, discussion of the theoretical issues underlying the design and development of L&T spaces in the Portuguese case draws on a literature review claiming for the role played by new learning spaces in supporting active, real world-centred and cross-disciplinary problem-solving learning and teaching methodologies. Literature shows that spaces, both physical and virtual, are increasingly acknowledged as having an impact on learning and as being themselves agents for change. Therefore, there is an increase on emphasis placed on the design of NLS and its impact on pedagogy.

Based on the analysis of papers focusing on Portuguese NLS, it was possible to identify emerging guidelines for universities, which are presented and discussed within the following categories: i) University policy; ii) University organization; iii) University pedagogy and curriculum design; iv) Digital structures in universities; and v) Planning and creation of physical learning and teaching space.

In terms of methodology, the exploration of policy and practice regarding L&T spaces in Portuguese higher education was organised as a desk-top analysis, based on a set of information collected from different sources – national legislation, national and institutional policy documents and the guidelines for the assessment and accreditation of degree programmes,

institutions and internal quality assurance systems – and actors – rectors of all Portuguese public universities were contacted. During this first phase of the project, it was possible, through a snowball effect, to identify 7 NLS in Portuguese higher education institutions, which provide interesting examples of good practices at this level.

Analysis to the existing Portuguese policy legislation directed at the higher education system and to the guidelines issued by A3ES (Agency for Assessment and Accreditation of Higher Education) for the assessment and accreditation of study programmes, institutions and internal quality assurance systems did not provide as much information as expected regarding issues such as digitalisation in higher education, importance and status of didactics, pedagogy and curriculum design in higher education and the importance and status of physical L&T spaces. Namely, L&T space design and implementation is only briefly addressed in the legal documents that rule the Portuguese higher education system. Overall, it is possible to say that the Portuguese legal framework establishes the need for adequate L&T spaces, but it does not provide any rules or details on how those spaces should be designed or implemented. Nor it specifically establishes the importance of space for the implementation of quality and innovative L&T practices. However, L&T spaces are a concern when it comes to the accreditation of study programmes and institutions.

In fact, in terms of quality and specific guidelines addressing quality assessment of L&T spaces, these are understood as relevant for the quality of L&T, and subject to external assessment under the Portuguese quality assurance system. Nevertheless, it is fair to say that the way these spaces are designed and implemented in each institution and/or by each degree programme are very much left to the decision of each university.

With regard to university strategy and practice for the design and implementation of L&T spaces in Portuguese higher education, there is again a lack of specific information on L&T spaces that enhance innovative L&T strategies and environments while scanning through the strategic and activities plans of 13 Portuguese public universities, through a search per keyword.

Overall, Portuguese public universities' strategic and activities plans evidence the importance given to L&T spaces for the L&T process. Only four universities make no reference to them in their strategic and activities plans. Among the universities that do evidence concern about (innovative) L&T spaces, some show already having implemented such spaces and others prospect to have specific spaces addressed to enhance the (innovative) L&T process. Some references address concrete action and others are vaguer and simply refer the need to have infrastructures that support L&T activities and to improve already existing L&T infrastructural conditions. As such, data collected in the strategic and activities plans does not allow to go further in the analysis of how Portuguese universities address relevant questions related to L&T space, such as who is engaged in the design and implementation of those space, how the space is actually designed and implemented or how does it relate to organisational levels and units.

It was, nevertheless, possible to identify and collect more specific information on four cases of NLS in Portugal that are presented as examples of potential good practices of physical L&T spaces existent in Portuguese higher education institutions: the FTE-LAB – Future Teacher Education Lab, at the Institute of Education of the University of Lisbon; the CreativeLab_Sci&Math®, at the Higher School of Education of the Polytechnic Institute of

Santarém; at the University of Algarve, different spaces were pointed out by the Pedagogic Innovation Support Office as have being designed and developed to support new teaching and learning methodologies; and the Laboratory of Teaching and Learning Methodologies (LMEA@UA), at the University of Aveiro.

Some recommendations can be drawn from these findings, some addressed to national policy makers (Ministry of Science, Technology and Higher Education) and the national Agency for Assessment and Accreditation of Higher Education (A3ES) and some addressed to the higher education institutions themselves, such as:

- To check for good practices that have already been implemented at national and at international level, by reviewing national and international documents on the subject and by promoting on-site visits.
- To regulate L&T spaces building norms by reviewing existing legislation on higher education or creating new one and doing so considering the context of innovative L&T approaches so that these new spaces fit that purpose.
- To learn from the remote emergency L&T experience and provide norms/legislation for these new innovative L&T spaces to be easily adaptable to e-learning needs.
- To review A3ES accreditation and assessment guidelines (programme degrees, institutions and quality assurance systems) to include specific guidelines on L&T spaces, both physical and virtual infrastructures.
- To organize national events that bring together higher education institutions so that already implemented good practices can be shared and the floor open to discussion on the topic of how should NLS be in order to enhance and serve innovative L&T approaches.
- Performance indicators on innovative L&T spaces characteristics should feature in internal quality assurance systems of higher education institutions.
- Higher education institutions should include in their strategy and activities plans the design and building of L&T spaces that reflect concerns on innovative L&T approaches.
- To reflect internally (in HEIs) on innovative L&T approaches, assess existing and possible L&T spaces and how they should be like.

1. Introduction

The present Intellectual Output O1 of the LTSHE project explores the policy and practice of designing and implementing learning and teaching (L&T) spaces in Portuguese higher education comprising the national and institutional levels.

Preparing this report was not an easy task, mainly because not much official information exists on the design or implementation of L&T spaces in Portuguese higher education. The national policy laws and regulations addressing higher education in Portugal, including those related to its quality assurance system, only briefly refer to L&T spaces and always in very generic terms. On the same vein, the official institutional documents (strategic plans plus activities plans) only marginally address L&T spaces or do not mention this issue at all. Furthermore, the contacts established with Portuguese public universities were not very fruitful at this respect, with only a very small number of institutions answering our call for more specific information on how they address L&T spaces. Perhaps this was an effect of the pandemic crisis, but it may also be the case that so far this is not indeed a concern for most of public universities, despite the fact that learning and teaching pedagogic innovation and improvement tend to appear in the agendas of institutions nowadays.

Perhaps this lack of information is also one of the reasons why it is relevant to work on this specific output and based on the information (non)collected to come to at least some recommendations for action related to the role L&T spaces can have in further enhancing higher education quality in Portugal. In order to find additional substance for such recommendations, a review was made of a set of identified papers that specifically deal with the development of L&T spaces in the Portuguese non-higher education sector, in search of relevant guidelines that can be translated to the higher education context (see Section 2 of this report).

This report proceeds as follows. Section 2 discusses the theoretical issues underlying the design and development of L&T spaces, in particular for the Portuguese case. Section 3 presents the methodological approach. Section 4 presents the findings related to the national policy and practice for L&T spaces in Portugal, while section 5 describes the existent policies and practices but at institutional level. Finally, section 6 summarizes the findings and puts forward a set of recommendations on how to address L&T spaces at national and institutional level, so they can indeed contribute to better learning environments, able to foster the quality of higher education learning and teaching.

2. Theoretical issues

Following the Education and Training 2020 framework¹ and the EU agenda for Higher Education (HE)², one priority for action is the support of effective and efficient HE systems, by building links between HE Institutions and outside partners, promoting research-based teaching, supporting inter-disciplinary education and research and bringing pedagogical innovation into the classroom. Strong scientific evidence from different fields shows the efficacy of active learning strategies, such as collaborative, problem-based, inquiry-based and challenge-based learning (Hsieh, 2013; Michael, 2006). For that endeavour, flexible and technology-enriched new learning spaces (NLS) supporting active, real world-centred and cross-disciplinary problem-solving learning and teaching methodologies, are crucial (Elkington & Bligh, 2019; Pombo, Carlos, & Loureiro, 2017; Wilson & Randall, 2012). As spaces, physical or virtual, are themselves agents for change and can have an impact on learning, the power of built pedagogy (ability of space to define how one teaches and learn) is being increasingly acknowledged in HE (Elkington & Bligh, 2019; Oblinger, 2006) and emphasis is being placed on the design of NLS and its impact on pedagogy (Groff, 2013; Neary et al., 2010). Three major trends inform current NLS design: learning principles to support social and active learning strategies; human-centred design; and digital devices that enrich learning (Neary et al., 2010; Oblinger, 2006). The student's voice and their collaboration with staff is key (Jolly, Llewellyn, & Sober, 2019) and the designs of NLS should also be informed by research on pedagogical principles and by evidence-based evaluations (Neary et al., 2010).

Since new buildings and innovatively designed spaces, on their own, are no guarantees of learning outcomes improvement (Elkington & Bligh, 2019; Wilson & Randall, 2012), empirical studies on impact assessment of NLS are highly encouraged (Imms, Cleveland, & Fisher, 2016; Temple, 2008). Considering the difficulties of assessing the ways in which NLS affect academic engagement, teaching methods and use of learning spaces (Neary et al., 2010), several theoretical frameworks for assessing NLS have been developed, namely: Framework for the Evaluation of Learning Spaces–FELS; Post-occupancy evaluation–POE, Pedagogy-Space-Technology–PST; Effective Models and Practices for Technology Supported Physical Learning Spaces–JELS and Effective Teaching and Learning Spatial Framework (Dane, 2016; Imms et al., 2016; Pearshouse et al., 2009).

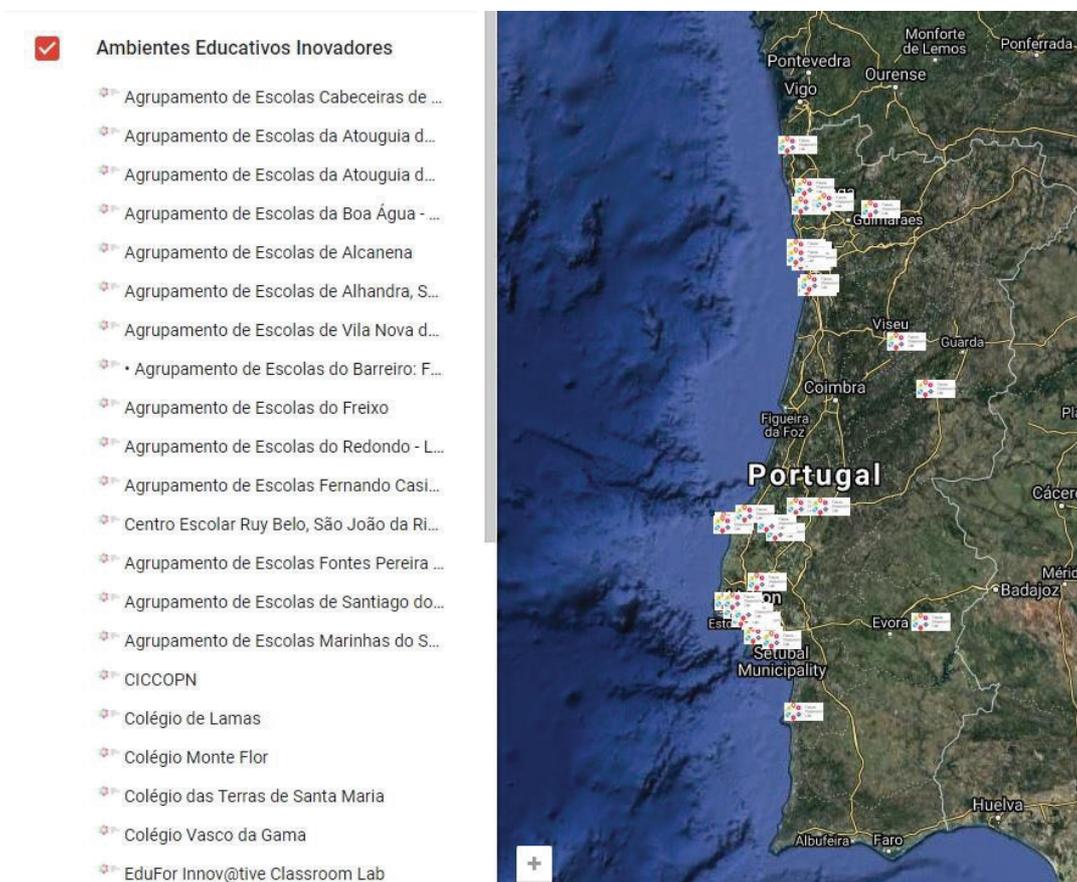
Scientific research on Portuguese HE NLS is scarce, in what concerns both policy, design and assessment of pedagogical impact of L&T spaces. Another relevant indicator of the lack of investment and/or discussion about this topic in Portuguese HE is that from the 32 ILE - Innovative Learning Environments in Portugal (<https://erte.dge.mec.pt/innovative-learning-environment>) (see Figure 1), the Portuguese General Direction of Education (DGE/ERTE) has

¹ET 2020 framework (https://ec.europa.eu/education/policies/european-policy-cooperation/et2020-framework_en)

²EU agenda for Higher Education (2017) (<https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52017DC0247&from=EN>)

identified only one ILE related to the Higher Education context: Lisbon Institute of Education – FTE-LAB (Future Teacher E-ducation Lab) (<http://ftelab.ie.ulisboa.pt>).

Figure 1 | Map of Portuguese ILE - Innovative Learning Environments (excerpt)



Source:

<https://www.google.com/maps/d/viewer?mid=1jxpwzSLprQhcxDUljNIDguCiiTw&ll=40.45952763616644%2C-6.581178859539646&z=7>

However, the Portuguese partner of the LTSHE project has managed to identify four other ILE in HE, due to a contact with the specialized furniture company for flexible learning environments *Steelcase* (which is working with the University of Aveiro in the implementation of a NLS at its premises), namely the spaces located at: the Higher School of Education of the Polytechnic Institute of Santarém; the Lusophone University - DELLI Space; and the Polytechnic Institutes of Leiria and Setúbal (still under construction). Moreover, the existence of other NLS has been pinpointed to the Portuguese team after an interview with one of the responsible for the FTE-LAB: one dedicated to History teaching at the University of Coimbra; a post-graduation classroom especially designed for blended learning at the Polytechnic Institute of Porto; and one at the Portuguese Catholic University Business School. Also, the Nova Information Management School (NOVA IMS), the Data Science Institute of the New University of Lisbon, is now the first higher education institution in Portugal to provide all its classrooms with intelligent teaching

tools. Some of the responsible for these spaces have been contacted and we were able to gather relevant information about the Higher School of Education of Santarém and the Institute of Education of the University of Lisbon (reported in section 5 of this report).

In order to overcome the lack of literature on NLS in HE, and still identify some guidelines regarding these spaces and their relevance for L&T improvement, Portuguese studies were gathered concerning the non-higher education system, such as the one by Pedro (2017a) that analysed 19 Portuguese NLS in basic and secondary schools. Therefore, a total of 9 article papers focusing on Portuguese NLS were identified: Veloso, Marques and Duarte (2014), Pedro (2017a), Pedro (2017b), Sardinha and Almeida (2017), Sardinha, Almeida and Barbas (2017), Monteiro et al. (2018), Baeta and Pedro (2018a), Baeta and Pedro (2018b) and Correia and Cavadas (2019) (Figure 2). Based on the analysis of these papers, it was possible to identify emerging guidelines for universities, which are presented and discussed within the following categories: i) University policy; ii) University organization; iii) University pedagogy and curriculum design; iv) Digital structures in universities; and v) Planning and creation of physical learning and teaching space.

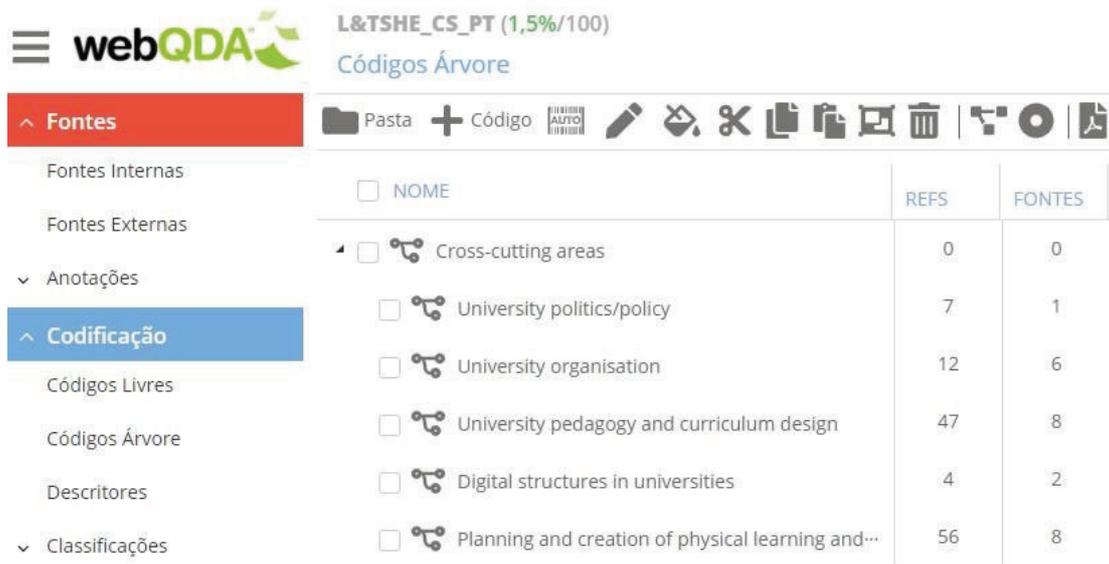
Figure 2 | Studies analysed – qualitative analysis (content analysis technique)

NOME	NOTA	CLASSI...	CÓDIG...	REFS
2019_Correira_As implicações dos Ambientes Educativos Inovadores para as práticas dos professores			4	18
2018_Pedro_Salas de Aula do Futuro			3	16
2018_Pedro_AMBIENTES EDUCATIVOS INOVADORES vs SALAS DE AULA REGULARES_TiCEduca			1	1
2018_Monteiro_AMBIENTES Educativos inovadores em Portugal			4	7
2017_Sardinha_The Classroom Physical Space as a learning ecosystem_SLERD			5	18
2017_Pedro_REDESIGNING LEARNING SPACES WHAT DO			2	16
2017_Pedro_Práticas Educativas nas Salas de Aula do Futuro			3	21
2014_Veloso_Changing education through learning spaces			4	20
2017_Sardinha_O espaço físico multidisciplinar_Conf			4	14

Source | WebQDA software (<https://app.webqda.net/>)

From the content analysis conducted (see Figure 3), the categories that presented most relevant guidelines were: “Planning and creation of physical learning and teaching space”, with 56 references within 8 studies, and “University pedagogy and curriculum design”, with 47 references within 8 studies.

Figure 3 | Codification structure and percentage of references coded by categories



Source | WebQDA software (<https://app.webqda.net/>)

After the coding process was completed, the references coded in each study, by category, were combined in signification clusters, as presented below.

University politics/policy - political debates over higher education and its provision; engagement with external communities

- A study that analysed the impacts of a nation-wide school renovation program in Portugal concludes that **the upgrading of schools increased pride in and responsibility for the school, but teaching practices remained set in a traditional mould**, remaining tensions between the objectives defined at the political level and effective conditions for learning. Although the need to accommodate scientific and technological innovations into the educational process is generally recognized, the relationship between learning paradigms and political decisions is unclear, and generates, as in the Portuguese case, a lively debate about its virtue and effectiveness (Veloso, Marques and Duarte, 2014);
- The former study also reports the Secondary Schools Modernisation Programme (SSMP) with the broader objective of reforming the state school buildings, based on the assumption that the quality of school buildings is a driving force for improving education and promoting equal access to education. It was launched in 2007, together with the creation of a state-owned company – Parque Escolar (PE) – to materialize the programme. Its objectives go beyond the improvement of schools’ conditions and, as a result of the requirements demanded of the architects in terms of programme and timings, it ends up influencing the pedagogic programmes, the teachers’ professional practices, the space occupation by pupils, etc., concluding that a neutral perspective of

architecture and space is not defensible. Moreover, one of the specific aims of the SSMP was to reshape the dominant teaching practices in Portuguese secondary schools (which were mainly directed at training pupils to pass university access exams), providing the physical support to the heterogenization of learning spaces, inside and outside classrooms, and particularly values spaces oriented towards vocational and artistic education. This massive investment in renovating schools was justified by two factors: the physical degradation of schools; and the obsolescence of school buildings largely due to changes in school curricula and teaching methods, the generalization of vocational education, and the large-scale introduction of ICT (information and communication technologies) in schools (Veloso, Marques and Duarte, 2014).

University organization - how an institution is managed; how learning and teaching is managed; how all actors are integrated; influence of teachers over how institutions develop

- A paper was identified that presents the results of research work based on studying the role of innovative interior design strategies in the creation of new educational spaces, for the creation of a Digital Future Classroom (DFC). This DFC is meant to promote the inclusion of the young population Not in Education, Employment or Training (NEET) and Refugees, based on different approaches to physical space in which space interacts and depends directly on various dimensions such as social, cultural, architectural and digital (Sardinha, Almeida and Barbas, 2017). This study points out as main guidelines that: i) the study of the physical space of the classroom should have a multidisciplinary and multidimensional approach; ii) it is essential to interview key elements, among decision makers, teachers, students and architects/designers who are involved in Portuguese Future Classroom Labs;
- The study of Veloso, Marques and Duarte (2014) also points out relevant insights on the participation process regarding new learning spaces design. The diversity of processes developed in the 13 case studies analysed shows that there is a long way from the listening stage to active user engagement. In the 13 case studies it was possible to identify models of resistance, negotiation and collaboration. In fact, users' perceptions of the program's impact are strongly dependent on the way they participated in this process. That is why it is important to outline participation models in the design process, not only for consultation purposes, but as part of a comprehensive discussion of learning models and practices, in order to attain a shared understanding among staff and students of what learning is, or could be. Moreover, the study of Veloso, Marques and Duarte (2014) emphasizes that, aiming at linking the participation process with the impacts of the renovation of the school buildings, both schools and political actors need to consider that to renovate education spaces demands taking into consideration their users' needs and objectives. However, this demands that social actors inside schools – teachers, principals, pupils – settle models of participation and define learning principles;
- Sardinha, Almeida and Barbas (2017) also stress that smart learning ecosystems encompass not only the students, teachers and school staff as individual actors of the

learning process but also the stakeholders, surrounding community, family, services, social life, challenges and skills of all actors involved in learning processes;

- Correia and Cavadas (2019) also reported that FCL-related (Future Classroom Lab) projects have involved policy makers, industry partners, teachers, higher education institutions and other educational agents in the construction of teacher learning scenarios;
- Finally, in what concerns the only active learning space in HE documented on the literature - Future Teacher Education Lab (situated in the Lisbon Institute of Education), from Pedro and Baeta (2017), it is mentioned that, while it was designed for teacher training, the mentioned laboratory also serves to provide its visitors (policy makers, project partners, teachers and other interested parties) with opportunities for reflection and discussion on what they aim for in the Classroom of the Future and what strategies it is necessary to implement so that the ambitious vision becomes attainable for its realization.

University pedagogy and curriculum design - what are the key principles of pedagogical practice – for example, shift from teaching focus to learning focus, or moving from big lecture classes to small and more collaborative group classes

- **The classroom environment is not neutral**, it communicates to students what they can and should do in it. A classroom with fixed rows and individual tables gives students an idea very different from that transmitted by a room whose tables and chairs are easily moved, configured for group activities and adaptable to the characteristics of the students. If aspects such as collaboration, communication and other digital skills are important, students need a space that is receptive and adjusted to educational experiences that promote their development. Thus, there is an increasing need for schools to adopt classroom models focused on students instead of orienting themselves towards transmissive practices on the part of the teacher, whether through the integration of mobile and flexible furniture, or the creation of spaces within, that is areas that promote collaboration, reflective and individual thinking, product creation, among others (Pedro and Baeta, 2017; Monteiro *et al.*, 2018);
- Reflecting on school architecture also implies **considering how it is linked to learning concepts and theories developed over time**, seeking to understand if they are set in a traditional mould or show signs of change (Velooso, Marques and Duarte, 2014). The new social architecture discusses precisely the relationship between space and learning: on the one hand, it is claimed that curriculum development requires the availability of new spaces that encourage different kinds of learning; on the other hand, evidence shows that the design of school buildings hardly reflects state-of-the-art pedagogical designs and the new paradigms of learning and learning environments (Velooso, Marques and Duarte, 2014);

- Two studies refer to the **impact that physical space** (lighting, temperature and air quality), individualization (appropriation and flexibility) **and stimulation** (complexity and colour) **have on learning** (Pedro and Baeta, 2017; Sardinha and Almeida, 2017);
- In the **creation of new educational spaces, international initiatives stand out**, such as the Future Classroom Lab (FCL), created in 2012 by European Schoolnet, in Brussels; the Innovative Learning Environments (ILE), as a project started in 2016 by the University of Melbourne; or at national level such as the Learning Laboratories (LA) developed in 2014 by the General Directorate for Education. In this context, ILEs have been created in the national educational context that present themselves as spaces with a modular, reconfigurable and multifunctional structure, and which are intended to be incubators of new dynamics of work in the classroom, through the articulation between active teaching methodologies, teaching-learning and the innovative use of digital technologies (Baeta and Pedro, 2018b);
- In addition to the multidimensionality of space (architectural, social, emotional and technological dimensions of space, among others) as a promoter of knowledge creation and innovation processes, **the didactic environment, pedagogical choices and the teacher's personality** (way of thinking and beliefs) are also important factors that need to be considered (Veloso, Marques and Duarte, 2014; Sardinha and Almeida, 2017);
- The study of the movements and its positions and directions allow the arising of patterns enabling the analysis of the dynamic of the physical space. The positioning and directionality of movements in a classroom usually are not random, having a meaning, as well as face expressions, gestures and the voice intensity. These encompass a semiotics dimension, which alongside with the language and pedagogical ones, among others, define spatial pedagogy. From the perspective of **semiotics and spatial pedagogy**, it is essential to consider: a) the interaction between teacher/space, teacher/students and space/students; b) the meaning of how the teacher and students move through space and the paths they create; c) the patterns that emerge from the movements of the teacher and students along with gesture, vocal intensity and language, among others (Veloso, Marques and Duarte, 2014; Sardinha and Almeida, 2017);
- The results lead us to mention that the specific space of Future Classrooms Lab is **not yet the one in which students feel that there is an improvement in both teaching and learning**, and that the **social dimension of the physical space of the classroom is still below** the desired level (Sardinha and Almeida, 2017);
- The findings are also relevant for **rethinking teachers' initial and continuous training as the modernization of the classrooms spatial and social environment**, as well as its adequacy to the adoption of teaching practices that promote active and collaborative learning are still neglected (Pedro and Baeta, 2017);
- This empowerment should not be achieved by simply placing the teacher as the commanding agent, but as the one that scaffolds and enhances students' motivation towards successful achievements, through design factors (leadership, flexibility, control,

awareness, etc.). Classroom orchestration in the referred perspective aims to provide a **better learning ecosystem** (physical, technological, social, personal, emotional) to students in order to scaffold and enhance their knowledge acquisition (Sardinha, Almeida and Barbas, 2017);

- Part of the results obtained showed **the influence of the space in the adoption of diversified pedagogical dynamics**, with the adoption of more traditional instructional teacher-centred methodologies in Regular Classes, and more interactive approaches being adopted in the Innovative Educational Environments based on discussion activities between students, as well as activities related to facilitation of the learning process and feedback (Baeta and Pedro, 2018b; Correia and Cavadas, 2019);
- The **new school dynamics introduced by ILE** depend on the training and commitment of teachers to change, but also on the same involvement of the wider school community. This exploratory study raises the need to continue investing in the training of teachers on ILE, namely so that they can take advantage of the benefits of its use for their practices and to achieve the students' learning objectives, providing them with strategies to overcome the constraints that can associate with these environments (Correia and Cavadas, 2019);
- In terms of effects, even though the majority of ILE are recent and there is some caution in the answers, consensual elements stand out, such as: **the satisfaction of students and teachers, the motivation to perform tasks and the change in teachers' practice involved** (Monteiro et al., 2018).

Digital structures in universities - how universities use virtual learning environments; relationship between physical and virtual space

- Bearing in mind that the classroom space is a complex system and that it articulates different dimensions such as social, cultural and architectural, among others, we argue that digital technologies can play a fundamental role in creating scenarios that enhance processes of learning (Sardinha and Almeida, 2017);
- Today we are witnessing a paradigm shift with regard to teaching and learning, due especially to the huge expansion of ICT and the fact that these technologies are increasingly present in people's daily lives, as well as like inside the classroom. The debate on the pedagogical approaches that can best respond to this change has been intensified, but not always accompanied by the study of the educational space where they can be implemented. However, several projects have emerged, such as the Future Classroom (FC), from which an educational space was born in Brussels designed for the approaches created and adopted by the same - the Future Classroom Lab (FCL) (Sardinha and Almeida, 2017).

Planning and creation of physical learning and teaching space – and exploring the relationship and blending of the two: development of hybrid structures

- The **concept of “Space”** is comprehensive, relating to the place (form, configuration, qualities and functionalities) in which learning takes place and processes of relationship between humans and the surrounding environment develop. Aimed at establishing formal and functional qualities, objects, processes and systems, taking into account their interaction with human beings and the surrounding environment (Matos & Pedro, 2015), the classroom space needs to be redesigned and adapted to the characteristics of the classroom. 21st century, in so far as if it remains unchanged, it will become very difficult to renew educational practices and rethink the multiple elements, namely the curriculum and the pedagogical approach used (Pedro and Baeta, 2017);
- Worldwide, within learning processes, new realities are taking shape, as the **increasing incorporation of ICT**, the transformation of libraries into multimedia resource centres and the introduction of virtual spaces show. Learning is no longer restricted to the classroom, but should pervade the whole school and extend beyond its doors. Thus, planning and building schools must imply conceiving the building as a whole, including outdoor space and its relationship with the inside of the schools, the connections between formal and informal spaces, and their organization. In this sense, it is argued that there is a transition from classrooms to learning spaces (Veloso, Marques and Duarte, 2014; Baeta and Pedro, 2018b);
- In effect, from these new times, a need for new **(re)edifications of learning spaces - physical and virtual** - emerges, in a pedagogical, didactic and human scope that is decisive in the development of knowledge (Monteiro et al., 2018);
- In the **(re)construction of the space for the modernization of the classroom**, the following aspects should be considered: spatial organization (how the space is organized and used; location of equipment and furniture, degree of flexibility); humans (spatial relationship between the teacher and the students, how they move and move in the classroom space); physical (quality and maintenance of the room, furniture and equipment); and environmental (light, air quality, temperature, sound) (Pedro, 2017b; Pedro and Baeta, 2017);
- **Human-Building Interaction**, in which the association of Human-Computer Interaction with physical and social space proposes a new approach through the creation of conscious interactions between man and space through technology (Sardinha and Almeida, 2017);
- Although they differ from each other at a conceptual level, these three elements must be considered in common: if the element referring to **pedagogy** is ignored, a pedagogical model that makes the space and technology profitable is not obtained (originating that the class is limited to the same activities and making it impossible to obtain better results); if the **technology** element is ignored, “additional teaching work for the teacher” is obtained, in which the teacher is obliged to work without the effectiveness of the technologies; if the element of the **space** is ignored, “restriction of

activities” is obtained, resulting in constraints in the application of active collaborative approaches (where it is necessary to organize the space so that the configuration of the room allows this collaborative activity) (Pedro and Baeta, 2017);

- **Descriptive key concepts** of what is seen as a future classroom, spatial organization (different working zones identified by the teachers), physical elements (furniture and equipment) and environmental aspects (light, sound, air quality, temperature, color, natural elements, comfort and security) (Pedro, 2017b);
- Teachers organized the classrooms mock-ups around different working areas and the most represented area was the one related to **collaborative work**; the ‘group activities’ zone was present in 87,5% of the 3D future classrooms mock-ups. It was also highlighted the benefit of having an area for students to work with technologies, mostly referred tablet and interactive/multitouch tables, as well as an area for Projection activities, with multiple display technologies that could support the presentation of multimedia educational content, by the teacher and by the students. It is also important to notice that in 50% of the mock-ups **informal learning spaces were put inside the formal learning space that classrooms** are by convention. The results also shown that, although most often, the layout of classrooms mock-ups was oriented by a **zoning approach, where the classrooms were divided into smaller areas**, 6 of the mock-ups (37.5%) represented the future classroom as an open space, where students and teachers could move freely and where tables and chairs were mostly removed from the picture and/or replaced by workbenches (Pedro, 2017b);
- With regards to the physical elements displayed in the future classroom mock-ups, specifically furniture and equipment, the results evidenced that teachers report **cupboards as one of mostly needed furniture** in the future classroom. This was explained with the idea that today’s classrooms already lack places for storage (students’ backpacks, coats, etc.) and that, in the future, classrooms must have even more educational tools and supplies for students to use, and that these tools (analogical and digital) should have a place to be securely kept (Pedro, 2017b);
- It is possible to see that teachers took in consideration the need for **improving the level of comfort of the classrooms**. 75% of the mock-ups included elements that represented concerns with the physical comfort provided to the classrooms users. 68.75% of the mock-ups also revealed the need to improve the luminosity of the classrooms, more specially teachers referred the need for more natural daylighting. With the same percentage, 68.75%, the future classrooms mock-ups reported the need for a more natural ambiance inside the classrooms. 50% of the mock-ups also showed teachers concerns for improvements on the room acoustics, more specifically with regards to noise control, considering that communication and team work is expected to significantly increase in the classrooms of the future (Pedro, 2017b);
- In view of the results obtained, it appears that the ILE in Portugal, whose responsible participated in the study, have **different motivations for its design and implementation characteristics**, with the common issue being the division into “learning zones”,

furniture mobility, flexibility of the configuration and dimension of the spaces, as well as the presence of technological equipment (Monteiro et al., 2018);

- According to ERTE (Team for Resources and Educational Technologies of the Education General Directorate) (2017), there are **29 ILE in the national context**, distributed over four educational regions: Norte, Centro, Lisbon and Vale do Tejo, and Alentejo. In view of the proliferation of these new spaces, it is important to focus the study on this phenomenon that lacks empirical data about the activities that are developed in these spaces (Baeta and Pedro, 2018b);
- **ILE are characterized by the organization of space in physical areas** that promote the development of different skills. ILE are also characterized by providing unique opportunities to accelerate the generation and diffusion of innovation, namely through the possibility of experimenting with new ideas, fostering effective communication and collaboration channels and creating a supportive social environment. In the innovation process, technology plays a fundamental role in ILE, however, the mere presence of technology does not make a classroom space innovative, nor can innovation be taken as a synonym for using digital technologies, as it can only serve as a support for traditional teaching methods (Correia and Cavadas, 2019).

3. Methodology

The exploration of policy and practice regarding L&T spaces in Portuguese higher education was organised as a desk-top analysis, based on a set of information collected from different sources and actors.

Contemporary research literature, publicly available documentations of L&T spaces in Portuguese education, national legislation, national and institutional policy documents and the guidelines for the assessment and accreditation of degree programmes, institutions and internal quality assurance systems (issued by the Portuguese Agency for Assessment and Accreditation of Higher Education – A3ES) were scanned for references to the design and implementation of L&T spaces in higher education. Among the search terms used for the identification of relevant information and data were the following: higher education law; learning and teaching in higher education; learning and teaching spaces; quality assurance of learning and teaching spaces; digitalisation in higher education; pedagogic innovation; university teaching and learning strategy; structure; infrastructure; room; teaching; innovative; space and area.

Additionally, the rectors of all Portuguese public universities (14) have been contacted by email in order to get more precise information about the real and actual concerns these institutions have regarding spaces for L&T – how far these spaces are indeed a strategic priority – as well as to identify possible NLS being implemented at their institutions' campuses. Unfortunately, these contacts have been difficult to establish and not much additional information was collected through this channel, except for the University of Algarve where a contact has been established with the responsible for the pedagogic innovation supporting office.

Finally, during this first phase of the project it was possible through a snowball effect to identify 7 NLS in Portuguese higher education institutions, which provide interesting examples of good practices at this level. The examples come from the University of Lisbon (Institute of Education), the Polytechnic Institute of Santarém (Higher School of Education), the University Lusófona, The Polytechnic Institute of Porto, the University of Coimbra, the Portuguese Catholic University and the Nova Information Management School. Also, in the University of Aveiro a NLS is in the process of implementation. For the moment, it was possible to contact both the responsible for the Higher School of Education of the Polytechnic Institute of Santarém and the Institute of Education of the University of Lisbon. Virtual visits and interviews were conducted, and the information collected is presented in section 5 of this report. For the interviews a guideline was prepared, which is presented in annex A.

The academic literature and the documents identified as relevant for the purposes of this exploration of policy and practice have been content analysed (see Section 2 for the analysis of the relevant literature identified; Section 4 for the analysis of national legislation and the A3ES guidelines and Section 5 for the analysis of institutional policy documents – strategic and activity plans). As for the information collected directly from the University of Algarve, the Higher School of Education of the Polytechnic Institute of Santarém and the Institute of Education of the University of Lisbon, it allowed corroborating the institutional documents analysis and presenting national examples of NLS (Section 5).

4. National policy and practice for the design and implementation of L&T space in Portuguese higher education

This section provides information from existing Portuguese policy legislation directed at the higher education system and from the guidelines issued by A3ES for the assessment and accreditation of study programmes and institutions and for the certification of internal quality assurance systems. The main goal was to identify in these documents concerns about learning and teaching spaces in the scope of the higher education learning and teaching process, namely principles, standards or guidelines addressing how these spaces should be designed and implemented to foster high quality and innovative learning and teaching methodologies.

Unfortunately, not much about this topic has been found in the analysed documents, namely regarding issues such as digitalisation in higher education, importance and status of didactics, pedagogy and curriculum design in higher education and the importance and status of physical L&T space. As such, the remaining of this section will be devoted to present the legal framework of the Portuguese higher education system, including the legal prescriptions for and autonomy of institutions, and the main concerns with L&T space in higher education as expressed in the national policy documents analysed.

4.1 Legal framework of the Portuguese higher education system

The Portuguese higher education system is a binary one, comprising universities and polytechnic institutes. Furthermore, a public and a private subsector coexist, both including the two types of institutions. Overall, 14 public universities, 20 public polytechnic institutes, 19 private universities and 29 private polytechnic institutes make the Portuguese higher education system. It must be stressed however that the number of institutions is not correlated with the dimension of each subsystem or subsector, since most students are enrolled in public institutions (around 82%), namely in public universities (around 52%). Table 1 summarizes the number of students enrolled by subsystem and subsector for the year 2019.

Table 1 | Portuguese students' enrolment in higher education by subsystem and subsector

Year	Public/ University		Public/ Polytechnic		Private/ University		Private/ Polytechnic		Total
	Students	%	Students	%	Students	%	Students	%	
2019	199388	51.8%	116801	30.3%	48479	12.6%	20579	5.3%	385247

Source | PORDATA (2020)

The Portuguese higher education system went through a deep process of change in the first decade of the 21st century, following reviews and recommendations by international organisations such as the OECD (The Organisation for Economic Co-operation and Development)

and ENQA (European Association for Quality Assurance in Higher Education). The actual institutional policy context is characterised by the passing of legislation on the following topics:

- Legal Framework of Higher Education Institutions (Law 62/2007, 10th of September, XVII Constitutional Government) – RJIES.
- Legal Framework for the Evaluation of Higher Education Law (Law 38/2007, 16th of January, XVII Constitutional Government).
- Creation of the Agency for Assessment and Accreditation of Higher Education (A3ES) (Decree-Law 369/2007, 5th of November, XVII Constitutional Government).
- Decree-Law n.º 63/2016, 13th September – Juridical Regime of Higher Education Degrees and Diplomas

The RJIES was passed by Parliament in 2007 and introduced major changes in the governance structures and processes of Portuguese higher education. By 2009, Portuguese higher education institutions (HEIs) had adapted their statutes, and consequently their organisational and governance structures, to the new legal framework. The RJIES brought changes in the relationship between State and HEIs; on the other hand, it induced the reconfiguration of HEIs' governance structures, strengthening organisational rationales such as the enhancement of managerial bodies in detriment of collegial bodies, the centralisation of decision-making processes and the presence of external stakeholders at central and faculty/department/school level.

In its article 11º, the RJIES establishes that all public HEIs have statutory, pedagogic, scientific, cultural, administrative, financing, patrimonial and disciplinary autonomy. As for the private HEIs, they hold pedagogic, scientific and cultural autonomy in face of the entity that owns them and the State. In face of their autonomy, institutions establish their own statutes, defining their mission and pedagogic and scientific goals, as well as their organic structure. The autonomy of higher education institutions does not preclude, however, State supervision, nor accreditation and external evaluation, under the terms of the law.

The legislation focusing on quality assurance (QA) of higher education (Law 38/2007) establishes that HEIs must define a QA policy and take the necessary steps and decisions for its implementation, including the self-evaluation and the participation in external evaluation processes. The legislation also imposes that external quality assessment principles take into account the effectiveness of the internal QA procedures implemented by each HEI. The actual system for QA in higher education is characterized by a program of study programmes and institutions' assessment and accreditation and of an independent body for its coordination – the Higher Education Assessment and Accreditation Agency (A3ES). Within this new system, accreditation assumes a preponderant role as a way to assure that study programmes and institutions accomplish minimum requirements conducting to their official recognition.

The new legal framework for quality evaluation and accreditation also determines that institutions should develop a QA policy for their programs, a culture of quality and QA in their activities and a strategy for their continuous quality improvement. Furthermore, the law

establishes institutional audits of HEIs' QA systems. A3ES, with the aim of supporting Portuguese HEIs to implement their own systems of internal QA, has made a concrete proposal about the standards for auditing internal QA systems and is now responsible for the certification of such systems, on a voluntary basis.

4.2 National concerns on L&T space design and implementation

As already referred, L&T space design and implementation is only briefly addressed in the legal documents that rule the Portuguese higher education system. In the legal framework of Higher Education Institutions (Law 62/2007, 10th of September, XVII Constitutional Government) – RJIES, the Evaluation of Higher Education Law (Law 38/2007, 16th of January, XVII Constitutional Government) and the Decree-Law n.º 63/2016, 13th September – Juridical Regime of Higher Education Degrees and Diplomas, facilities and equipment emerge as relevant for the establishment of higher education institutions (both universities and polytechnics, public and private), as well as for the accreditation and functioning of study programs. Facilities are understood as teaching and learning spaces, libraries and laboratories that are adequate to the study programs the institutions want to offer.

More specifically, there are two articles (30º and 40ª) in the RJIES that explicitly refer higher education institutions (public and private, universities and polytechnics) should have the facilities and material resources appropriate to the nature of the institution, namely L&T space, equipment, libraries and laboratories suitable for the study programmes they aim to offer. Furthermore, article 41º mentions that study programmes leading to the attribution of academic degrees can only function in facilities duly authorised by the ministry in charge of higher education.

Also, for an institution to have the university status it must fulfil a set of conditions established in the law, including the existence of facilities with the characteristics required for the provision of university education and libraries and laboratories appropriate to the nature of the study programmes (article 42º). The same is valid for an institution aiming to achieve the polytechnic institute status (article 44º). The annual number of new admissions to an HE institution, as well as the maximum number of students enrolled in each study program by academic year is also dependent on the available facilities and equipment (article 64º).

Even if the above references are made to facilities and equipment nothing is particularly said about the characteristics of L&T space. In fact, the only more specific mention RJIES makes to space relates to the promotion of students associations, being referred that institutions are “responsible for stimulating artistic, cultural and scientific activities and promoting spaces for experimentation and support for the development of extracurricular skills, namely for collective and social participation.” (article 21º).

As for the other national laws analysed, references to spaces have been found in relation to the accreditation of study programmes. Article 4º of the legal framework for the Evaluation of Higher Education Law (Law nº 38/2007), establishes quality assessment parameters related to the performance of higher education institutions, which include the educational offer, namely its scientific level, L&T methodologies and students assessment processes; the strategy adopted

to assure the quality of the educational offer and the way it is concretised; the facilities and didactical and scientific equipment.

The Decree-Law n.º 63/2016 (Juridical Regime of Higher Education Degrees and Diplomas) establishes as one of the general requirements for the accreditation of a study programme “the human and material resources indispensable to guarantee the level and quality of training, namely teaching spaces, equipment, libraries and appropriate laboratories.” (article 57º)

Overall, it is possible to say that the Portuguese legal framework establishes the need for adequate L&T spaces, but it does not provide any rules or details on how the spaces should be designed or implemented. Nor it specifically establishes the importance of spaces for the implementation of quality and innovative L&T practices, including the development of didactics, pedagogy and curriculum design in higher education.

However, it is fair to say that L&T space is a concern when it comes to the accreditation of study programmes and institutions. The guidelines issued by the A3ES specifically address the need for adequate and quality physical facilities (L&T space; libraries; laboratories; computer rooms, etc.) and equipment (didactical and scientific equipment; materials; and ICT) pertaining to the institution and allocated and/or used by the study programmes.

Furthermore, the A3ES has defined its own standards and guidelines for the design and implementation of internal quality assurance systems in Portuguese HE institutions (in line with the ESG 2015) and some of them reflect the need for adequate space, able to promote a quality higher education offer. Standard 10 is particularly relevant in this respect since it establishes that institutions should have a variety of resources available to support L&T, including physical resources (facilities, libraries, ICT resources, pedagogic and scientific equipment). Furthermore, it states that such resources should be adequately planned, managed and improved in order to support students learning and other scientific and pedagogic activities.

Additionally, there are other A3ES standards that also call institutions attention to the need of promoting adequate learning environments, such as Standard 3 intended to promote a student’s centred teaching, learning and assessment. This standard specifically urges institutions to adopt adequate procedures to assure that teaching is conducted in order to favour an active role of the student in the creation of its own learning path. Finally, Standard 5, which establishes guidelines for the continuous monitoring and periodical review of study programmes, refers that such monitoring and review should include the learning environment and support services to students.

Although L&T spaces are understood as relevant for the quality of L&T, and subject to external assessment under the Portuguese quality assurance system, it is fair to say that the way these spaces are designed and implemented in each institution and/or by each degree programme are very much left to the decision of each university. To be more specific, one can argue that although rooms for classes should exist in each institution, allocated to each study programme, how these rooms are designed, the furniture, the ICT and digital resources or others that these rooms have is a decision left to institutions themselves. Of course, there are some guidelines from the ministry addressing the areas that each type of building, room, laboratory and other facilities/equipment should have, but these are mainly meant at establishing maximum areas in order to build facilities that are not too big and expensive. In conversation with one architect

from the University of Aveiro it was possible to know that these guidelines are followed, but that mainly universities' architects tend to develop their work using as reference general architecture books such as the one edited by Pamela Buxton – *Metric Handbook Planning and Design Data* – or the *Neufert – Arte de Projetar em Arquitetura [Architects' Data]*, from Ernst Neufert.

4.3 Digitalisation and the importance of and status of didactics, pedagogy and curriculum design in higher education

Only recently attention has been given, both at national and institutional levels, to the need for digitalization and pedagogical innovation in higher education, namely regarding didactics, pedagogy and curriculum. This is evident when the Portuguese higher education legal framework is analysed and no evidence can be found specifically about these topics, nor about their relation with the need for innovative L&T spaces, which apparently denotes a situation where it is left to institutions decisions on these matters under their pedagogic autonomy status.

The only exception one could find to this panorama, relates to the Decree-law n.º 133/2019, passed in September 2019, which approves the juridical regime for higher education offered at distance. In this diploma it is stated that education at distance implies a new pedagogical approach, representing an opportunity to introduce innovations at curricular level able to respond to this modality students' needs, including flexibility in the offer of optional courses aiming at valuing personalized learning paths. This legal diploma also mentions that education at distance relies on i) an interaction and participation that is technologically mediated and supported by online (academic and technological) teams; ii) a curriculum designed to allow access to contents, processes and L&T contexts with no temporal or spatial limits; and iii) a pedagogical model conceived for L&T in virtual environments. Indeed, in the case of this diploma a link is clearly established between didactics, pedagogy and curriculum and the spaces (virtual) in which L&T occurs.

Furthermore, the diploma establishes the need for institutions to have the adequate materials and technological resources for their educational offer, namely: i) the infrastructures and technological systems able to configurate a virtual campus with functionalities of pedagogic interaction; ii) and a web site directed at students able to assure the permanent access to digital libraries, repositories, digital materials loan services and virtual labs. It also states that each degree programme should obey to a pedagogical model containing the fundamental pedagogical assumptions and guidelines for L&T in this modality and a curricular design that constitutes the modular conception of the L&T contents, methodologies and activities.

Finally, in its article 12º - Quality Evaluation – the Decree-law states that the parameters of the quality assessment of distance education study programmes also include:

- the adequacy of technological infrastructures and systems for pedagogical interactions between teachers and students, for access to resources for study, research and experimentation and for academic management interactions;

- the adequacy, effectiveness and efficiency of the measures adopted for the promotion of the students' digital inclusion, and the fairness, reliability and accessibility of the methodologies and assessment processes.

Interestingly, the COVID19 pandemic crisis, despite all its negative effects for higher education in Portugal, has made the need for pedagogic innovation and digitalisation in higher education more evident. In May 2020 the *Skills 4 pos-COVID – Competências para o Futuro* (Competences for the Future) initiative has been launched with the goal of stimulating a rapid adaptation of teaching, learning, work and research practices and approaches able to better prepare the transition for the pos-COVID-19 period. This initiative has been promoted by the General-Directorate of Higher Education, in close articulation with the OECD and with the collaboration of higher education institutions and public and private employers. Among other objectives, the initiative intends to:

... encourage innovative teaching and learning practices, adapted to a mixed and differentiated system, betting on the diversification of pedagogical methodologies, particularly active methodologies, broadening and deepening project-based forms of teaching and learning, intensifying forms of self-learning and work as a team, always in an inclusive and non-discriminatory way... (Office of the Ministry of Science, Technology and Higher Education, May 2020)

Also worth to mention is the recommendation made in August 2020 by the Ministry for Science, Technology and Higher Education in relation to the preparation of the academic year 2020-2021, where it is stated that this preparation should be done according to three basic principles, one of them being:

... the opportunity this period brings of stimulating experiences and dissemination of innovative teaching and learning practices adapted to a presential higher education system supported by digital technologies, as well as teaching mixed/combined approaches in all levels (e.g. short duration training; first cycle degrees; masters; doctoral studies)... (Office of the Ministry of Science, Technology and Higher Education, August 2020)

To conclude, it seems that the Portuguese higher education system is somehow evolving in the path for a more national and concerned approach to the importance of the digitalization and innovation in teaching and learning, although so far this concern does not translate yet the need for the design and implementation of innovative L&T space.

5. University strategy and practice for the design and implementation of L&T space in Portuguese higher education

This part of the report focuses on institutional strategy in public Portuguese universities concerning L&T innovative spaces. The most recent strategic and activities plans of 13 Portuguese public universities (see Table 2 below)³ have been analysed in order to have an idea of the national panorama and identify institutions that are specifically concerned about and have already implemented L&T spaces that enhance innovative L&T strategies and environments.

The web search for these documents was not successful for all institutions: some universities' activities plan (AP) were not found or were not sufficiently recent (>2015) and for those institutions we have considered solely the strategic plan (SP), as detailed in Table 1.

A search per keyword was performed to all documents focused on the following words: structure, infrastructure, room, teaching, innovative, space and area.

Table 2 | Strategic and Activities Plans analysed per Portuguese university

Universities	Strategic Plan (SP)	Activities Plan (AP)
Açores	2018-2022	–
Algarve	2018-2021	2020
Aveiro	2019-2022	2020
Beira Interior	2020	2020
Coimbra	2019-2023	–
Évora	2015	2020
ISCTE-IUL	2018-2021	–
Lisboa	2014-2017	2018
Lisboa / Técnico Lisboa	2015	2019
Madeira	2017-2020	–
Minho	2017-2021	–
Nova de Lisboa	2020-2030	–
Porto	2020	2020
Trás-os-Montes e Alto Douro	2017-2021	2020

The results from this analysis will be detailed below. Generally speaking, we did not manage to identify a great number of references to (innovative) L&T spaces, be they already implemented or still to be implemented. We have included in our analysis one unit from the University of Lisbon – Técnico Lisboa (IST) – as, due to its degree of autonomy, it has its own strategic and activities plans and they evidence a great concern with L&T spaces and specifically refer to a good practice in that regard, as we will be showing further ahead.

³ Universidade Aberta (Open University) has been left aside as this is a university relying on distance learning and therefore specific concerns for physical L&T spaces were not expected to be found.

5.1 University politics/policy/strategy

Overall, Portuguese public universities' strategic and activities plans evidence the importance given to L&T spaces for the L&T process. Only four universities make no reference to them in their strategic and activities plans: Açores, Évora, Madeira and Nova de Lisboa.

Among the universities that do evidence concern about (innovative) L&T spaces, some show already having implemented such spaces and others prospect to have specific spaces addressed to enhance the (innovative) L&T process. Some references address concrete action:

Construction of the "Arco do Cego" Learning Center: The "Arco do Cego" Learning Center is a major investment, which will create a study and learning space of great standing, enabling faculty and students of IST and other schools to interact. (Técnico Lisboa, SP2019)

Creation and organization of activities in Rooms where students can present and clear their doubts and work. (Técnico Lisboa, AP2015)

ULisboa intends to pursue a policy consisting of making spaces available to the autonomous work of students, after the successful case of the Caleidoscópico building, and is preparing the possibility for that to occur in EUL's restaurant area, particularly well positioned to welcome part of the students of the Campus da Cidade Universitária. (Univ. Lisboa, AP2018)

Others are vaguer and simply refer the need to have infrastructures that support L&T activities and to improve already existing L&T infrastructural conditions

To improve infrastructure conditions of learning spaces. (Univ. Minho, SP2017-21)

To promote the modernisation and requalification of pedagogical spaces. (Univ. Minho, SP2017-21)

To invest in a sustainable way in the maintenance and requalification of spaces that provide the academic community with better conditions for study and work, namely spaces for learning and teaching activities – pedagogical and services spaces, libraries, museums, residences, canteens, etc. (Univ. Coimbra, SP2019-23)

Two institutions refer having already in place (innovative) L&T spaces: Aveiro and Técnico Lisboa. IST's Strategic Plan refers to the need to improve student support infrastructure:

The design and quality of spaces dedicated to the students should keep pace with the transformations that are taking place in the learning processes, due to technological change and new ways of social interaction. Priority should be given to the rehabilitation of existing spaces and the creation of new ones that foster the development of academic and social activities and promote interaction with other members of the IST community. Additionally, IST should develop efforts and partnerships to increase the number of available rooms in student residences. (Técnico Lisboa, SP2019)

The Strategic Plan also refers to the construction of a learning centre ("Arco do Cego" Learning centre), a study and learning centre that promotes interaction among IST students and students attending other schools. This institution's Activities Plan further refers to 24 hour study rooms and spaces for students to clear their doubts and work.

The University of Aveiro's Activities Plan refers to the reorganization of teaching spaces in order to create innovative learning spaces. It further states that

To promote educational success and the overall development of students implies, also, to optimize infrastructures, creating innovative learning environments in all contexts: physical and virtual, curricular and extracurricular. (UAveiro, SP2019-22)

The Strategic Plan of ISCTE-IUL calls for the need to pay special attention to L&T spaces:

the working conditions in classrooms and study rooms, as well as the availability of computerised means and internet access in those spaces, should have a special attention and monitoring, considering the time students spend at ISCTE-IUL. (ISCTE-IUL, SP2018-21)

The presence of digital technologies for the L&T process and in those (innovative) L&T spaces is a common concern among Portuguese universities, as evidenced by their strategic and activities plans. The University of Porto's Activities Plan specifically mentions the introduction of digital technologies in the classroom as providing a stimulus to innovation and diversification of the pedagogical work and assessment methods.

At the University of Minho, the idea of having L&T spaces with pedagogical infrastructures adequate to new teaching methodologies is very much present in its activities plan. This document refers to the intention of strengthening the adequate infrastructures for computer-based exams and increasing Wi-Fi coverage to all teaching spaces (AP2018). In its strategic plan (SP2019-21) there is further mention to the creation of video conference rooms to support teaching activities and the strengthening of infrastructures of support to autonomous work.

The account given above shows that the data collected in the strategic and activities plans does not allow to go further in the analysis of how Portuguese universities address relevant questions related to L&T space, such as who is engaged in the design and implementation of those spaces, how the space is actually designed and implemented or how does it relate to organisational levels and units. Furthermore, as explained in section 3 of this report, although universities' rectors have been contacted by email in order to find out more about their policy for L&T space, almost no answers were obtained. The fact that contacts were made during the pandemic crisis may explain the absence of answers to a certain extent. Other possible reason may be the fact that such policy is still incipient and hardly formalised in Portuguese universities.

Furthermore, themes like demands of sustainability, internationalisation, diversity and inclusivity as well as quality assurance of design and implementation of L&T spaces were not found in the strategic documents of Portuguese universities. It is possible that these themes are regulated in the context of individual design and building projects, but only a deep analysis of the situation in each university would allow to know how exactly this regulation occurs and who are the key actors at this respect.

5.2 University physical L&T spaces – some examples of good practices

As referred in section 3 of this report, until now it was possible to identify and collect more specific information on three cases of NLS in Portugal that, as such, can be used in this report as examples of potential good practices of physical L&T spaces existent in Portuguese higher

education institutions. In addition to these three spaces, also the NLS that is being implemented at the University of Aveiro is presented, as well as another informal L&T space recently created in the university to foster self-learning.

FTE-LAB – Future Teacher E-ducation Lab (<http://ftelab.ie.ulisboa.pt/>)

The FTE-LAB – Future Teacher E-ducation Lab is a NLS created at the Institute of Education of the University of Lisbon, with the aim of developing a multifunctional space where different software, technology and applications interact for the modernisation of teachers' professional development. The space was designed to be an incubator of ideas where it is possible to identify the future needs of technological solutions for education and simultaneously develop tangible educational resources. It was formally open in 2014, and according to its coordinators (Profs. João Filipe Matos and Neuza Pedro), the space has an adaptable and flexible layout which allows the exploration of new learning scenarios with digital technologies for initial and continuous professional development of elementary and secondary school teachers. Furthermore, the space can also be used for regular workshops on educational use of technology and online environments for higher education teachers and researchers with the purpose of transforming the practices of L&T in higher education. It is also meant to work as an incubator of ideas where the need for future technological solutions for education can be identified and, simultaneously, be a space for the development of tangible educational resources.

The space was designed to receive the (future) teachers involved in Masters Programmes in Teaching and Education at the Institute of Education (University of Lisbon), but also the teachers and researchers of the 18 faculties and institutes of the University of Lisbon, in collaboration with the university's Unit of E-learning. The idea is to offer to its users the possibility of having different formative experiences, that can afterwards be replicated in their own schools or university's departments.

According to the information provided by Prof. Neuza Pedro, with whom an interview was conducted in November 2020, the space has been designed according to the Learning Space Performance Rating System, developed by Felix and Brown (2011) to guide the organization of an active learning space for higher education. Furthermore, the space intends to have: i) a spatial organization that promotes multiple dynamics of activity; ii) a variety of technological tools and flexible furniture; iii) a high-quality environment: temperature, light and sound; and iv) a clear relational integration with the campus and institutional goals of the university.

The space has evolved along the years and has now a configuration that is slightly different from the initial one (see Figures 4 and 5). However, it maintains its modular structure, divided in different small spaces, with articulation between the dimensions identified as relevant in the UNESCO ICT Competency Framework for Teachers, underlining a multidisciplinary perspective of teachers' work. The space is human-centred and includes a series of equipment: a system for online collaborative work, a software for creating e-learning contents, a wardrobe for plugin in tablets to be used in the space, an area of digital fabrication with 3-D printers, software for editing videos and podcasts, software for creating animations, HD video cameras, a screen for videos' production, software for videoconferencing (streaming), audio recording equipment, multimedia interactive whiteboards, a 'learner response' systems and equipment, robots,

sensors and digital microscopes, an HD projector and portable projectors, tablets, smartphones and laptops hybrids. It also as a ‘maker’ space that secondary schools’ students can use to do things aligned with their education.

Since its inception, the FTE-LAB has counted with the active involvement of different partners and multiple stakeholders: researchers, architects, teachers' trainers, educational professionals, companies in the area of educational technology, policy makers, etc.

Figure 4 | Schematic representation of the FTE-LAB NLS

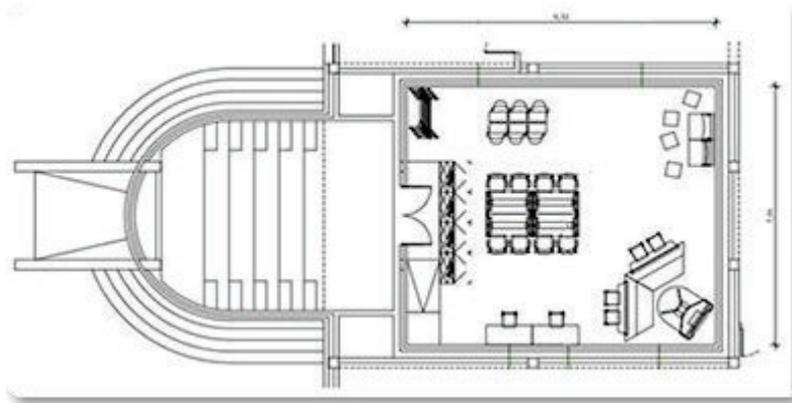
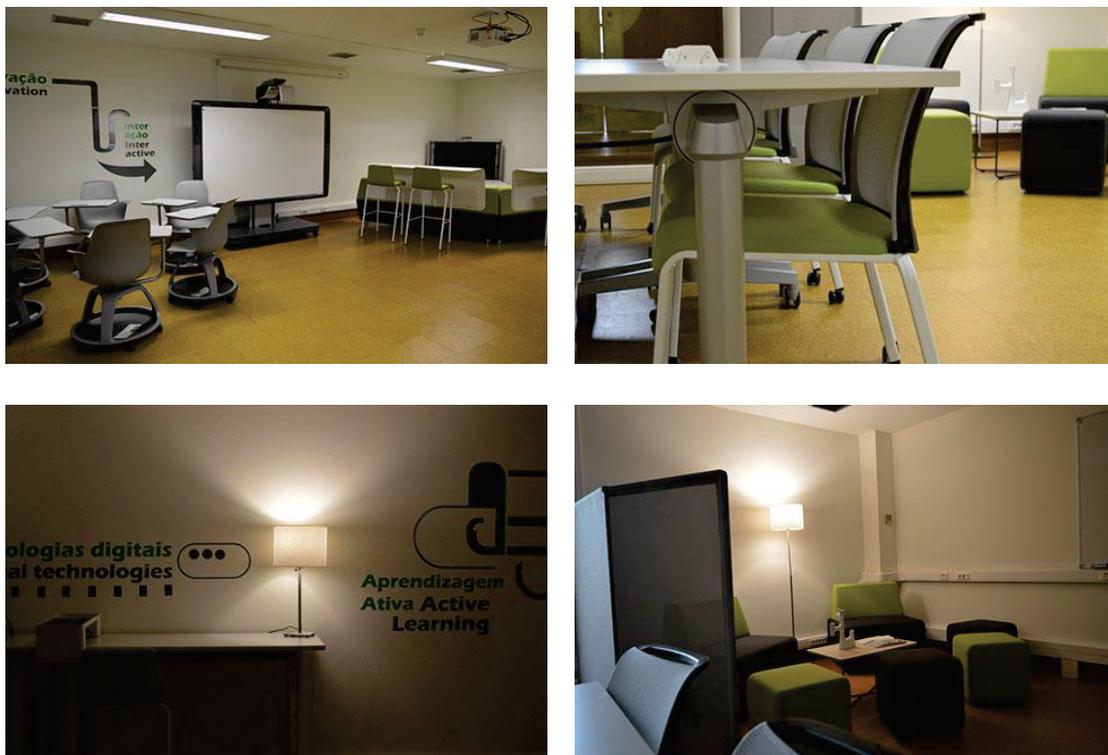


Figure 5 | Images of the FTE-LAB – Future E-ducation Lab



So far, and according to the interviewee, the FTE-LAB – Future E-ducation Lab has been moderately successful. It did not manage to reach all the teachers education masters of the University of Lisbon, essentially because the use of this NLS is highly dependent on the higher education teachers' beliefs about how teaching and learning should happen in a classroom. And many of the actual teachers still hold very classical beliefs, not aligned with the approach and principles underlying the FTE-LAB, particularly the use of technologies. Furthermore, pedagogic innovation in higher education is not adequately valued in the academic career so teachers do not take too much time to develop new ways of teaching or promoting their students learning.

It is not possible to know for sure if the FTE-LAB – Future E-ducation Lab has had an effect on the academic performance of the students that had classes in this NLS, since no research was conducted on monitoring aspects such as: student engagement, teaching practices and space usage. Furthermore, since no studies tracing the practice of students as teachers during the supervised practice (pedagogical internship) and afterwards as professional educators were conducted, it is not possible to anticipate if the students have promoted different teaching and learning methodologies after graduation. Steelcase, the company that helped the FTE-LAB team to design and equip the space, both in terms of furniture and technological solutions, has developed an Active Learning Post-Occupancy Evaluation (AL-POE) research tool in an effort to measure the effect of the solutions provided on student engagement in the classroom. In 2017 they applied the tool at University of Lisbon - Institute of Education, to students and teachers that have used the FTE-LAB and overall the results obtained allowed to conclude that the use of the space was a positive experience for promoting active learning.

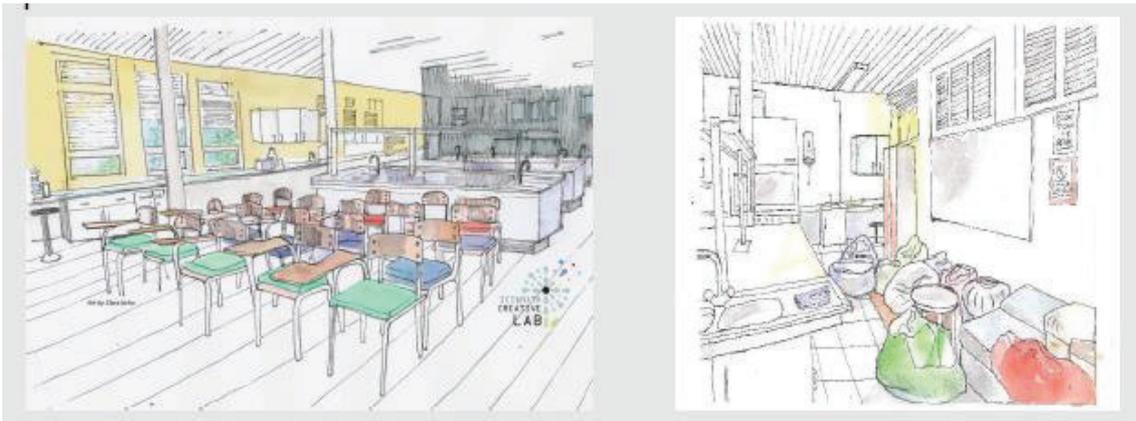
CreativeLab_Sci&Math®

The CreativeLab_Sci&Math® is the NLS created at the Higher School of Education of the Polytechnic Institute of Santarém. The space is a project of the teachers of the Department of Mathematics and Natural Sciences and the goal behind its creation was innovating in these two disciplines teaching, learning and assessment (Cavadas et al., 2018). The teachers wanted to work differently with their students, following an approach based on the 7E instructional model (Engage; Explain; Explore; Elaborate; Exchange; Evaluate; Empowerment) and on Inquiry Based Learning. They also wanted to introduce interdisciplinarity in their approach and, as such, they decided to put together maths and sciences and promote a co-teaching practice. For this change in their L&T approach, the teachers needed a new space, where collaborative work could more easily be performed.

Figure 6 presents an image of the CreativeLab_Sci&Math®, which according to its promoters:

has a spatial organization, inspired by the initiative Future Classroom Lab (European Schoolnet, 2017), with different learning areas. These areas were designed to promote diverse teaching strategies and new teachers' and students' roles (OECD, 2013). The areas are related to the 7E teaching moments and promote skills associated to S&M. (Cavadas et al., 2018).

Figure 6 | Images of the CreativeLab_Sci&Math®



In the interview conducted with its two responsible in July 2020, it was clear that the space was a consequence of the will to change the teaching and learning approach, introducing a new didactical model. The space has three educational environments and resorts to digital technologies, but also to non-technological solutions. There is an area with laboratory equipment, a more formal conversational area and an informal one.

The CreativeLab_Sci&Math® works under an open space logic, with teachers being able to enter the space even when classes are taking place. Furthermore, it is possible to have two groups of students using the space simultaneously. It is used by students of both the undergraduate and master's programmes in sciences and math, and also as a facility to support research.

Asked about the impact of the space in students' academic performance, the interviewees referred that so far they do not see significant differences in the final grades obtained by students. But they stressed that students' level of involvement with the classes' activities is significant higher, which helps the development of transversal competences. They also referred that when graduating, students can take with them for the schools where they are going to work, a different approach to teaching and learning, that hopefully will have effects on how basic and secondary students are taught in maths and sciences.

University of Algarve (UAlg)

In the University of Algarve, it was not possible to identify a 'true' NLS. However, different spaces were pointed out by the Pedagogic Innovation Support Office as have being designed and developed to support new L&T methodologies, namely PBL (Project Based Learning) in the context of the study programme in medicine.

PBL rooms exist in the Department of Biomedical Sciences and Medicine and they are equipped with tables in the centre, where eight students and a tutor can sit in circles, in front of each other (Figure 7). They have all of the walls "lined" with whiteboards for tutors and students to take notes, as well as an interactive whiteboard and computer with projector.

The same department has a simulation room, which possesses several human simulators, of low and high intensity; in one of its walls there is a unidirectional window that allows students and teachers to observe all that is going on in the room from a contiguous room (Figure 7).

Figure 7 | PBL room and Simulation room at the Department of Biomedical Sciences and Medicine of the University of Algarve



With a different goal, namely the promotion of a good and pleasant environment for students, the University has created open-air social/meal venues at one of its campus (Gambelas), by placing tables and benches built on pallets in the campus outdoor to allow a more comfortable and pleasant use of the spaces (Figure 8). With the same goal in mind, the university has refurbished the bars of the Gambelas Campus Pedagogic Complex, as well as those from the Higher School of Education and Communication (Figure 8).

Figure 8 | Outdoor spaces and the Pedagogic Complex bar at the Gambelas Campus



Laboratory of Teaching and Learning Methodologies - LMEA@UA

The UA 2020 Activity Plan has established as one of its strategic lines for this year the promotion of the academic success and of the integral development of the students. Under this line, it is established that in 2020 “flexible learning spaces” will be identified, where the teaching staff will be able to explore new methodologies. In the Education and Psychology Department a new space will be created, the Laboratory of Teaching and Learning Methodologies (LMEA@UA), open to all the teaching staff community. In fact, an operational objective has been established for 2020, which states that teaching spaces will be reorganized, creating innovative learning environments (Performance Indicator: n.º of rooms in the university framed in the concept of “Innovative Educational Environments”; the target is to have one in 2020).

Behind the creation of the LMEA@UA was the need and the aim to design, promote and monitor a flexible learning space, enabler of student-centred teaching methodologies and promoter of active learning. To enhance the implementation of these methodologies, the space is being thought and conceived with flexible layouts to accommodate different ways of learning: collaborative learning and individual and private learning spaces; furniture flexibility that allows students to personalize spaces for different ways of working; and technology-enriched environments.

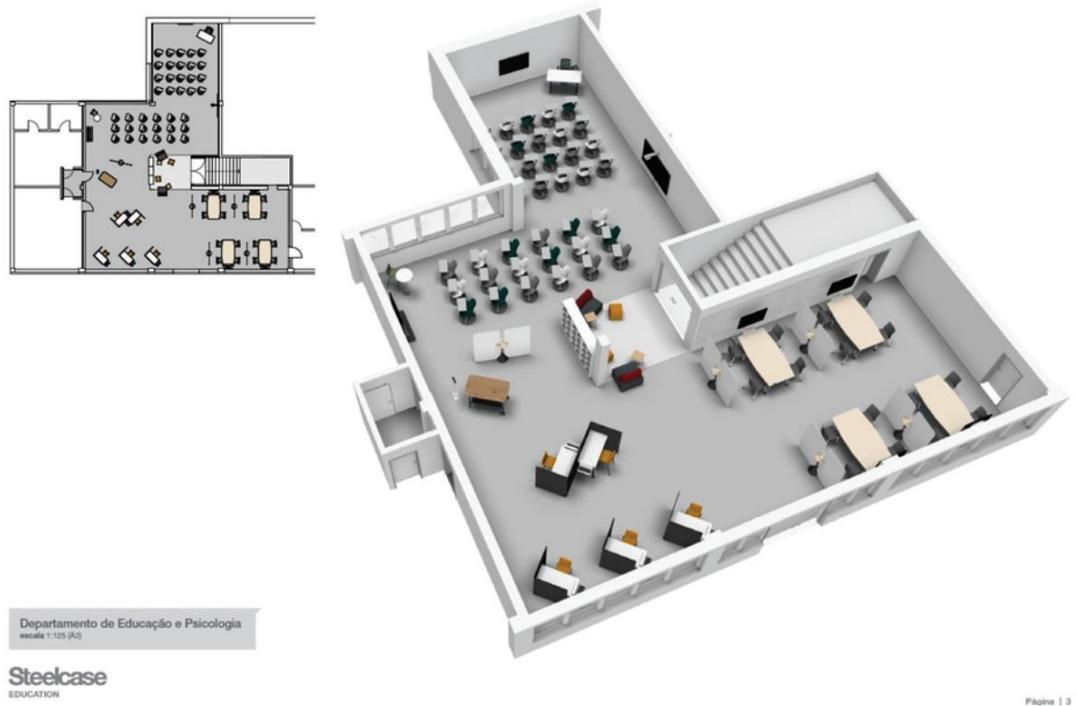
Two phases have been defined for the project implementation:

- In Phase 1, in the second half of 2020/2021, the following areas will be covered:
 - 2 teaching / training areas, with a system of “hybrid learning” (combination of classroom teaching with distance learning)
 - 1 collaborative work area enriched by technology and writing boards
 - 1 social area (small space with informal furniture)
 - 1 individual study area
- In phase 2, for the year of 2021/2022, the LMA@UA will also include the areas:
 - MakerSpace - STEAM laboratory
 - Digital content recording / creation studio

Figure 9 presents two images of the future LMEA@UA. More information about this NLS will be provided in the report of the UA case study (intellectual output 2 of the LTSHE project).

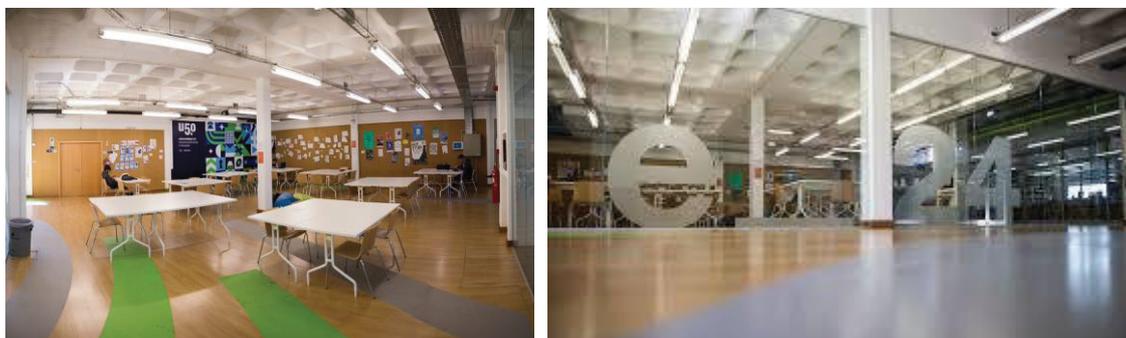
Additionally, the UA intends, under its 2020 Activity Plan’s strategic line “promoting participation and citizenship”, to increase the spaces dedicated to students’ autonomous work, such as the E24 spaces (available to the students’ community since 2019) (Performance Indicator: n.º of self-study rooms 24; the goal is to have one more in 2020).

Figure 9 | Images of the Laboratory of Teaching and Learning Methodologies (LMEA@UA)



The E24 rooms have been set up with the goal of adapting the existing concept of study rooms to the new needs of students and their individual pace of work. Rooms are accessible at any time of the day (the 24 hours of the day) and any day of the week, and, because of the way that they are organized and set out, allow students to better work together in groups. These are rooms that allow ideas to be exchanged and discussed, interaction to take place between colleagues and which leverage the building of new dynamics of working and of new skills. Figure 10 presents two images of the first of these spaces created at UA.

Figure 10 | Images of a E24 Space



6. Conclusions and recommendations

The research aiming to explore the policy and practice of designing and implementing learning and teaching spaces in Portuguese higher education addressed two levels. On one side, it aimed to know if there were any national regulations addressing norms on designing and implementing L&T spaces in Portuguese higher education and the corresponding quality assurance issues; on the other side, it aimed to know whether higher education institutions actually make the design and implementation of such spaces a part of their strategy in terms of innovative L&T approaches by reflecting it on their strategy and activities plans, and whether it was possible to identify such L&T spaces already implemented in Portuguese higher education institutions.

The literature review framework used was based on research work dealing with the impact of the design of NLS on innovative pedagogical approaches, such as those promoting research-based teaching, supporting inter-disciplinary education and research and bringing pedagogical innovation into the classroom. However, the review showed how scarce research on Portuguese higher education NLS is, when considering policy, design and assessment of their pedagogic impact.

The lack of literature dealing specifically with higher education made it necessary to draw a parallel with the non-higher education system, where it was possible to identify more guidelines regarding the design and implementation of NLS. On the basis of this literature, it was possible to identify guidelines that could be applied in universities. Those were, then, presented and discussed within the following five categories: i) University politics/policy; ii) University organization; iii) University pedagogy and curriculum design; iv) Digital structures in universities; and v) Planning and creation of physical learning and teaching space. Content analysis of the reviewed papers allowed to identify different aspects to be taken into account when designing NLS:

- governmental policies directed at the promotion of NLS are relevant, but the achieved results do not always match the intended ones;
- an alignment should be promoted between learning paradigms and political decisions;
- at the institutional level, different stakeholders should be involved in the design and implementation of NLS, including teachers, students, managers, designers/architects, policy makers, industrial partners and employers;
- a multidisciplinary and multidimensional approach should underly the design of a NLS;
- the design of NLS should be intertwined with the pedagogical practice and the learning concepts to be put in place in such spaces; the spaces should be promoters of active teaching methodologies, the innovative use of digital technologies and the adoption of diversified pedagogic dynamics;
- in the design of NLS different areas should be considered for collaborative work, for students to work with technology, for projection activities and for informal learning;
- NLS share some common characteristics: learning zones, furniture mobility, flexibility of configuration and dimension of spaces and presence of technological equipment

- training should be provided to the teachers that are going to develop their activities in the NLS.

Alongside with literature review, the research conducted to explore the policy and practice regarding L&T spaces in Portuguese higher education included also the collection of information from different sources and actors. Therefore, the strategy and activities' plans from 13 Portuguese public universities have been scanned with a search per key word in order to identify any references to the design and implementation of NLS at institutional level; the same being done, at national level, with legislation, policy documents and guidelines for the assessment and accreditation of degree programs.

The analysis of national legal documents on design and implementation of learning spaces in higher education, or even regarding issues such as digitalisation in higher education, didactics and pedagogy, curriculum design, relating them to physical spaces did not reveal to be rich in information. There is still work to be done in this regard (cf. the recommendations section below).

The analysis of strategy and activities plans of the 13 Portuguese public universities showed that there is an overall concern about L&T spaces and their impact on the L&T process. Although the subject is still absent from some universities' strategy documents, most of them refer to this topic evidencing the importance they attach to it. Nevertheless, not many examples of such L&T spaces are referred as being already implemented – although the intention of building/implementing them is present. Universities refer to the need of modernising and requalifying existing spaces, to improve L&T spaces in order to provide the academic community with better spaces where they can study and work. The universities that do mention the existence of already implemented NLS relate it to the promotion of academic success, a concern for the students' wellbeing during the time they spend at the university, and to new, innovative L&T approaches that could be better supported by the existence of innovative NLS, with infrastructures that support autonomous work, among others.

The findings do not go as far as expected, at university level, in terms of being able to retrieve information also on who is engaged in designing and implementing these NLS and how this is actually done. This kind of information could have been obtained from the contacts established with these universities' rectors who, unfortunately did not answer back as wished – this might, of course, be due to the pandemic crisis the country has been going through and due also perhaps to an incipient policy in Portuguese universities in this regard.

Considering our findings, the following recommendations could be made at two levels:

- Recommendations addressed at national education policy level
 - To regulate L&T spaces building norms by reviewing existing legislation on higher education or creating new one and doing so considering the context of innovative L&T approaches so that these new spaces fit that purpose.
 - To learn from the remote emergency L&T experience and provide norms/legislation for these new innovative L&T spaces to be easily adaptable to e-learning needs.

- To review A3ES accreditation and assessment guidelines (programme degrees, institutions and quality assurance systems) to include specific guidelines on L&T spaces, both physical and virtual infrastructures.
- Recommendations addressed at higher education institutions level
- To check for good practices that have already been implemented at national and at international level, by reviewing national and international documents on the subject and by promoting on-site visits.
 - To organize national events that bring together higher education institutions so that already implemented good practices can be shared and the floor open to discussion on the topic of how should NLS be in order to enhance and serve innovative L&T approaches.
 - Performance indicators on innovative L&T spaces characteristics should feature in internal quality assurance systems of higher education institutions.
 - Higher education institutions should include in their strategy and activities plans the design and building of L&T spaces that reflect concerns on innovative L&T approaches.
 - To reflect internally (in HEIs) on innovative L&T approaches, assess existing and possible L&T spaces and how they should be like.

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Appendix A

Interview Guideline prepared for the interviews with the responsible for the NLS at the Institute of Education/University of Lisboa and the Higher School of Education/Polytechnic Institute of Santarém.

Q1 – At strategic level:

Q1.1 What were the reasons behind the creation of this NLS?

Q1.2 Who has had the initiative/the idea that led to this NLS creation?

Q1.3 What were the goals intended to be achieved with this NLS creation?

Q2 – At operational level:

Q2.1 What type of space is this NLS?

Q2.2 What type of furniture/design was selected to the NLS and why?

Q2.3 Which pedagogic models and/or technologies are used in this space?

Q3 – At micro level:

Q3.1 How is this space actually used?

Q3.2 Who uses the space?

Q3.3 What is the assessment made of the impact of the NLS utilisation regarding teaching and learning improvement?