idea

investigating design in architecture

2023 edition

edited by
Gaia Leandri

foreword by
Angelo Schenone

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Conference Proceedings
IDEA – Investigating Design in Architecture
2023 Edition
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This meeting stemmed out from studies, investigations and PhD lectures, in particular:

- 2022, Departamento de Expresión Gráfica Arquitectónica, Universitat Politècnica de València (UPV) and Dipartimento di Neuroscienze, Riabilitazione, Oftalmologia, Genetica e Scienze Materno Infantili (DINOGMI), Università degli Studi di Genova (UNIGE): Gaia Leandri, PhD thesis *Freehand digital drawing: a boost to creative design the observer's eye and the draftsman's brain*;
- 2022, Dipartimento Architettura e Design (DAD), Università degli Studi di Genova (UNIGE), lectures to PhD students in Architecture, Design, Digital Humanities and Neuroscience;
- 2023, Post Doc Consolidator Scolarship: *Ideazione dell'immagine e neurofisiologia: l'apporto creativo e gli strumenti per la comunicazione visiva*, Dipartimento Architettura e Design (DAD), Project Supervisor: Prof. Ruggero Torti; Research Fellow: Dr. Gaia Leandri.

The promoting committee is composed by professors, lecturers, PhD students and researchers from Italy, Spain, the US and the UK:

Angelo Schenone, Marco Testa (DINOGMI, Unige); Maria Linda Falcidieno, Andrea Giachetta, Gaia Leandri, Linda Buondonno, Elisabetta Canepa (DAD, Unige); Francisco Juan-Vidal, Susana Iñarra Abad (UPV); David Sunnucks (Queen Mary University of London).

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Foreword

This book is a collection of papers presented at the first workshop on Investigating Design in Architecture (IDEA ‘23). Aim of the event is to promote an interchange of ideas and expertise from several sources to tackle the issue of architecture and design on one side and neuroscience and psychology on the other. This meeting is a unique opportunity to define scientifically sound experimental bases to the mental process of design, craft creation and the perception of architectural spaces and forms. Different from the unilateral approach of neuroarchitecture, where the object of investigation is the well-being of the user, in IDEA ’23 the main interest shifts towards the relationship between the author, architect or designer, and the project, a notion well expressed in the words “Investigating design”, suggesting that it is the design process itself that is the object of investigation. This is a prospective project based on a joint PhD program awarded by the Department of Graphic Expression in Architecture University of València, and the departments of Neurosciences, Rehabilitation, Ophthalmology, Genetic and Maternal and Infantile Sciences (DiNOGMI) and Architecture and Design (dAD), University of Genova.

The topic of the program, conducted by Dr. Gaia Leandri, was focused on the cerebral activity of the designer according to the method used to lay down the project. At the end of the doctoral path, Dr. Leandri presented a thesis entitled “Freehand digital drawing: a boost to creative design. The observer’s eye and the draftsman’s brain”. Since then, further research has been carried out, and is still being developed, with the essential and very active collaboration of the dAD, University of Genova, where lectures have been held to students and seminars organized for discussing and planning future interdisciplinary projects. In the course of these meetings, a rather widespread interest was discovered from various sources which went from local and international Ph.D. students in architecture and neuroscience to academics of both fields. Therefore, a promoting committee was established, formed by professors, lecturers, PhD students and researchers from Italy, Spain, the US and the UK (A. Schenone, M. Testa (DINOGMI, Unige); N. Casiddu, E. Bistagnino, M.L. Falcidieno, A. Giachetta, G. Leandri, L. Buondonno, E. Canepa (dAD, Unige); F. Juan-Vidal, S. Iñarra Abad (UPV); D. Sunnucks (Queen Mary University of London), and it was decided to send a call to present papers for this first symposium.

The response has been encouraging, since more than 20 papers have been accepted for publication, a token of the interest arisen by this topic. We may now foresee that the future meetings, that hopefully will be planned, may further increase the number of scientific contributions to this interesting subject.

A. Schenone

Spaces where concepts click. Designing Fab Labs for education

Xavier Ferrari Tumay

Università degli Studi di Genova

Abstract

This article focuses on Fab Labs which are spaces equipped with advanced tools and technologies for digital fabrication, such as 3D printers, laser cutters, and computer-controlled machines. The article explains how the environment, atmosphere, and mood of a Fab Lab can play an important role in shaping the perception of the space and influencing the experiences of its users. Various factors such as the layout and design of the space, lighting and colour combinations, noise level, temperature, cleanliness, and the social dimension of the space can affect the perception of the environment. The article argues that the perception of the Fab Lab can significantly impact the experience of its users, and it is essential for managers and designers to consider these factors to create a welcoming, productive, and stimulating space for innovation and collaboration. The article also emphasizes that the design of a Fab Lab involves much more than just selecting equipment and technology, as it is a space where collaboration and the open culture of innovation apply. The article concludes that architects and designers should consider the impact of architectural stimuli on the emotional reactions of users when designing Fab Labs. The article focuses on the framework of digital fabrication university labs.

1. Introduction

A Fab Lab, or Fabrication Laboratory, is a space equipped with advanced digital manufacturing tools and technologies, such as 3D printers, laser cutters, CNC machines, and other computer-controlled tools.

The environment, atmosphere and "mood" of a Fab Lab can play an important role in shaping the perception of space and influencing the experiences of those who use it.

The perception of the Fab Lab environment can be influenced by various factors, including the layout and design of the space, lighting and color schemes (Kwallek, Lewis & Robbins, 1988), noise level and temperature, cleanliness and overall layout of the space. For example, a well-lit and clean laboratory with a clear layout and efficient organization of tools can create a more professional and productive atmosphere, while a cluttered or dimly lit space can create a more chaotic or disorganized feeling (Boubekri, Cheung & Reid, 2014).

The social dimension of the Fab Lab can also play a role in shaping perception. A community, living space, welcoming and inclusive of users and staff can create a more positive and supportive atmosphere, while a competitive or unwelcoming culture can create a negative or intimidating atmosphere (Ross & Ressia, 2015).

The purpose and goals of the Fab Lab can also influence external perceptions: A Lab with a clear and meaningful mission, such as promoting open-source innovation or responding to the needs of the local community, can create a more stimulating and purposeful, while a workshop without a clear goal or purpose may seem aimless or uninviting (Scholz & Schneider, 2017).

Overall, the perception of a Fab Lab environment can have a significant impact on the experience of those who use it, and it is important that Fab Lab managers and designers consider these factors to create a welcoming, productive, and stimulating space for the innovation and collaboration. By definition, it is a space designed for digital fabrication, where users can design and create objects using various tools and equipment, where the fit-out and layout of the space is a major factor on user experience and performance (Orsini & Marchetto, 2005).

Designing a fab lab involves more than just selecting equipment and technology. These laboratories are spaces in which the economy of collaboration is applied, based on the fundamental principle of the "open culture", in which physical spaces, equipment and know-how are made available to individuals, organizations and other entities, constituting a resource community to facilitate the development of projects of different nature, and therefore assuming the role of a laboratory as a facility[1].

[1]Facilities therefore mean the infrastructures and services supporting the core business processes of an institution: it is therefore clear that the primary objective of laboratory facility management is a sort of "back-end" support.

For these reasons, the architectural space in which the laboratory is located determines the actions performed by the users with a significant impact on their emotional reactions. For example, the intensity of colours, the texture of surfaces and the quality of lighting can influence how people feel when they enter a space. These factors can also affect the productivity, creativity and well-being of those using the space. Therefore, understanding the influence of architectural stimuli on emotional reactions in occupants and producers is essential to creating a successful and effective fab lab. These inputs suggest that architects and designers should consider the impact of stimuli on users' emotional reactions when designing fab labs (Knudsen & Andersen, 2002).

In this case, the contribution focuses on the framework of digital manufacturing university laboratories in Design and Architecture schools, open to students, teachers, researchers and stakeholders housed within universities, in dedicated spaces or within existing laboratories.

In this context, in 2020, U-FAB was born, the Italian network of university Fab Labs and makerspaces, a network inspired by a broader mapping, Makers' Inquiry (2015), to stimulate collaboration between Italian and university Fab Labs and makerspaces, more generally, between academic spaces and laboratories that are characterized by the development of educational and scientific activities based on digital fabrication.

U-FAB is an initiative launched by two university Fab Labs – Polifactory (Politecnico di Milano) and Santa Chiara Lab (University of Siena) to network Italian university makerspaces with the aim of sharing practices and developing operational synergies, co- plan and organize cultural and experimental activities.

U-Labs (University Laboratories) generally have a trichotomic nature, determined by the Missions of the University itself: Teaching, Research and Third Mission. In these places, students can develop ideas, design products, use available technologies to create working prototypes, test them by solving real problems thanks to technologies that are becoming an industry standard. Additionally, these spaces provide a collaborative learning environment, where students can work together to solve problems and share knowledge and skills, practice prototyping skills, and develop problem-solving skills, using STEAM (Science, Technology, Engineering, Arts and Mathematics) on industry standard equipment. They also provide students with opportunities for professional development and reinforce concepts taught in the classroom with practical application.

Fab Labs can be used in many fields of study, including engineering, architecture, design, materials science, synthetic biology, art and computer science, promoting the basic principle of the New European Bauhaus: the interdisciplinarity of art, science and technology, similar to the original vision of the Bauhaus, (concept of "Bauhaus" literally means "built house", reflecting the movement's mission to create a more functional and beautiful built environment) with the aim of developing innovative and sustainable solutions to the problems of the modern world. This interdisciplinary approach is expected to promote a better understanding of Europe's complex environmental, social and economic problems and help to find concrete solutions through effective collaboration between the disciplines involved. 3D printing labs position schools in the arena of cutting-edge technologies, fostering iterative testing and research excellence. Furthermore, they open the door to partnership opportunities with local companies, offering young people the opportunity to put their skills into practice and to acquire new ones, in a real and concrete context.

2. What does a best-in-class academic lab or makerspace look like?

The size, shape and purpose of a lab depends wholly on the goals set prior to its construction and will differ from school to school. Here are three examples of labs — ranked from simple to state-of-the-art.

- *Simple Collaborative Makerspace* (Fig.1)

Simple Collaborative Makerspace Open to all experience levels and specialties, a collaborative makerspace focuses on throughput and creating the final part rather than achieving specific material properties or creating for specific applications. This type of lab is a great place for beginners to learn about 3D printing.

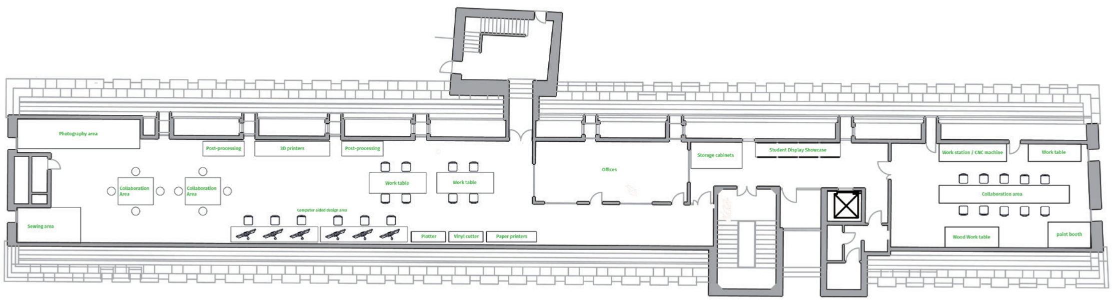

Figure 1 - Example of Simple Collaborative Makerspace. Image by the author.

- *Standard Academic Lab* (Fig.2)

Standard Academic Lab Only available to students in a specific college within a university (e.g., the college of design or engineering), the academic lab typically features a mix of high-end and user-friendly equipment. This type of lab should also be staffed by knowledgeable experts who would ensure the lab runs like a parts provider.

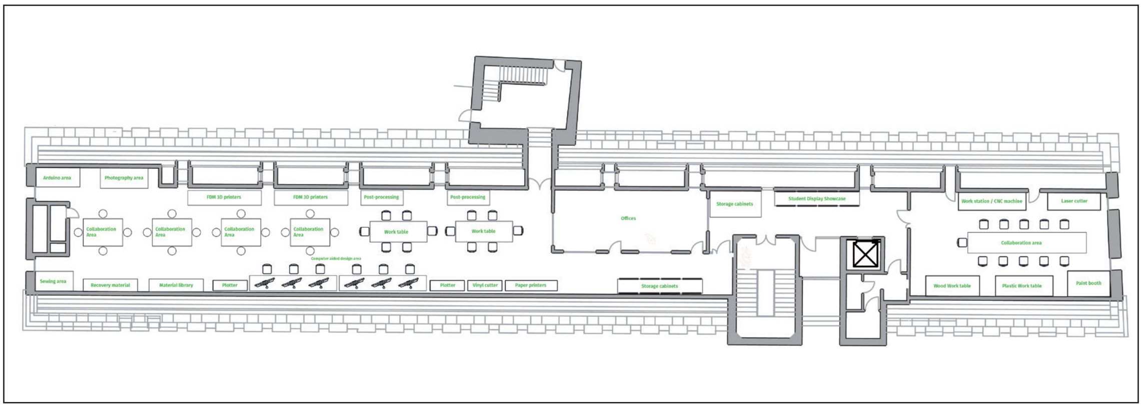

Figure 2 - Example of Standard Academic Lab. Image by the author.

- *State of the Art Center of Excellence* (Fig.3)

State of the Art Center of Excellence Available to students, professors and researchers in a wide range of disciplines, or to all, this type of lab features the latest in high-end 3D printing equipment as well as a streamlined process for part building and delivery. Run and staffed by knowledgeable product experts, this lab also functions as a parts provider and 3D printing resource for the surrounding community.

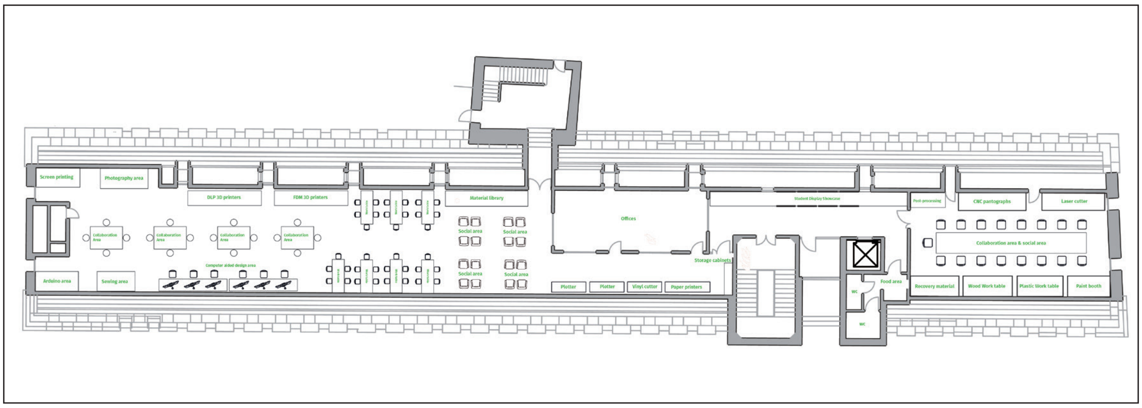

Figure 3 - Example of State of the Art Center of Excellence. Image by the author.

Based on this categorization of laboratories, a handbook has been drawn up for the correct design of the spaces of a Digital Lab, which requires the adoption of some best practices to ensure maximum efficiency and safety of the environment.

Determine the workflow and the influx of equipment requests. Before buying a 3D printer, it's best to evaluate the capabilities of different systems based on the specifics of the space and Start with the right number: use a benchmark formula to determine the number of 3D printers needed to meet demand.

When planning the layout of the laboratory, check with facility management to ensure that there is adequate lighting, ventilation, and power.

Staff Lab with Students:

Create apprenticeship opportunities, internships or 3D printing studios to give students the opportunity to improve their skills and manage the flow of printing jobs, and to make them feel an integral part of the process.

Teach students how to design for 3D:

Offer a course or tutorials to teach students how to create and optimize designs for successful prints.

Try project-based group learning:

Organize teams of students of three to five and assign them a job to replicate the printing process.

The co-planning and active participation of sharing spaces foster interaction between people and organizations, thus creating a stronger and more resilient network (Ratti, 2015). Living in a space and creating it can go hand in hand. «To achieve change», in the words of Dunne and Raby (2013), «it is necessary to unlock people's imagination and apply it to all areas of life at the micro-scale. Critical design, originating from the generation of alternatives, is able to help people build compasses, rather than maps, allowing them to navigate new sets of values».

The synergy can also be applied in the academic field, where design thinking can be used to develop innovative solutions based on understanding the relationships between the various actors.

References

Bianchini, M., *et al*. (2015). Makers' Inquiry. (online pdf) https://re.public.polimi.it/bitstream/11311/970262/1/MAKERS'INQUIRY%20ITALIA.pdf (visited on January 4, 2023).

Boubekri M, *et al*. (2014). Impact of windows and daylight exposure on overall health and sleep quality of office workers: a case-control pilot study. In *J Clin Sleep Med*. 2014 Jun 15;10(6):603-11. DOI: 10.5664/jcsm.3780. PMID: 24932139; PMCID: PMC4031400 (visited on January 4, 2023).

Dunne, A., Raby, F. (2013). S*peculative Everything: Design, Fiction, and Social Dreaming*. Cambridge: The MIT Press.

Knudsen, L. V., Andersen, V. (2002). Office design and evaluation: A case study. In *Ergonomics*, 45(1), 18-30.

Kwallek, N., Lewis, C. M., Robbins, A. S. (1988). Effects of office interior color on workers' mood and productivity. In *Perceptual and motor skills*, 66(1), 123-128.

Menichinelli, M. (2015). *Mapping the structure of the global maker laboratories community through Twitter connections*. Twitter for research handbook, 2016, 47-62. (online pdf) https://scholar.google.com/citations?user=_dnvybAAAAAJ&hl=nl (visited on January 4, 2023).

Orsini, R. A., Marchetto, H. (2005). An approach for the ergonomic design of offices based on spatial analysis and cognitive aspects. In *Applied Ergonomics*, 36(1), 69-78.

Ratti, C., Claudel, M. (2015). Futurecra: tomorrow by design. In T*ECHNE-Journal of Technology for Architecture and Environment*, 28-33.

Ross, P., Ressia, S. (2015). Neither office nor home: Coworking as an emerging workplace choice. In *Employment Relations Record*. 15. 42. (online pdf) https://research-repository.griffith.edu.au/bitstream/handle/10072/99108/RossPUB1140.pdf?sequence=1&isAllowed=y (visited on January 4, 2023).

Scholz, T., Schneider, F. (2017). Open-source innovation: The power of user communities. In *Business Horizons*, 60(2), 247-256.