

University Medialabs: New Learning Spaces for Educational Innovation

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Higher Education Institutions, like many other organizations, are facing pressure from the development of digital technologies as a push towards the digitization of their activities and towards a type of change that some describe as disruptive and that forces them to review their processes and structures. This article describes the case of the medialab of the University of Salamanca, MEDIALAB USAL, as an experience of new learning space in higher education. Its origin is explained from the experiences of citizen technology laboratories and experimental laboratories at the point of intersection between Art, Science and Technology. Its structure and working methods are explained, and its activities are illustrated through the description of four educational innovation projects based on different digital technologies: a mathematics didactics project using AppInventor, Wikipedia as a tool for knowledge generation, Arduino for innovation in the teaching of Fine Arts and a university Hackathon as an activity to introduce students to social and entrepreneurial innovation processes.

Keywords: educational innovation, medialab, new methodologies, collaborative work, social innovation, new learning spaces

INTRODUCTION

The technological development of the last two decades has transformed all aspects of our society. One of the areas that has been most affected by this technological breakthrough is education, especially in terms of teaching methodologies and methods. But this world of digital culture in which we find ourselves has also brought with it many challenges and difficulties that the educational world still has to face, and even more so in circumstances of a global pandemic due to Covid-19. In this context, innovation is a key element in order to offer answers to the new needs of education, especially in the university environment.

Educational institutions at all levels are very conscious that innovation goes far beyond the use of technology; change requires, among other elements, new processes, the inclusion of certain educational practices, a greater connection with the social reality of the moment and new spaces.

The University of Salamanca is facing these challenges from different perspectives and as part of its actions to innovate in Higher Education in 2010 created a *medialab*; a space that aims to support the transformation of education through experimentation with emerging technologies, the promotion of creativity and the implementation of new teaching methodologies. (González, 2020, p.2).

This article describes its characteristics, its work philosophy and some examples of projects for educational innovation that have been implemented in this space of the University of Salamanca.

INTEGRATION OF DIGITAL CULTURE AND CITIZEN TECHNOLOGICAL LABS

The creation of MEDIALAB USAL emerged as a response to the changes that were taking place in education and society after the consolidation of digital culture. This new scenario required the creation of university spaces that could face the challenges of the new teaching and learning processes, which, among other aspects, involved the constant use of technology and a greater connection between disciplines and with society.

These new paradigms of Higher Education, which MEDIALAB USAL also integrates, materialized after the Bologna process¹ and mainly involve a change in the teaching and learning methodology and, among other aspects, the development of certain skills, such as creativity.

In this way, MEDIALAB USAL was created as a space for educational innovation in which, at the same time, many of the principles and social movements arising from the digital era converge, including production and citizen participation laboratories, the *maker* movement, the *open source* philosophy, the commons model and collaborative culture. One of the objectives of all these movements is to promote collective work and production, to increase the participation of citizens in processes that were previously exclusive to large corporations or entities (such as the manufacture of objects) and the creation of interdisciplinary groups where people from all fields of knowledge are integrated.

Most of these forms of technological creation and use are developed in citizen spaces, which take the form of laboratories, such as *city labs*, *fab labs*, *makers labs*, or *hacker labs*. Its creation and structure is based on the definition of the medialab concept, defined by Ortega and Villar (2014) as "a laboratory designed to project prototypes and consumer tools that can be used in the media" (p.156).

Although there is no unanimity for the attribution of the creation of this type of space, the geographic context in which it develops seems to be clear: the United States. For many authors there is no doubt that the term was first introduced at M.I.T. (Massachusetts Institute of Technology) in 1985. Researchers such as (Sangësa, 2013) consider that the *media lab* would have its origins in: scientific laboratories, the industrial laboratory, the design laboratory and the digital technological laboratory.

The 1960s seem to be the breeding ground for this type of spaces, a moment, in which according to Inés Ortega and Reinaldo Villar (2014, p.155), "there are a series of initiatives that target to produce and spread artistic and design works, using computers and other technological and mass media tools".

One of these initiatives, which has also often been considered a pioneer of this type of space, is the professional collaboration between Billy Klöver (an engineer who worked at the Bell Labs communications center) and Robert Rauschenberg (American artist and painter and one of the main representatives of Pop Art in the United States), as described by De Vicente (2008).

In Europe, the experience of Baltan Laboratories (Eindhoven, Germany), creators of a space for experimentation in the interaction of Art, Science and Technology, and promoters of an international debate regarding the future of the MediaLab concept, is a reference (Plohman, 2011).

In Spain, one of the best known citizen laboratories of these attributes is Medialab Prado, which began its work in 2000 at the Conde Duque cultural center in Madrid and continues to develop its work today. It is, in accordance with its own definition, a "citizen laboratory for the production, research and spreading of cultural projects that explores the forms of experimentation and collaborative learning that have emerged from digital networks". It is a project that belongs to the Department of Culture and Sports (formerly the Department of Arts, Sports and Tourism) of the Madrid City Council.

In addition to Medialab Prado, there are other outstanding citizen spaces of these characteristics in Spain, most of which depend on provincial councils, town councils and similar institutions. This is the case

of centers such as Laboral Gijón (an exhibition center specifically dedicated to art, science, technology and visual industries), Hangar (an open center for the investigation and artistic production that supports creators and artists) or Arteleku (an art center created by the Regional Government of Gipuzkoa in 1987 and which ended its activity in 2014).

The *media lab* of the University of Salamanca, MEDIALAB USAL, is linked to the International Campus of Excellence Program (CEI), launched between 2009 and 2011 by the Spanish Ministry of Education, together with the Ministry of Science and Innovation, the Autonomous Communities and other public and private organizations.

The main purpose of the CEI program is to improve Spanish universities and advance towards excellence. MEDIALAB USAL started its activity as part of the initiatives of the University of Salamanca carried out under this program in which the projects developed previously went through a rigorous international evaluation process.

Its origins date back to 2010, linked to the *ARS model*² (Art, Research, Society), developed in the same year by the Institute of Contemporary Art in collaboration with the General Secretariat of Universities of Spain and whose main purpose is to promote the connection between art, science and technology to strengthen the university environment and to promote cooperation between universities, society and business.

MEDIALAB USAL was created, based on this model of convergence of disciplines, as a space in which to promote educational innovation from the creative use of technology and the connection with society for the implementation of projects and activities related to new ways of learning and university research.

In addition of being a multidisciplinary environment, one of the tasks of MEDIALAB USAL is to promote the connection between all the agents and areas of the University in order to facilitate the development of joint initiatives and to favor an innovative environment.

THE WAY TOWARDS A *MEDIA LAB* FOR INNOVATION IN THE UNIVERSITY

In the Spanish university ecosystem, the creation of this type of technological laboratories has not been common. The few examples that can be found are usually laboratories associated with a very specific area of the university (a faculty, a school, a department...), which complicates the connection between the different profiles and agents of the university, a necessary task to promote a more innovative educational environment.

Based on this idea, the creation of MEDIALAB USAL became even more necessary and it is not only a space in which to promote the connection between professors, students, technology and digital media. It is above all, a project that seeks to provide a response to the needs of the new educational model from a position still little exploited in the field of Spanish universities. Therefore, in addition of combining the characteristics of citizen laboratories and movements linked to digital culture, the integration of society as a whole in this process is sought.

In this way, MEDIALAB USAL has become an open university space in which all types of people can participate, regardless of their connection to the University. This global character of openness is probably the element that most distinguishes it from similar environments in Spain, making it unique in its category.

In addition to this connection with citizenship, MEDIALAB USAL seeks the active participation of students and teachers and, therefore, all its projects and program of activities have been conceived from a very practical and immersive point of view, as pointed out by José M. Ruíz (2016), the *media lab* model offers several advantages to the new educational models because in them the student "is transformed from a passive being to an active being, changing the communicative act into a constant feedback of information" (Ruíz, 2016, p.103).

Therefore, the activity of MEDIALAB USAL is developed from some of the principles of *learning by doing*, a methodology promoted by Roger Schank (recognized expert in artificial intelligence and professor at Yale and Stanford) and based on the following principles:

Over the years, in our efforts to develop intelligent computers, we have learned much about how human memory works and how people learn. In an effort to employ these lessons and to address the aforementioned problems with traditional learning environments, we developed a structure for teaching and learning called goal-based scenarios (GBSs). A GBSs is a learn-by doing simulation in which students pursue a goal by practicing target skills and using relevant content knowledge to help them achieve their goal. During the simulation, students are provided with coaching just in time for them to use the information. Giving feedback in this manner allows learners to remember what they are taught (Schank, Berman y Macpherson, 1999: 165)

Along with practical learning, there are many other elements that guide the operation, projects and activities of MEDIALAB USAL in order to provide a dynamic, creative and innovative environment. To achieve this, MEDIALAB's configuration has been established by giving great importance to spatial design, to its areas of work, to the development of transversal activities, to collaborative and interdisciplinary work, and to projects focused on social and educational innovation.

NEW SPATIAL CONFIGURATIONS FOR INTERDISCIPLINARY AND CREATIVE WORK

In order to undertake the changes required by today's higher education, it is also necessary to redesign the physical spaces. If the aim is to increase student participation in the learning process, it is essential to move away from the usual disposition.

The approach to new educational spaces is not new; it has been the subject of study for many professionals, such as architects, teachers and pedagogues, for decades (Salmerón, 1992; De Pablo and Trueba, 1994; Gairín Sallán, 1995; Gairín Sallán, 1995; Laorden, C., 2001). Several of these experts consider space as another didactic factor, since it becomes a facilitator of learning, as is the case of Honorio Salmerón (1992), who considers the following:

School architectural spaces provide students with non-verbal cultural and social information, they are not mere behavioral envelopes but interact with students, being an important part of the hidden curriculum for the storage and material presentation of social core and cultural information (Salmerón, 1992, p.92).

In MEDIALAB USAL, the architecture and the layout of the space are two of the fundamental elements for its operation. The MEDIALAB space has been designed to provide a place for meeting, reflection, collaboration, experimentation, production, creative, interdisciplinary and innovative. But above all, it is a mobile space where no type of furniture or object is fixed; it is a constantly changing space that adapts to each activity and needs. This spatial layout is linked to the different work areas of this *media lab* in which the following spaces are mainly identified:

1. **A creative space** where all activities and initiatives focused on sharing ideas, innovative experiences, *brainstorming* processes, reports based on the results of projects or innovative technologies and round tables are carried out.
2. **Collaborative work area.** Given that another of the fundamental objectives of MEDIALAB USAL is to promote the meeting between people of different profiles for the development of collaborative actions and projects, a specific area has been created for this type of purpose. This area is mainly used to host the different working groups that develop their proposals with the collaboration of MEDIALAB and that meet periodically in this space.
3. **Production area. MEDIALAB Factory.** The work teams and all MEDIALAB users have at their disposal a workshop and digital prototyping area. This is the factory area where the results of the interdisciplinary works are materialized and where workshops and practical activities are developed to learn how to use digital tools such as 3D printers, along with other tools more related to traditional carving (vinyl cutter, laser engraving machine, etc).

The following is a description of some interdisciplinary projects aimed at promoting innovation in Education, developed in this *media lab* of the University of Salamanca.

CASE I. WIKI USAL. WIKIPEDIA AS A LEARNING TOOL

In the last decade Wikipedia has transformed from being one of the great enemies of education to become a great ally, especially thanks to the degree of rigor and organization it has achieved. The free encyclopedia is increasingly being used in universities and offers numerous opportunities for teachers to innovate in education.

The *WikiUSAL* project, promoted by the University of Salamanca, from MEDIALAB USAL, seeks to foster the creation of quality content in Spanish at the University, to include rigorous editing of Wikipedia content as part of the practical work of undergraduate and graduate subjects at the University of Salamanca, and to offer a new free learning tool to teachers and students.

This project began in 2012, as part of the *USAL's Teaching Innovation and Improvement Plan*, whose main objectives are to promote the updating of teaching methodologies, foster collaboration among the teaching staff and increase the active participation of students. It was conceived, therefore, as an active collaborative teaching initiative (Alonso de Magdaleno and García, 2013) that any teacher could join.

Participating teachers link Wikipedia content editing to one of the subjects they teach. In turn, students must choose relevant content related to the subject, which are not developed in Wikipedia or that have little content and they must work on it, applying the publication rules of the free encyclopedia. To this end, students and teachers are trained beforehand with practical workshops on Wikipedia.

As a result of this initiative's development from 2012 to 2016, 118 professors from different degrees, 584 undergraduate and master's degree students from the University of Salamanca have participated and 1,752 new entries from all areas of knowledge have been created.

The development of this project has been an excellent opportunity to involve the university community in the creation of specialized and rigorous content in Spanish on Wikipedia. Certainly, one of the main motivations for the involvement of the participants has been to be able to work on a real environment that millions of people consult every day. This project has enabled students to present some of their academic work to a global audience.

CASE II. APPLICATION OF APP INVENTOR TO MATHEMATICS TEACHING

In this second case, another of the proposals for technological innovation in teaching is described, through the application of *App Inventor* technology (open source tool created by Google Labs), which allows creating Android applications through a web browser for the development of didactic applications for mobile learning in the teaching of mathematics.

Using this technology as a basis, this project was intended to include in the Final Project, applications for *smartphones* that collected the contents of a topic and a self-assessment system, trying to reach the last level, because once students download the application, they would be the owners of it and could use it whenever they see fit in order to self-learning.

The first stages of access and exploration of the technology were developed in MEDIALAB USAL. Once the technology was identified and downloaded, the second phase of exploration began. The form of technology transfer that was chosen was the collaboration with teachers and students of the Master's Degree in Secondary Education, Vocational Training and Language Teaching so that some of them included App Inventor as a substantial part of their Final Project (TFM by its Spanish acronym).

Based on an introductory course regarding the use of technology, given at MEDIALAB USAL, three students tutored by a professor of Didactics of Mathematics dedicated their TFM to design didactic units for high school students that included the use of mobile applications created with App Inventor that implemented test-type activities and direct answers with the purpose of viewing the concepts.

Of the three proposals designed, one of them could be developed in a positive educational environment, in which high school students were introduced to the mobile application and during the sessions in which this project was carried out, they worked in groups of two in the classroom.

The application resulting from this collaborative work is a Mathematical Trivia game composed of six blocks of content: History of Mathematics, Numbers and Algebra, Geometry, Functions, Statistics and Probability. Each one of them has fifteen questions related to the contents of 3rd Obligatory Secondary Education.

Thanks to the participation in this teaching innovation project, the students got to know the mobile application in a practical way and during the sessions in which this project was carried out, working in groups of two people in the classroom. The work performed provided the Master's students with a complete knowledge and mastery of the technology.

CASE III. APPLICATION OF ARDUINO TO INNOVATION IN FINE ARTS EDUCATION

The integration of digital technologies and devices in the European education system has been a reality for several years. However, the simple integration of this type of elements is not enough, especially in certain degrees that have traditionally been less in contact with technology, such as Fine Arts.

In this case we expose the activities implemented in MEDIALAB USAL in order to promote the use of Arduino (open source hardware platform) among students of Fine Arts. This open source, printed circuit board makes it easy to integrate electronics and programming into any job, prototype or project.

This project was launched in 2012 following an activity at MEDIALAB USAL in which some of the most outstanding applications of this particular panel in art were exhibited. Since that moment, during 5 academic years MEDIALAB USAL has offered to the students of Fine Arts the participation in different lines of work for the learning and application of Arduino.

To date, the project has been carried out with students from different Fine Arts courses and has been developed in an interdisciplinary way; therefore, students from the University with other degrees have been integrated at the same time.

The application of Arduino as a teaching innovation tool in the Fine Arts degree was done in phases. The first one, more theoretical to offer the first approach to the board (explanation of components, parts, operation and uses).

After this first contact, practical workshops were organized in which the students were able to apply all their knowledge. Subsequently, a phase designed for self-exploration and collaborative experimentation with the tool was initiated. To this end, students were provided with a workshop in which they could work weekly at certain times; this task was established by groups. Once the participants had learned and integrated the necessary knowledge, calls for projects based on this technology were launched.

The development of these projects is also carried out by interdisciplinary groups that work for months. Finally, it is offered the possibility of displaying the results of the projects in an exhibition space at the University and disseminating them through all kinds of information channels (web, social networks, media, other agents...). All these activities are designed, developed, managed and implemented by MEDIALAB USAL.

Arduino integration activities in Fine Arts have resulted in the collaboration of more than 70 students in interdisciplinary projects, which have been part of several collaboratively created projects. Each project has its own blog explaining the work process and how Arduino has been integrated. One of the cycle of Arduino integration activities in Fine Arts, concluded with an exhibition in which a selection of four interactive works were shown.

The project has therefore contributed to innovation in Fine Arts teaching methodologies and has mainly served to provide students with tools for enhancing their artistic creations, since it allows them to integrate aspects that would otherwise be more complex, such as introducing light, sound, movement or making a work interactive. In addition, the participating students have subsequently been integrated into other work groups and projects of MEDIALAB USAL, based on Arduino, such as the assembly and use of a 3D printer

in a collaborative way. For many, it has also been their first opportunity to exhibit their interactive work in a public space.

CASE IV. HACKFORGOOD

The implementation of hackathons in the educational context is an interesting formula to promote new forms of teaching and learning and to include universities in the processes of social and entrepreneurial innovation. HackForGood is an inter-university social hackathon promoted by Telefónica and joined by the University of Salamanca, through MEDIALAB USAL. It is carried out once a year, as a singular event, and six editions have been held.

The meeting takes place during three consecutive days with the simultaneous participation of different Spanish universities. Participants must work over this period of time on solving specific challenges that can improve the world and people's quality of life through technology. The best projects are awarded through different formulas. The organization supports the development of the projects and the training of its members in aspects such as entrepreneurship. The participating students are considered 'hackersforgood', which as defined on the website of this meeting are "enthusiastic, positive, optimistic, stimulating young people, with ideas and initiatives to solve those problems that no one has yet solved through innovative technological solutions".

The call for challenges to be solved is public and both individuals and associations of the environment participate in it. Participants in the hackathon must choose the challenge they are going to solve and after that, the work of developing the project begins, which includes project ideation, code development, image and application design or web design, if necessary. The work is carried out in teams that are created by distributing the professional and academic profiles of the participants in the best possible way.

They acquire numerous academic, personal, cognitive and professional skills, among which the following stand out: creative problem solving, computational thinking, learning by doing, critical thinking, analytical skills, emotional intelligence, work organization skills, leadership, interpersonal relationships and communication, real problem solving, teamwork skills, capacity for self-criticism, proactivity, entrepreneurial attitude, sense of social responsibility, and capacity for innovation (Martín-García et al., 2021). During the three days, students get to work in a collaborative and interdisciplinary way, in a practical way and very close to the real professional world. This allows them to greatly enrich their academic and social perspective. Another significant benefit of participating in this type of initiative for students is that they can become social innovators, since many of the ideas they come up with are truly original and serve as a response to social problems that had not yet been considered or solved.

CONCLUSIONS

Educational innovation based on emerging digital technologies requires new open, interdisciplinary and collaborative learning spaces, such as MEDIALAB USAL. Its dynamics allow students and professors to experiment with interdisciplinary collaborative projects that are not easily found in traditional university environments, which are excessively structured and compartmentalized.

In the current context of digital transformation of Higher Education, innovation must be considered a necessity and a constant activity. Not as an isolated event but as an essential part of the educational action. Therefore, universities must provide themselves with permanent spaces and well-established procedures to encourage experimentation with emerging digital technologies and their application to educational innovation. Spaces where creativity can emerge from the freedom to connect ideas in new ways, beyond the strict schemes of university education. The availability of several emerging digital technologies makes it possible to create such spaces without the need for large investments.

MediaLab USAL is a permanent space of the University of Salamanca dedicated to the exploration of innovations based on digital technologies. Its main contributions are to be a space for interdisciplinary meetings and for unstructured experimentation, where trying new options is a value and making mistakes

is not considered a failure. It also has the added value of being a space open to the environment, outside the university environment, which facilitates the transfer of academics to the social environment.

ACKNOWLEDGEMENT

Translated & edited by American Publishing Services (<https://americanpublishingservices.com/>).

ENDNOTES

1. This is the name given to the European Higher Education Area, a field of educational organization initiated in 1999 and whose main objective is the harmonization of the different educational systems of the European Union.
2. On October 4, 2010, the General Secretariat of Universities and the Institute of Contemporary Art, an association of visual arts professionals, signed an agreement to "promote the development of excellence models, which integrate aspects linked to interdisciplinary artistic sensitivity understood as the fundamental core of citizenship and cultural education". As a first result of this collaboration agreement, the Institute of Contemporary Art proposed to the General Secretariat the ARS model, whose main objective is to strengthen the real intersection between Art, Science and Technology. This model is included in the publication International Campus of Excellence. The art as an excellence criterion, published in 2010 by the Ministry of Education.

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