New learning experiences. How the space planning and the technologies can be activators of innovative teaching methods

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Abstract

The future of design teaching is going toward new reflections and challenges in the field, due to the evolvement of the users' needs and the new and updated learning models. New pedagogical approaches, based on active and blended learning paths, tend to consider a wider range of aspects going from the social conscience of students' and teachers' roles to the ever-increasing implementation of technologies.

This growing use of teaching practices, however, encourages a deep reflection on the design of learning spaces in universities and colleges. Nowadays existing spaces are generally unsuitable and ineffective to support the progress of an educational path based on the massive use of ICTs and digital supports. This lack of proper spaces must foster the revision of university environments - such as classrooms, laboratories, and connective spaces - in

terms of flexibility, personalization and collaboration, creating an envelope designed to support and encourage different types of learning practises.

The desire to stimulate the implementation of active and participative teaching by space's assets aims to support the students' involvement in the entire learning path, trying to enhance their creativity and encouraging the development of personal soft skills in order to face future challenges independently.

This paper focuses on the evolving requirements of learning spaces to become effective spatial supports able to make lectures as learning experiences developed by a network of different people and sharing of knowledge with a total involvement of them.

A specific case study of an on-going research project will be presented as an application of a set of tools and spatial guidelines for the implementation of an innovative learning environment in the University Campus of the Politecnico di Milano (Italy). Teaching experts were asked to conduct a survey on different learning activity groups (KPA, KPA and KDA) to identify specificities within a design didactic path and to define different levels of interaction with space.

The expected results aim at a deep rethinking of university spaces as environments able to induce a continuous mechanism of interaction between people and spaces according to changing and updating needs. Classrooms' setting must engage connections on different levels, creating and encouraging both real and virtual experiences using smart devices and immersive solutions. This learning space prototype specifically designed reflects the whole university environment as an alive and vibrant organism, composed of constantly moving information flows through actors, spaces, and supports for a 360-degree performing use, able to achieve a very high educational impact.

Author keywords

Keywords: Learning Environments, Higher Education Facilities, Collaborative, Spatial Design

Introduction

Universities' teaching offers are in continuous reviews thanks to the multitude of innovations that promptly influence the field of teaching. Although the social context has significantly changed over the centuries, universities continue to fulfill their role of training the future social class through the maturation of professional figures ready to enter an increasingly competitive world. However, the progress of technological proposals and the consequent need for speed most of the actions carried out daily are significantly destabilizing today's society towards an evolution extremely difficult to sustain. This speed also affects the educational offerings of universities and the latter require a constant review of their educational paths to better face the changes imposed by technological innovations.

In the last decades, we have witnessed the development of learning models that could be updated to the new generations of students born and raised in a strongly digital context. The increasingly low efficacy of adaptation shown by the passive learning model has encouraged a large number of teachers, scholars, and researchers to complement the canonical training path with a new method of learning based on a more involving approach. The active learning - the learning method where students are actively or experimentally involved in the process of understanding (Bonwell & Eison, 1991), has been able to patch up the difficulty of exchanging knowledge between teachers and students by promoting an effective type of learning for the latter aimed at a greater implementation of personal skills and communication abilities. The combination of these two types of learning creates a blended model where the classic relationship between teaching and learning, as well as the degree of relationship between teacher and student, is overturned through a didactic path that winds through a passive and active exchanging of knowledge (Maglioni & Biscaro, 2014). In all levels of education, from primary to tertiary, this hybridization of the learning system is emerging as a more performing innovation than the passive one (Christensen, Horn, & Staker, 2013).

New learning models are one of the essential details to implement an effective teaching afterthought. The different types of teaching, however, are always in contact with a physical environment that guarantees their development and proper functioning. Space is not only an outer shell that requires a series of purely structural features to be effective, and it is necessary to reflect more on the importance of its supporting role in an educational path.

The purpose of the paper is therefore to highlight the capacity of the classroom environment to be able to shape itself according to the different activities that take place within it. The research will specifically analyze the academic world of design and how it is important to have a performing space able to activate an innumerable series of functions, people and spaces according to changing and updating needs. Classrooms' setting must engage connections on different levels, creating and encouraging both real and virtual experiences using smart devices and immersive solutions. This learning space prototype specifically designed reflects the whole university environment as an alive and vibrant organism, composed of constantly moving information flows through actors, spaces, and supports for a 360-degree performing use, able to achieve a very high educational impact.

Learning spaces for different activities

In order to activate an innovative type of teaching such as the one presented, it is vital to design a proper learning space. Loris Malaguzzi, an Emilian pedagogue and creator of the Reggio Emilia Approach, defines the physical environment as a non-neutral dynamic in the learning process: "its structure, conformation, quality and teaching predisposition, are equivalent to a third teacher" (Edwards, 1993).

By designing new styles of learning in a social context much more dynamic and technologically rich, it is necessary to acquire greater sensitivity and cognitive ability to intercept the requirements transforming them into physical space. It is no longer possible to rely only on defined design standards, but it is necessary to take into consideration new variables, in some cases poorly

investigated, for a total re-planning of dynamic and effective spaces both in the present and in the future. Most of the classrooms that can be seen in contemporary universities present an extremely rigid structure with an almost null margin of modification and improvement. Teaching is an element in extreme transformation that over time has continued to redefine itself in its various meanings. Nowadays, however, its canonical composition has lost its expressive capacity, having to face the sudden advent of innovative tools. Unable to bear the weight of innovation, the environment, in most cases, is currently in a situation of pervasive inadequacy. Its lack of effectiveness is visible in the inability to support what the actions and behaviors of users require.

The increasing use of new innovative learning systems is profoundly changing the structure of the classrooms, favoring a design focused on the support of many interactions that are conducted both between teachers and students and through different groups of students (David J Neuman, 2013). In order to face these relationship dynamics, it is necessary to reflect on the learning spaces through different levels. Space has a high degree of influence on learning: materials, furniture, light (natural and artificial) are elements to be taken into great consideration for effective activation of knowledge that winds between the actors involved. However, if the installation is not conducive to optimal learning, even elements such as furnishings and other digital equipment can fill the functional need to perform better the primary function for which the spaces were designed.

Establishing an innovative educational path means reviewing all the founding components - pedagogy, space and technology (Radcliffe, Wilson, Powell, & Tibbetts, 2009) - in favor of the most possible flexibility. Mutability and plasticity must be set as essential elements to allow the activation of different educational paths in the same space. Besides being a top environment for flexibility, space should be optimized and prepared for those tools characterized by a high degree of comfort, safety, and functionality (Oblinger, 2005). The environments mainly studied for a single functional type can hardly reinvent themselves in time to be used again, and risk to remain incommunicable and unfit to perform other tasks. Although the space to be designed has indeed a precise vocation as learning, each university environment requires significantly different degrees of change depending on the activities to be stimulated. Humanistic teaching has more traditional spatial needs than a degree course based on the development of technology, where the degree of exchange and cooperation is decidedly higher. Universities dedicated to scientific studies require a high degree of permeability thanks to their need for specific and unavoidable spaces and tools for the correct execution of their mission. Some laboratory spaces have peculiar requests for system organization that automatically make them exempt from being part of a traditional classroom classification; however, if sometimes this spatial differentiation bases its motives on specific bases, at other times it can be considered as the result of an outdated vision of teaching spaces.

By focusing on the design world, it is essential to consider that the physical environment requires a different design sensibility than the canonical concept of the classroom. The value assumed by space is that of a porous environment with marked laboratory qualities, ready to support a variety of activities that

dynamically alternate within a narrow period of time. From the development of an idea to an ongoing revision with the help of professors, from the creation of prototypes to the final display of artifacts, we are immersed in a vibrant and continuously moving system. The need to perform different types of relationships between actors, tools, and space, therefore, requires a particular design at the service of activities and behaviors as essential design elements. This desire to create an effective environmental support to activate different types of activities will be analyzed later in the context of the School of Design at the Politecnico di Milano, where the design of a single space in support of a series of different teaching proposals is currently underway.

Objectives

Starting from the background presented before, the objective of this research is to understand if there are some parameters to refer to, able to design efficient environments and supports based on design disciplines during an active learning experience.

As mentioned above, the new way of teaching and learning are influencing the relationship between space, pedagogy and the way people interact with all the elements involved. Referring to the design field means to include scenarios with a different spatial-temporal dimension; various typology of disciplines, different scale of the design outcomes, different levels of proximity using the space, but also different use of the space over the time, with some temporary elements or long-term use ones.

When we are facing with pedagogy applied to the design discipline, it requires a new investigation on the different disciplines of design, different human behaviours, and the different needs related, in order to create a unique flexible learning experience in the classroom able to support all the predicted and unpredicted variables.

This paper aims to collect, with the direct involvement of the users, all the needs connected to each discipline. Is, moreover, fundamental to understand the right base level of a space that can support all the requirements that are common to all the disciplines, but it can also easily predict and solve the variable of each design discipline. The final aim is to create a unique flexible space, in terms of temporality and user's customization, providing opportunities to be shaped and adapted to the ever new nascent needs.

An Italian case study: Design at Polimi

A big challenge has emerged from present and plans of the Politecnico di Milano, defining a general programme with these primary goals for the next three years, to address the new contemporary needs on the topic by developing different prototypes of innovative university classrooms.

An in-depth revision of its spaces to understand the needs of all the university users, with a particular focus on the design discipline of the School of Design.

The primary purpose it’s not only to rethink the environment referring to the design disciplines in general, but it’s also fundamental to think about a system to combine the different subjects, with a total integration between them.

For these objectives, a research team of the Politecnico di Milano has been appointed to define a series of requirements and needs for the general organization of the innovative teaching and learning spaces, involving the users directly to investigate new demands in the field. The team has been asked to dissert on spatial needs, potentialities, new habits and uses, and organize all in spatial requirements in "directions", especially focus on the design field, to be applied to one classroom's prototype and then finalized and revised for large-scale dissemination.

Methodology

Since it has been decided to adopt a user-centered method, categories of research participants have been defined to involve them in the research process. It is possible to divide them into four categories such as internal actors experienced in teaching activities, internal actors experienced in innovative teaching, internal actors responsible for the maintenance of teaching spaces and external actors experienced in technologies applicable to the analyzed context. In this analysis, the teaching experts have been chosen as a focus of the research activity.

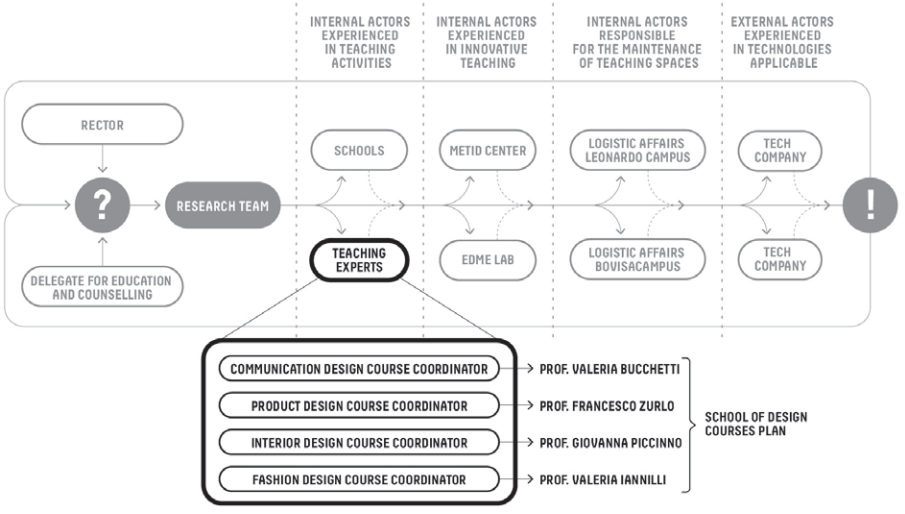

Figure 1. Map of the actors involved in the research process

We interviewed each Degree Course Coordinator, asking them to quantify, assigning a value from 0 (non-presence) to 10 (maximum presence), the presence of a specific activity due to the activities carried out in the laboratory courses. The figure of a Degree Course Coordinator is in charge of its own course plan that it's submitted to the course council (where disciplines and teachers are discussed) to follow, with the support and the supervision of the School's organs, a designed didactic objective. Therefore they are fully aware of the different typologies of activities that are carried on in a design course. We determined different parameters that are useful to find out the purpose of the learning space and that can help us to map the current activities related to the type of teaching provided within the same space.

Parameters for didactic activity

We can divide them in three different categories:

Knowledge Transfer Activities (KTA)

All the activities conducted by the teacher that aim to provide information and guidelines to the students and all the activities in which the students are involved in presenting their advancement. We can recognize activities such as:

- Frontal lessons: lesson for an audience of auditors
- Case studies presentations: presentations carried out with the support of specific communication elements, real products or experts
- Student presentations: presentations made by the students with different support elements and with a final debate for each presentation
- Seminars with guests: seminars with one or more speakers followed by round tables or debates
- Blended learning: mixed learning activity carried on partly online and partly in classroom

Knowledge Production Activities (KPA)

All the activities conducted by the students that aim to create new knowledge and result in which different learning activity approach are used. these activities include all those relating to the different teaching processes in which users are involved during the design phases. We can recognize activities such as:

- Brainstorming: activity carried out by students in groups to work on the assignments
- Project development (single or in groups): discussion among students
- Drawing: execution of design elements and technical details
- Prototype making: Study models and prototypes
- Revision with the teacher: discussion on the project with the teacher for further developments
- Collaborative feedback sessions: collegial discussion on the project to receive opinions
- Peer reviews: discussion among between two groups with reviews and comments

Knowledge Dissemination Activities (KDA)

All the activities that aim to show the didactic results and that are across the assessment activities and the pure show to the public. We can recognize activities such as:

- Written exams: moments of verification of the knowledge of the students addressed to the teacher

- Public presentation: Explanation of project developed to teachers and peers
- Prototypes show: show of prototypes and models
- Layout show: show of layouts and drawings
- Catwalks: show of wereable prototypes and models
- Media show: show of digital communication elements
- Exhibit show: show of didactic results opened to the public
- Extra events: other event connected with didactic results dissemination

The evaluation takes into account both their experience as a teacher and their understanding as coordinators of the study courses and therefore with a broader view of what is the situation of the teaching activity carried out within the courses. The collected data have been translated in the following visual diagrams in order to compare the different approaches of the study courses.

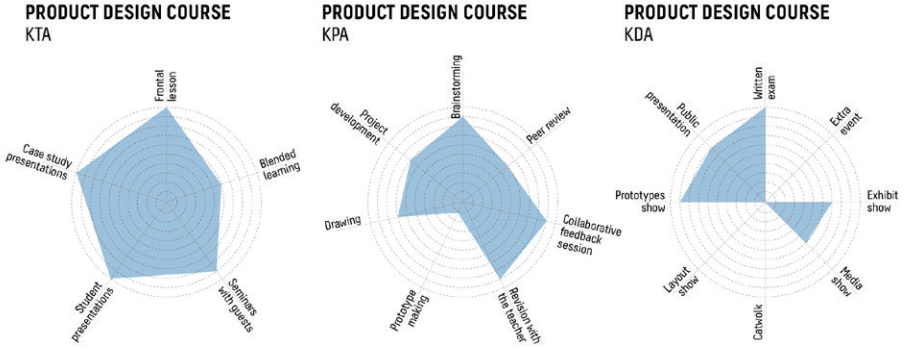

Figure 2. Product Design course diagrams

The Product Design Course diagrams show an high use of the classroom for the learning and relational activities (high evaluations for most of the KTA's activities of the KTA and for the activities of KPA and KDA that make a wide use of the space) marking the importance of space as a place for information exchange. Note that in KPA the rating of "Prototype making" is low because there are specific workshops for this kind of activities.

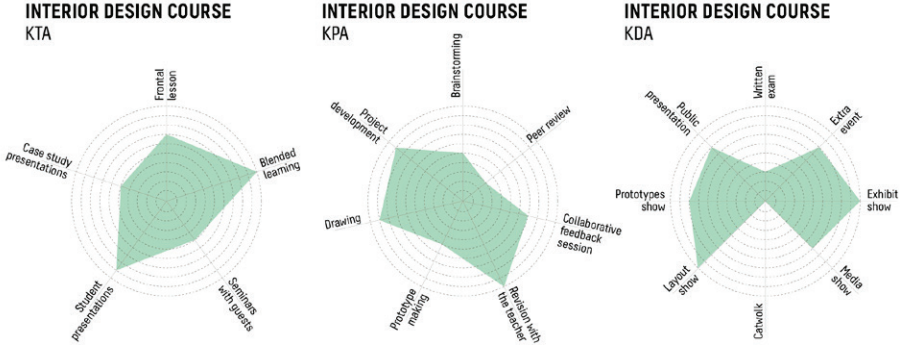

Figure 3. Interior Design course diagrams

The Interior Design Course diagrams show the importance of didactic activities such as those related to the project's phases and to those in which the student plays the role of protagonist. It is important to underline how activities such as extra events or exhibitions in which the students can show in a scenographic way the results of the educational path are important for the study course.

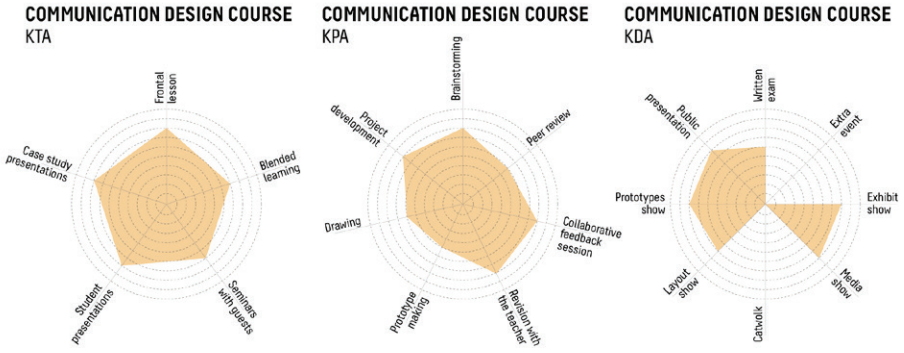

Figure 4. Communication Design course diagrams

The Communication Design Course diagrams show average-to-high evaluation for most of the parameters so it seems the all the activities are generally important. This is an indicator of the heterogeneity of the activities carried out in which both teachers and students are equal protagonists of the space.

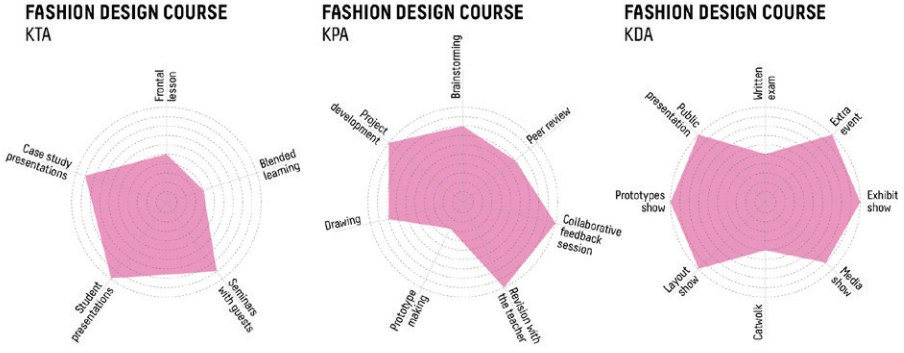

Figure 5. Fashion Design course diagrams

The Fashion Design Course diagrams show a general importance of all the parameters, especially in che KPA's evaluation. KDA's evaluations demonstrate a strong soul devoted to the exhibition of what has been realized in both different and specialized forms. All these indicators suggest the need of a flexible space, able to easily adjust according to the requested activities.

We can therefore interweave the diagram in order to better interpret the data and create rules and directions to define different configurations of the classroom.

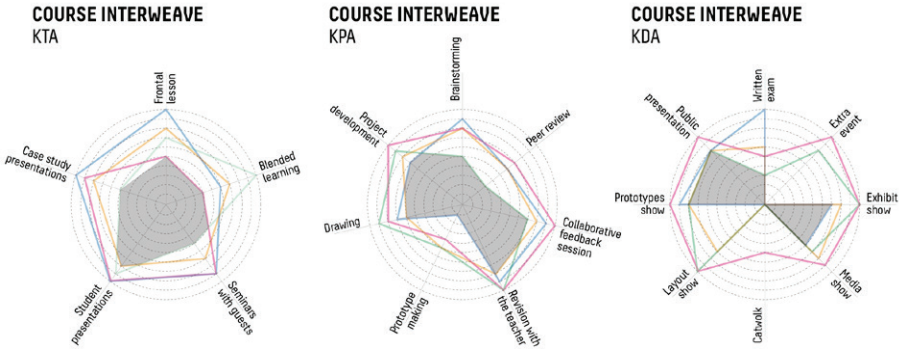

Figure 6. Diagrams of interactions between the four courses

Through the overlapping of the realized diagrams we can understand what are the minimum elements in common.

We can see from the KTA diagram that the study courses have a medium level of satisfaction of the parameters in common where, however, we find some peaks in some activities that seem fundamental and that reflect the nature in the learning process of the discipline of design. These activities are the presentation of case studies and student presentations. This translates into the preparation of an educational space that takes into account predominantly these activities, thus acting on technological equipment that optimally favors the transmission of information. In the KPA diagram many parameters indicate the need to foster the collaboration of users through spaces that, with the provision of appropriate technological equipment and furniture, can facilitate all activities where the comparison of ideas and the creation of new information are essential. Lastly, in the KDA diagram we note that the classroom must demonstrate the maximum efficiency with regard to flexibility of use and the ability to create new ways of showing space that translates into the creation of new surfaces, both vertical and horizontal.

Grammar of directions (GOD)

Starting from the previous considerations about didactic parameters for the four design courses, it has been outlined a common language to organize all the elements found. A grammar of directions (GOD) has been defined both to create a common base for the spaces of the new disciplines and to verify the types of intervention to elevate the space to an innovative and flexible status. In order to allow the development of a basal matrix to be updated with possible optimization interventions for the four different disciplines' peculiar activities, a scheme has been adopted to interweave the different spatial components with the possible degrees of intervention. The designed environment has to be able to support different types of teaching in the most elastic way possible and must, therefore, be ready to shape itself when necessary.

GRAMMAR RULES	BULDING	FURNITURE	TECHNOLOGY
BASE LEVEL	• ACCESSIBILITY • LIGHTING • DARKENING • ACOUSTICS • ENVIRONMENTAL COMFORT	• FURNITURE ACCORDING TO THE NORM • SOCKETS	• WIFI • PROJECTION • SOUND SYSTEM • WIRING
INTERMEDIATE LEVEL	• FLOATING FLOOR • ELECTRICAL SYSTEM • SOUND-ABSORBING PANELS	• MODULAR FURNITURE • WRITABLE WALLS • MOVABLE SOCKETS	• VIDEO SYSTEM • ADJUSTABLE SOUND SYSTEM • MULTI PROJECTION • SMART BOARD • CLOUD + WI-FI
ADVANCED LEVEL	• FLEXIBLE STORAGE SPACE • WALLS EQUIPPED FOR DISPLAY • MOVABLE WALLS	• TRANSFORMALE FURNITURE • FOLDING FORNITURE • INDUCTION/WIRELESS SOCKETS	• IMMERSIVE CLASROOM • ON DISTANCE COMMUNICATION TECHNOLOGY • CAMCORDERS • VIDEO MAPPING PROJECTON

Figure 7. Grammar Of Directions scheme

To differentiate the types of intervention needed, 3 groups of elements and components, physical and virtual, with a significantly different impact were outlined:

- **Building**: The framework of the space consists of systems and surfaces to better support any activity to be performed in the classroom
- **Furniture**: The furnishing components with high flexibility to allow a quick recomposition of the layout according to teaching needs
- **Technology**: Everything that includes the virtual appearance and digital devices to amplify the teaching experience

The 3 groups of elements contain all the supporting components necessary to allow an effective teaching path. However, as verified in the previous paragraph, since the space has to support different types of activities in addition to the common ones, it is necessary to make changes through an implementation and installation of resources. To raise the physical space of the teaching from a basic conformation to a more advanced level, 3 different degrees of completeness have been defined:

- **Base**: the starting level that includes all the elements in order to guarantee a basic support to the conduct of a canonical lesson that includes moments of exchange between professor and students (lectures, feedback sessions, seminars) and *peer-to-peer* activities to be carried out in groups. The furniture must be chosen according to the regulation and the system must allow the soundproofing, the darkening of the classroom and a digital apparatus able to allow the simple execution of audio/visual material and a high-performance wi-fi connection
- **Intermediate**: the changes made to the class are all performative, adding a higher degree of flexibility to allow a quick reconfiguration of the classroom. The furnishings chosen, as movable, modular and writable elements, are flanked by a more permissive technological baggage with the inclusion of smart boards, cloud platforms and multiple projections

- **Advanced**: in order to diversify a single space according to the different specific needs of each course, it is necessary to reach an even greater degree of optimization and improvement than the previous one. To allow the execution of some extra activities (such as the catwalk for fashion or exhibit shows) it is necessary to think of a flexible storage in order to store the furniture and completely free the environment and to add a system of mobile walls in order to widen the space. The furnishings themselves must be comfortable but able to fold in order to be easily moved and stored while the digital devices must allow a very high degree of immersion thanks to the installation of multi-cameras able to alter the perception of space and enhance the teaching/learning experience

The use of this grammar, which arises from the basic needs related to the behaviors found in the learning spaces, is useful for planning a laboratory environment that can gradually be implemented. Understanding the needs in common and the individual requirements helps to establish a hierarchy of interventions to be planned immediately to prevent the space becoming unable to support the teaching of the present and the future.

Conclusion

The results obtained until now show how it is possible to think of an evolution of the teaching space in which analogical and digital, physical and intangible aspects contribute to improving the relationships between the different actors involved in the teaching process.

The context in which the application was tested, the School of Design of the Milan Polytechnic, involves some specificities that better help to understand what has been done and the reasons that have defined the main directions of the project.

There are three characteristics of the School that most influence the choices of the project:

- the average number of classes, which foresee for the laboratories the attendance of about 60 students.
- the current facilities of the design campus, within which there is a dedicated system of extremely consolidated and efficient laboratories, a satisfactory quality of seminar rooms and well-structured frontal classrooms;
- the polytechnic approach that characterizes School and presence of degree courses of different design disciplines (for the bachelor level: product, interior, fashion and communication design).

These three assumptions have oriented the design choices towards solutions of medium / large size spaces, characterized by a flexible approach that increases on one hand the interaction with the students (student presentations, projects development / revisions / collaborative feedback session, public presentation , prototype show / exhibit and media show are the parameters most often considered in the interviews to the Degree Course Coordinators) and on the other hand the need to find a minimum common

denominator to satisfy the specifics of the different degree courses, noting however that from a solid world characterized from "disciplinary boxes" (Manzini, 2004) we moved to a fluid reality, in which the boxes were opened, making it impossible to identify disciplinary boundaries, but where the distinction is made through the identification of the core of knowledge.

The design of a transversal space used by the different degree courses can therefore lead to a cross fertilization that stimulates the student and the teacher through a vertical flexibility, in which during the same course you can experiment with different solutions depending on the type of Knowledge Transfer Activities or a horizontal flexibility, imagining a contamination between different knowledge.

The research described here is a point of arrival regarding the identification of the needs of the different degree courses followed by a prototyping phase to verify possible spatial and technological solutions that can allow to reach a high level educational impact.

A unique flexible space, in terms of temporality and personalization, that can be modeled and adapted to ever-changing new needs.

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