PORTUGAL FAB SCHOOL INITIATIVE

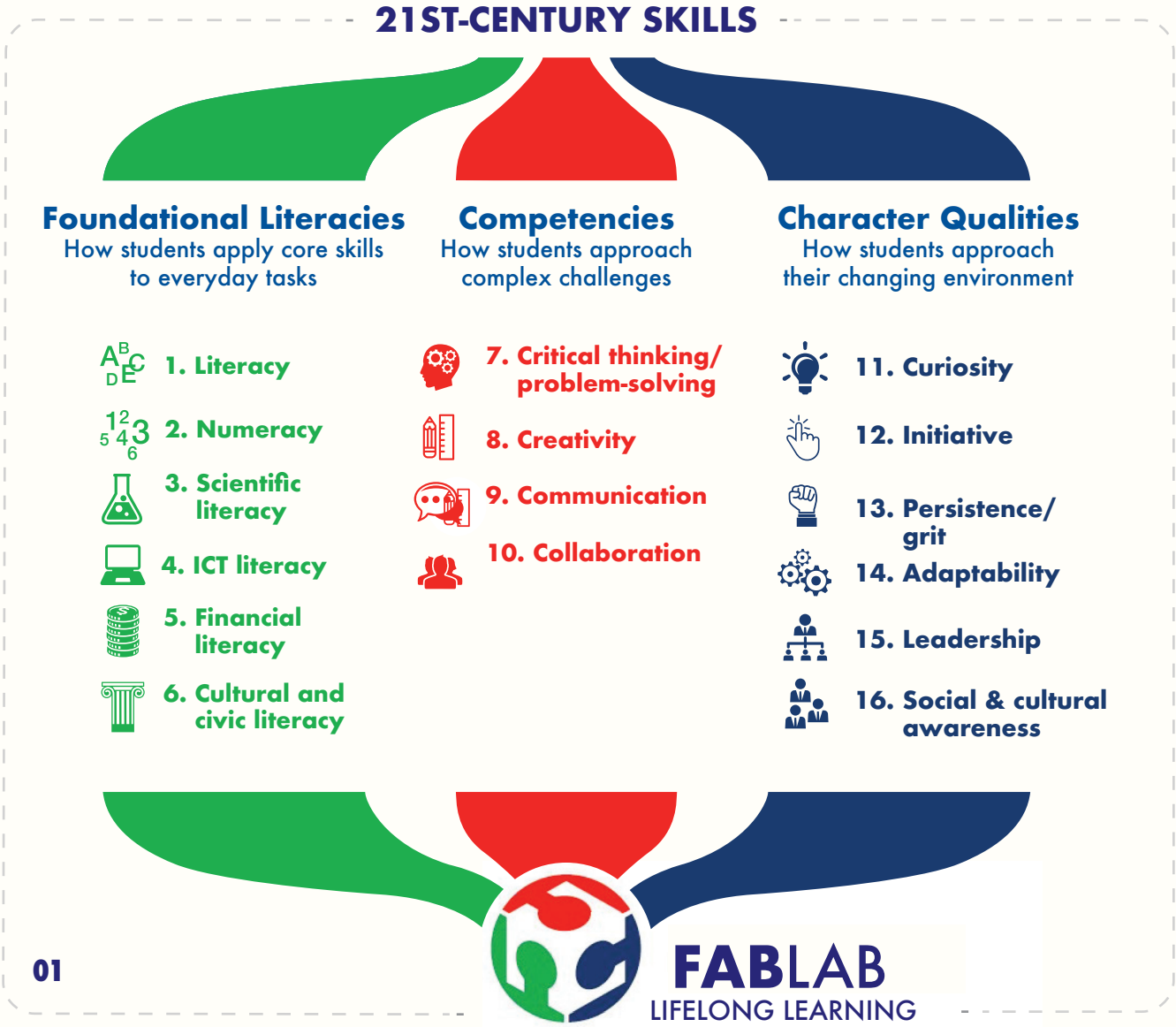
FABLAB@SCHOOL

How to create a successful, competitive, and relevant Portuguese workforce for the Industry 4.0 era.

PROJECT SUMMARY

Fab Labs in schools are needed in Portugal to educate successful and self-autonomous students to build a stronger future for the country. Combining Project Based Learning with digital fabrication technologies, Fab Labs in schools can enhance the curriculum and bring relevance to all types of learners. It is a complementary learning system to traditional education and it is greatly needed to fulfill the future workforce needs in Portugal. **(01)**

(01) Infography adapted from "New Vision for Education: Fostering Social and Emotional learning through Technology" _ https://www.weforum.org/agenda/2016/03/21st-century-skills-future-jobs-students/



DEMONSTRATION OF NEED

Companies in Portugal are facing a workforce need right now and are looking towards education to help fill this gap. The current and future Portuguese workforce needs to embrace the competencies that drive innovation, support technologies, and solve problems, but the current educational model is not evolving fast enough to keep up with these changing needs. In 2016 FabLabs Portugal met with Secretary of State for Industry, who defended the FabLabs as engines of innovative ideas: "On these occasion, the president of the FabLabs Portugal Association, Horácio Pina Prata, acknowledged the "vision" of the Secretary of State for Industry, João Vasconcelos, extending his congratulations "to the vision that presupposed the inclusion in the Government Program of creating a National Network of FabLabs as a measure to stimulate the creation of employment through a greater valuation and training of entrepreneurship ". Horacio Pina Prata also highlighted the importance of the FabLabs initiative in Portugal within the framework of the MIT [Massachusetts Institute of Technology] network, which could and should be "an aircraft carrier to support entrepreneurial initiatives and a driving force for the articulation of FabLabs as incubators of skills of the 4th Industrial Revolution ". **(02)**

(02 - First row, from right to left) Horácio Pina Prata - President of the FabLabs Portugal Association, João Vasconcelos - Secretary of State for Industry, Bernardo Gaeiras - Director of FabLab Lisboa; Duarte Cordeiro - Deputy Mayor of Lisbon; Remaining elements: Representatives of FabLabs in Portugal.

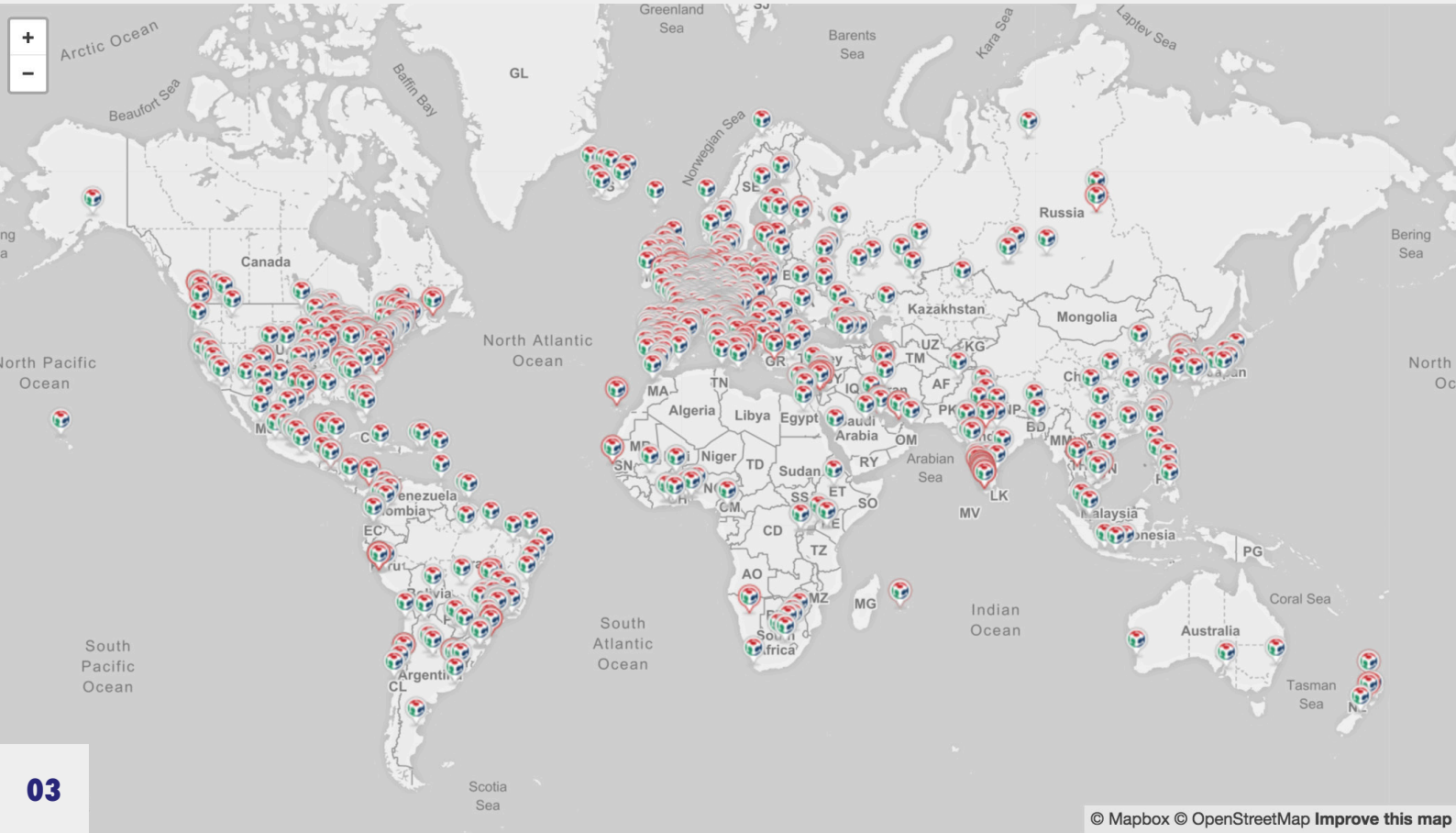
_ https://www.noticiasdecoimbra.pt/fablabs-portugal-reune-com-secretario-de-estado-da-industria/

WHAT IS A FAB LAB

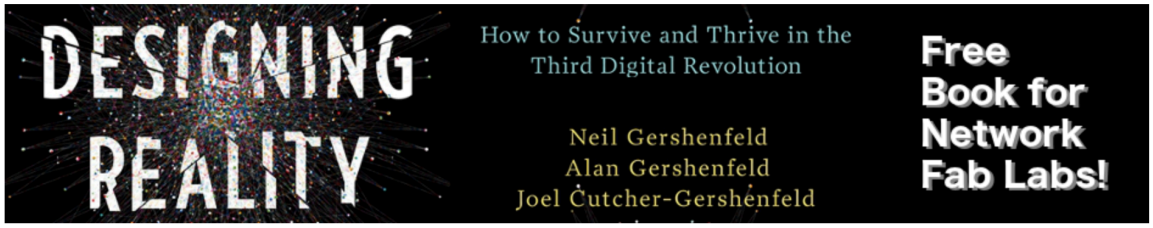
A Fab Lab is more than a makerspace; it is a community of inventors, entrepreneurs, and lifelong learners who use open source digital fabrication for innovative change. From 3D printers to multiple axis CNC machines, Fab Labs offer cutting edge technology to students, educators, community members, and families who can learn to make (almost) anything. The first Fab Lab was started at the Massachusetts Institute of Technology in 2001 through a grant from the National Science Foundation, and the concept has grown to over 1200 Fab Labs worldwide. **(03)**

All Fab Labs, though independently organized and locally unique, share a set of tools and software, computer files, drawings, machines, and inspiration so that users can collaborate with other labs, in any country. The Fab Lab movement is based on equity of access to these technologies, which can impact communities through innovation and entrepreneurship. **(04)**

(03) - For a current list of registered labs, visit www.fablabs.io/labs



FABFOUNDATION



Fab Labs

Fab labs provide widespread access to modern means for invention. They began as an outreach project from MIT's Center for Bits and Atoms (CBA), and became into a collaborative and global network.

Learn More ›

Fab Academy

The Fab Academy provides instruction and supervises investigation of the mechanisms, applications, and implications of digital fabrication. Fab Academy is where many new fab lab managers, gurus and teachers get their training in digital fabrication.

Learn More ›

SCOPES-DF

Digital fabrication has the potential to transform k-12 education. With the SCOPES-DF project, the Fab Foundation is bringing together fabbers, makers, and educators to deepen our understanding of the "what", "how" and "why" of STEM disciplines.

Learn More ›

Fab 14+

Fab14 will be held in France in 2018, having the main Fab Conference and meeting in Toulouse, the Fab Festival through France and the Fab City Summit in Paris

Learn More ›

Fab Lab Network

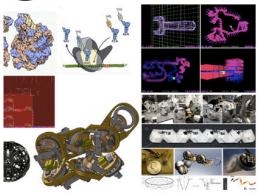
The Fab Lab Network is an open, creative community of fabricators, artists, scientists, engineers, educators, students, amateurs, professionals, ages 5 to 75+, located in more than 100 countries in over 1,000 Fab Labs. The platform is a curated, interactive directory of these locations.

Learn More ›

Fab Projects

From sustainable wireless internet infrastructure to fabbing solar houses to tracking global environmental data to creating opportunities for self-expression, the Fab Lab network is building a growing list of projects that benefit community in many different ways.

Fab Research



The Fab Lab project is the educational outreach program for MIT's Center for Bits & Atoms (link). As such the network is closely linked to MIT's research into the merging of physical science and computer science and the development of digital materials. The international Fab Lab network also contributes to new research and applications in digital fabrication...

Donations/Grants

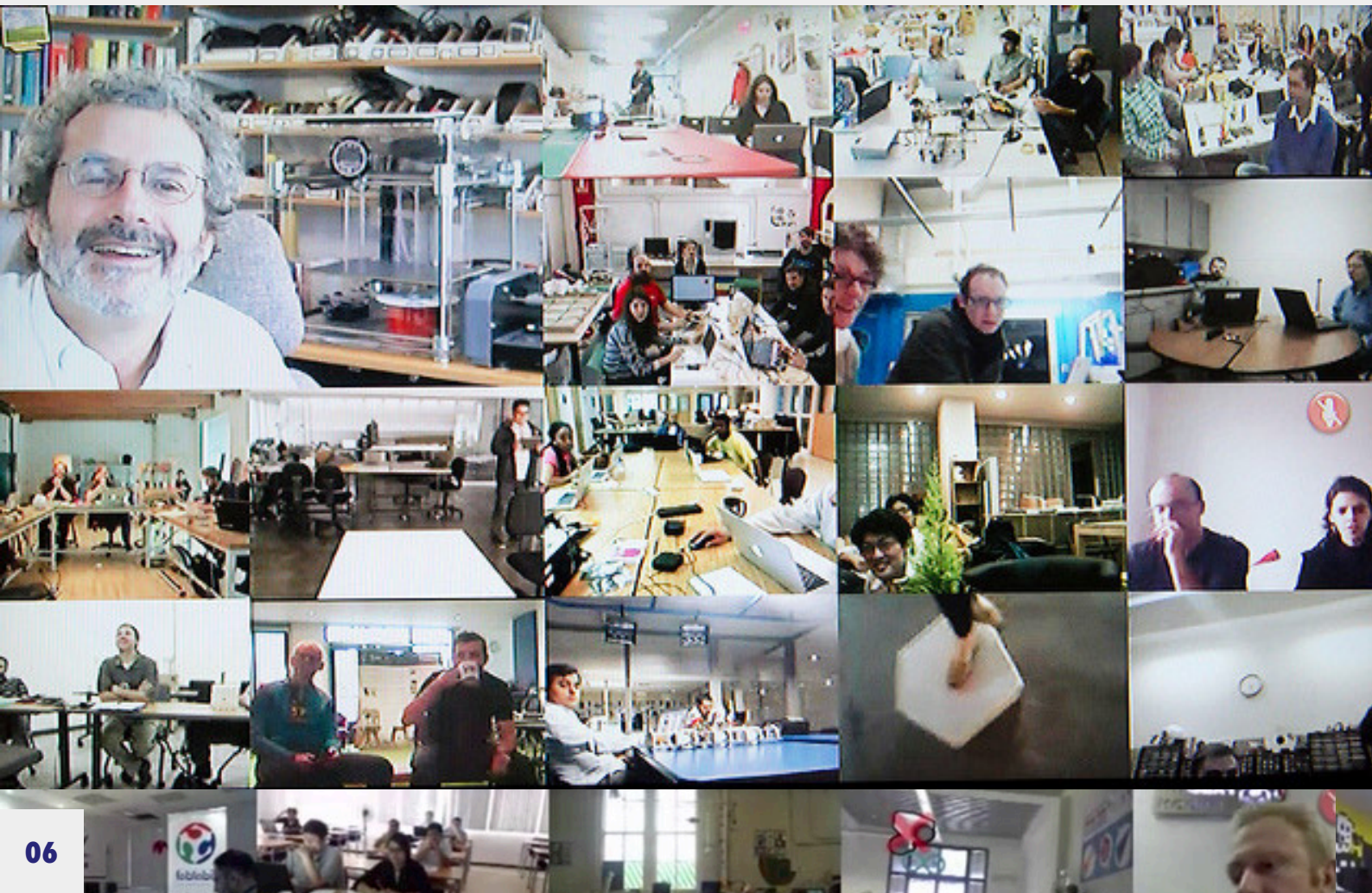
Funds are put to good use around the world in education and innovation environments. For more information on how to support the many educational and economic outreach projects in the network or to support the establishment of new fab labs, or infrastructure please contact us. Thank you for your interest and your support!

BRIEF FAB LAB HISTORY IN PORTUGAL(05)

The name FAB LAB in Portugal is known since 2007. On 22nd January 2010, the "Fab Labs Portugal Conference - Innovation for all", promoted by IAPMEI (in partnership with Ydreams), took place at Lisbon Congress Center, with the special presence of Neil Gershenfeld (MIT Bits and Atoms), Alex Schaub (Fab Lab Netherlands) and Haakon Karlsen (Fab Lab Norway). Faced with the enthusiasm of rulers, agencies and private individuals, Neil Gershenfeld challenged the audience, stating that "it was enough to concretize the statements of those present to have a Fab Lab initiative in Portugal ". **(06)**

(05) Paper distributed in the XI FabLabs National Meeting in Coimbra, april the 4th

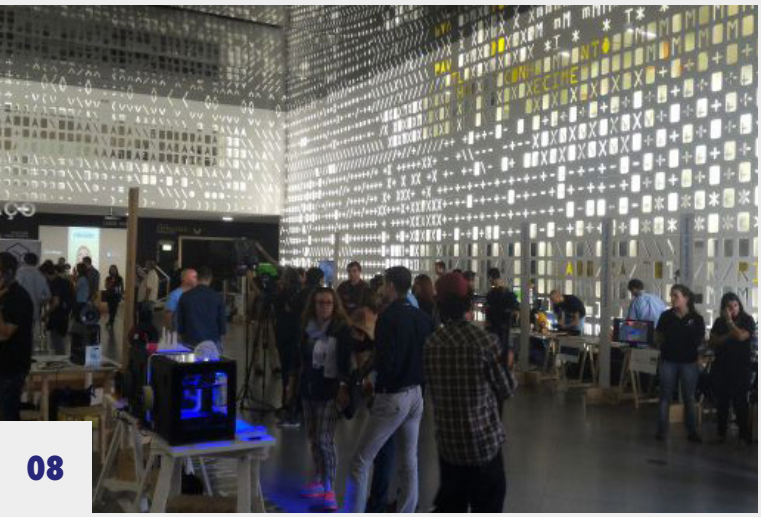
(06 - top left) Prof. Neil Gershenfeld in a video conference with more than 100 Fab Labs from the world-wide global community _ https://www.sqedio.com/fab-lab-edp-recebe-licencas-solidworks/



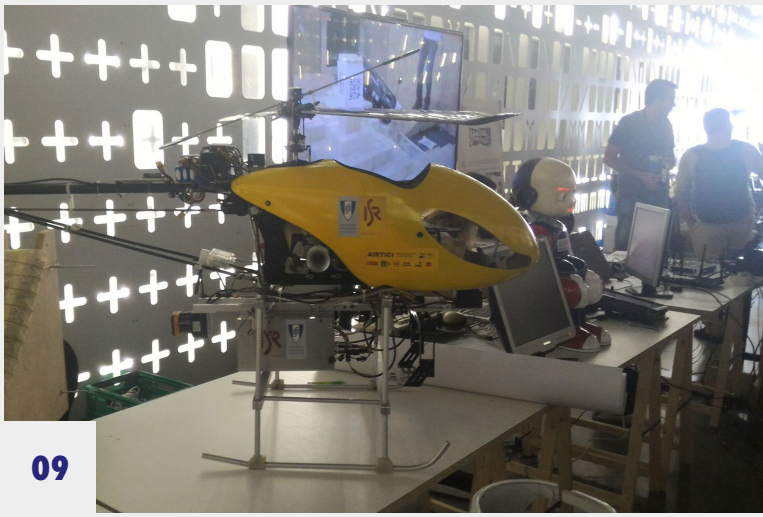
On June 7th of that same year, at the Portuguese Republic Assembly, António Câmara at the Parliamentary session on "What is the curriculum for the 21st century?" **(07)** pointed out a "Recommendation to create FabLabs as a fundamental element in the preparation of students with abilities and know how". Also in that year, on October 14th, FABLABS PORTUGAL - Digital Labs Portuguese Association (in portuguese, APLFD – Associação Portuguesa de Lab. de Fabricação Digital) launched publicly a Fab Lab initiative, in response to the challenge of Neil Gershenfeld and the promoters of the International Conference previously mentioned. This association was registered in Santarém and exists since 2010. **(08-12)**

(07) Page 21 of "CurrSecXXI.pdf" _ https://www.parlamento.pt/ArquivoDocumentacao/Documents/CurrSecXXI.pdf

(08-12) 30,000 visitors saw Portuguese Fab Labs represented in the "Makers Faire Lisbon", from 2014 - 2016 at the Science Pavilion _ http://makerfairelisbon.com/pt/ _ https://makerfaire.com/map/



08



09

10

11

In the next year, 2011, two major digital laboratories appear on the news, OPO'LAB **(13)** and a FAB LAB supported by EDP **(14)**, a major electric utility in Portugal. FabLab Coimbra **(15)** was also presented to the community on October 7th, in the same year, and the Lisbon FAB LAB was inaugurated in 2013 **(16)**. A dynamic that turned out to be successful because in the biennium 2014-2016 opened more than a dozen of FabLabs, developing a National Network **(17)** well distributed throughout the country, enriched by the variety of diverse natures of its promoters **(18)**, directing it to the business, social proximity and research. Since then there are nineteen registered in the Fab Foundation, promoted by state institutions or private entrepreneurs, spread all over Portugal, and more are coming to create a unique network dedicated to knowledge and collaboration. **(13-19)**

(12) https://tek.sapo.pt/expert/artigos/este-ano-nao-vai-haver-maker-faire-lisbon-mas-pode-ser-apenas-uma-pausa _ http://makerfairelisbon.com/pt/

(!3) https://www.publico.pt/2011/09/28/p3/noticia/o-porto-tem-um-laboratorio-xl-de-arquitectura-1811863

(14) https://www.publico.pt/2011/02/23/tecnologia/noticia/fab-lab-em-portugal-abre-esta-quintafeira-1481811

(15) https://repositorio-aberto.up.pt/bitstream/10216/75667/2/24961.pdf

13

14

15

16

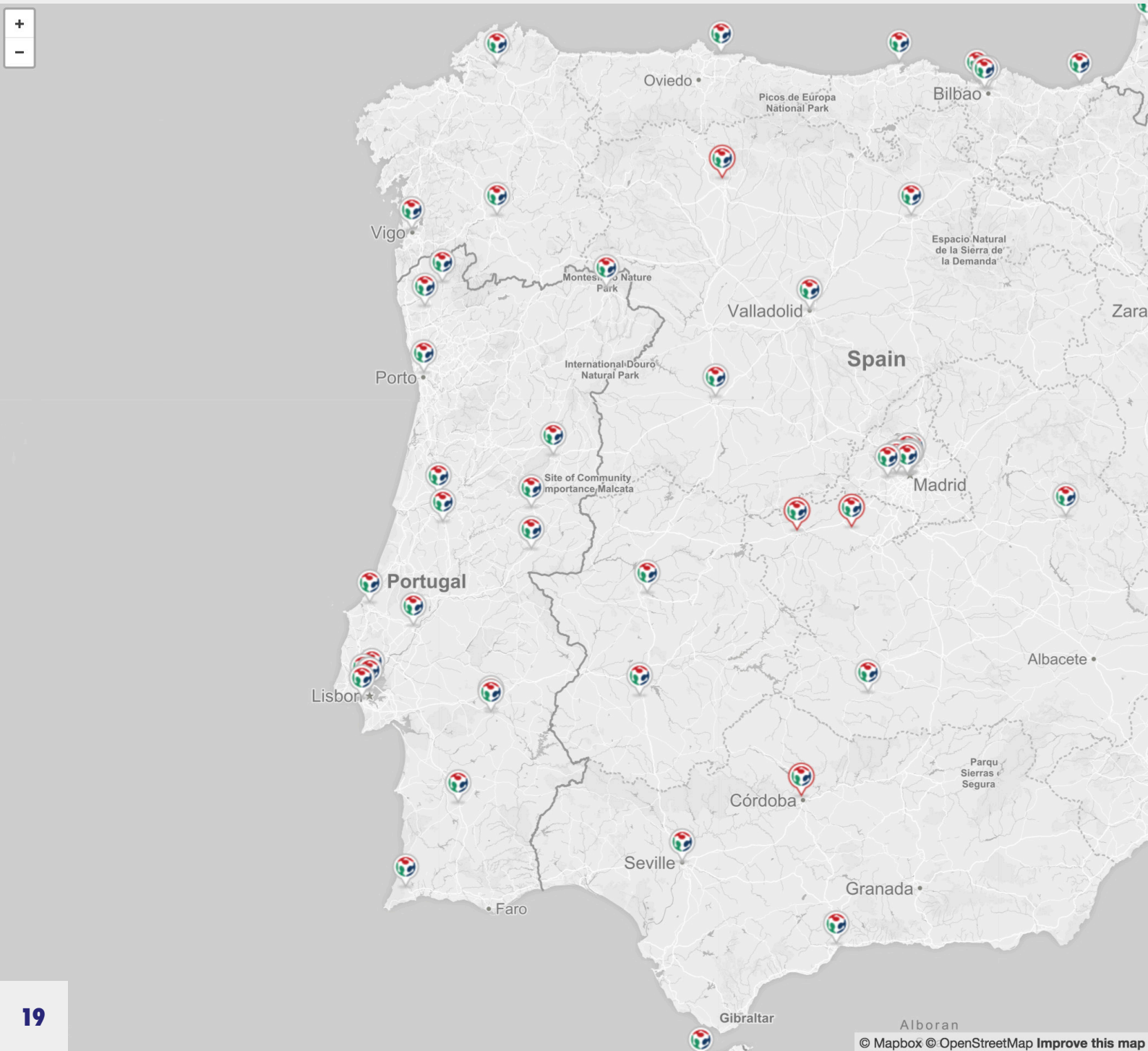
17

18

(19) At these moment there are 19 portuguese Fab Labs registered in the Fab Foundation _ http://www.fabfoundation.org/index.php/fab-labs/index.html

16 active Fab Labs registered in the Portuguese Association of Fab Labs _ http://www.fablabsportugal.pt/fablabs-activos/

and 3 Fab Labs are in the installation process _ http://www.fablabsportugal.pt/em-instalacao/



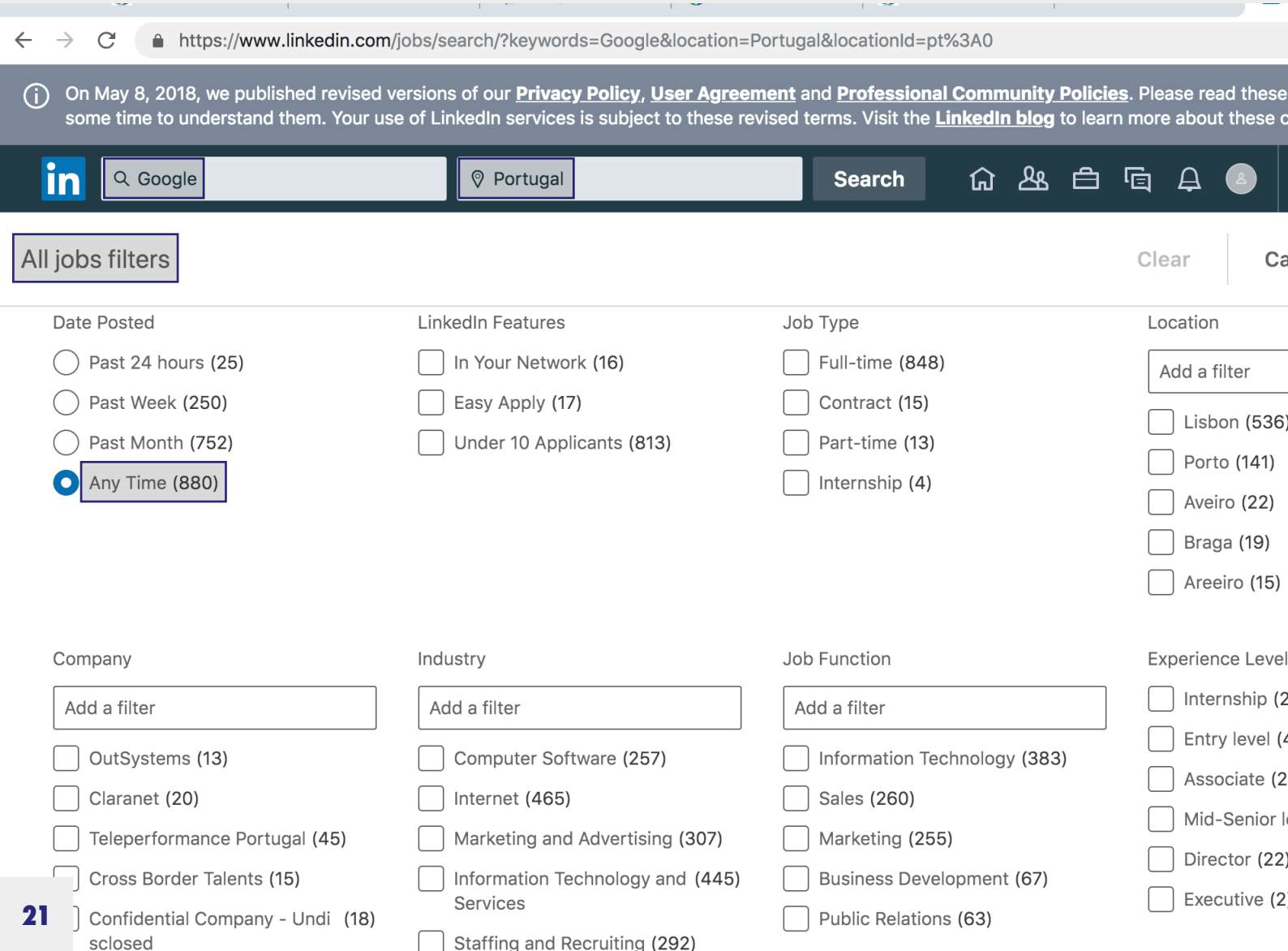
FAB LAB BOOTCAMP XII

July 12th-15th in Torres Vedras, the local Lab Center held the XII BOOTCAMP FAB LAB of the portuguese Fab Labs, organized by the association Lab Aberto Fab Lab. It was a gathering of the national schools, entreprises and Fab Labs, sharing knowledge and ideas on a informal environment. More than 200 people involved, 27 workshops done, with 3 nationalities, 25 trainers, 116 attendees, 58 teachers, 40 volunteers, 22 institutions, 2 universities, 9 companies and 12 Fab Labs national and international. This event was supported by the local city all, the Torres Vedras Lab Center, the US embassy in Portugal and the State Secretary of Science Technology and University Education, Maria Fernanda Rollo, as well as 28 institutions, among universities, enterprises, schools and projects. **(20)**

(20) Read more in ANNEX I: XII BOOTCAMP OF FAB LABS, FINAL MESSAGE.

PROBLEM TO SOLVE

The innovative technology jobs for next 10 years are not invented yet, but the educational system right now doesn't give response to this. The educational strategies should focus on the named soft skills for the XXI century. More multinational tech companies like Google and Amazon are coming to Portugal and we don't have enough Human Resources being educated. In some areas they are decreasing. 2/3 of the portuguese students don't proceed their studies to the university. To help solve this challenge, we need to include hands-on activities, marketing, sales, entrepreneurship, creativity, innovation and communication skills into the Portuguese curriculum as well as integrate the enterprises, local institutions, and universities in this effort. **(21)**

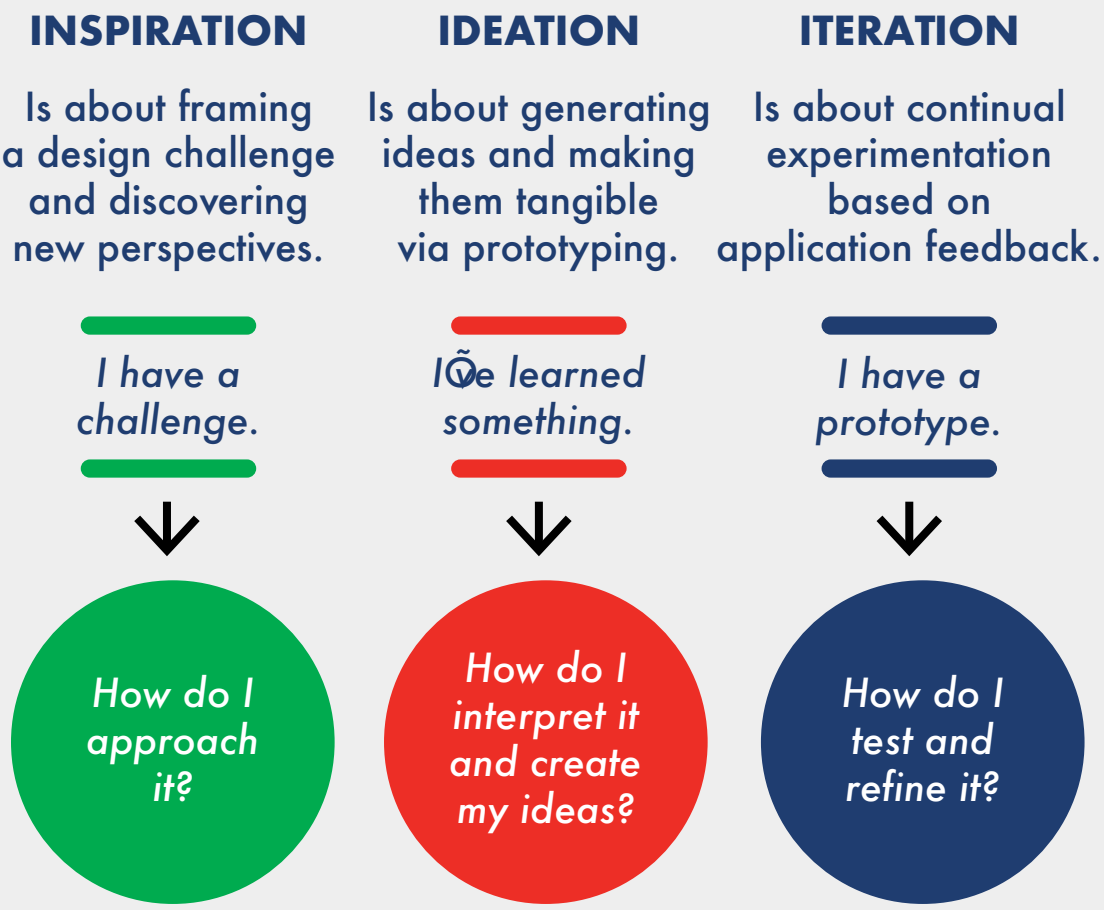


CALL TO ACTION

Teachers, industry leaders, families, and most importantly, students recognize the need for a change in traditional school. With this initiative we can start to work with local and national schools, with all the communities interested in education, including enterprises, Fab Labs, universities, traditional schools, and collective initiatives in order to propose another possible learning path within the Portuguese educational system. **(22)**

The **target** for now are the professional secondary and university students and can be scalable to other levels and types of schools as well as the subjects: not only scientific or technological.

(22) Infography adapted from _ http://cucfablab.org/



In educational technical terms, we propose an inductive informal pedagogical/ methodological brain based **learning strategy**, along with a project based learning and a content learning "as you need" strategy approach. This means that:

- **LEARNING PLAN/DESIGN -** will be like a flux that runs within two vectors, practical to abstract and from simple to complex (4C/ID methodology of van Merriënboer);
- **DURING THIS LEARNING PROCESS -** we always bear in mind the crucial need for cognitive and procedural automation at the end of each activity in order to achieve high complex skills levels;
- **LEARNING PATH -** will be flexible in order to be discussed and adapted to the student learning style;
- **COGNITIVE LOAD ISSUE -** will be addressed during the activities directly related to the skills automation;
- **CONTENTS -** can be presented informatively, like in traditional lectures, or through a web/library bibliographic search;
- **LEARNING ENVIRONMENT -** will be informal to reinforce the student-teacher interactions;
- **COLLABORATIVE AND COOPERATIVE ENVIRONMENT -** will be reinforced by proposing specific activities that allows team building;
- **PROJECTS PRESENTED TO THE STUDENTS CAN BE COMPLETELY CLOSED**,, with a very strict procedure, **OR COMPLETELY OPEN**, with a whole-real-problem to solve depending on the student level of motivation and autonomy. **(23)**

(23) International examples on how Fab Lab community is contributing with digital fabrication lessons to improve students development, changing the traditional school right now _ https://www.scopesdf.org/lessons

GRADES K-5

ANIMAL ENGINEERS & DESIGNING FOR SURVIVAL NEEDS

Students learn about the engineering design process by observing animal behavior and experimenting with the design choices animals make.

GEOCONSTRUCTIX

Students will work with a series of successive methods-based exercises to learn the fundamentals of geometry and fabrication techniques with increasing levels of complexity.

Nov 9, 2017 ·

CHILD DESIGNED FURNITURE

Young children will learn about digital fabrication by creating their own furniture for a Fab Lab.

Nov 13, 2017 ·
CNC, furniture, shopbot, Fab Tested, early childhood, museum/science center

CIRCUIT EXPLORATION

Young children learn about electronics and circuitry through exploration and play.

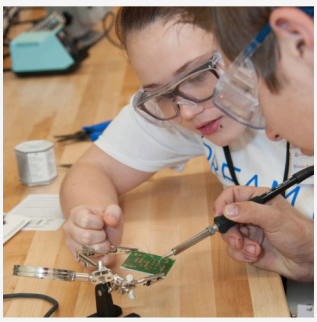
Nov 13, 2017 ·
electronics, intro to fab lab, laser cutting, Fab Tested, early childhood, museum/science center

GRADES 6-8

TECHNICAL 3D MODELING

Students learn how to design precise 3D printed fixtures for constructing large assemblies from dowels.

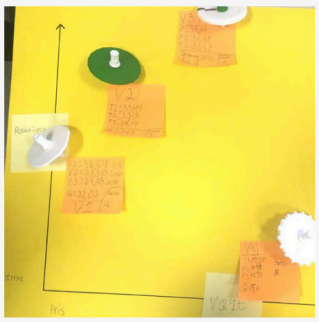
Nov 7, 2017 ·
architecture, intro to fab lab, Chevron STEM Awards, Fab Tested



MP3 SPEAKER

Students will design and fabricate their very own speaker system!

Nov 9, 2017 ·
electronics, laser cutting, soldering, Fab Tested, sound



THE ORESMIAN COORDINATE SYSTEM - BRIDGE

Students will learn about the design process and coordinate systems by going through a challenge to make a 3D bridge with scaled down real-life constraints.

FAB CHECKER BOARDS FOR MIDDLE SCHOOL

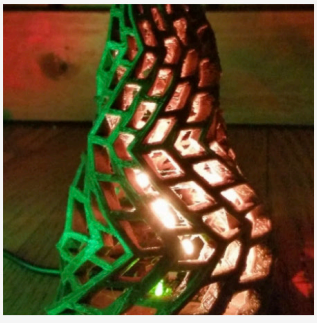
Students use multiple processes in a Fab Lab to create their own checker boards and checkers pieces.

Nov 13, 2017 ·
mixed media, laser cutting, casting, 3D

GRADES 9-12

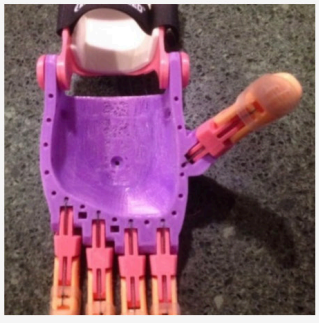
PINBALL MACHINE

Build some unique energy for physics and math by designing simple and complex machines, in the form of an old school arcade pinball



PROJECT NIGHTLIGHT

Students learn about electronics and programming by creating their own custom night lights.



3D PRINTED GRABBERS

Students learn about 3D printing through making custom assistive hands for children with disabilities.

FABRICATED CELL MODELS

Students use digital fabrication to create models of biological cells.

Nov 9, 2017 ·

HOW CAN YOU COLLABORATE?

- **PROMOTING** the rapid and inexpensive realization of prototypes, and the advantages of these creative environments for problem solving and concept testing.
- **VALUING** informal environments not only for learning but also for collaboration and cooperation.
- **PROVIDING** meetings between the educational, industrial communities and the informal network of Fab Labs.
- **SUPPORTING** the realization of the "Bootcamp 2020", participating in its closure and promoting inter-connection with industry, for example.
- **BOOSTING** an independent investigation within the history of Fab Labs in Portugal. **(24-27)**

24

25

26

27

MAJOR CONTRIBUTORS

This document was done with several contributors impossible to name them all because they were part of three workshops named "How to make a school from a FAB LAB?" **(28)** held at the XII BOOTCAMP FAB LAB in Torres Vedras, Portugal, organized by LAB ABERTO FAB LAB:

28

Liz Whitewolf, Director of Science and Education, Fab Lab Carnegie Science Center, USA _ http://CarnegieScienceCenter.org/FabLab Director of Education Initiatives, Fab Lab Hub, USA http://FabLabHub.org

Miquel Carreras, Barcelona School FAB LAB _ http://liceupolitecnic.es/index.html, Partner Lab of Transformative Learning Technologies Lab - Stanford University, Barcelona

Gonçalo Oliveira, FOCO – ACTION Cinema!, School Community Intervention Artistic Project (in portuguese, PROJETO ARTÍSTICO DE INTERVENÇÃO COMUNITÁRIA EM CONTEXTO ESCOLAR) _ http://www.atv.pt/noticia/58-FOCO-Cinema-em-Acao-final-do-projeto, https://repositorio.ipl.pt/handle/10400.21/8241

Tauan Bernardo, founder of Fablab de Garagem in São Paulo, collaborating with OPO'LAB, a FAB LAB in the Porto City, Portugal _ http://www.garagemfablab.com.br/;

Francisco Mendes, portuguese entrepreneur responsible for several projects and founder of BeeVeryCreative and Hardware City _ https://beeverycreative.com/http://hardwarecity.org/;

Alexandra Baltazar V!VALAB project _ https://www.facebook.com/vivalabporto/

Luis Carvão, FAB GURU, Local/Remote Instructor FAB ACADEMY _ http://fabacademy.org/

João Leão, manager at Porto Fab Lab, OPO'LAB.

António Gonçalves, founder of LAB ABERTO, FAB LAB coordinator _ http://lababerto.pt/

CONTACTS

Lab Aberto Fab Lab _ lababerto@gmail.com,
António Gonçalves (Coord.)
_ fqantonio@yahoo.com

ANNEX I:

XII BOOTCAMP OF FAB LABS, FINAL MESSAGE

+ THAN 200 PEOPLE
40 VOLUNTEERS
58 TEACHERS
27 WORKSHOPS
12 NATIONAL AND INTENATIONAL FAB LABS

3 NATIONALITIES
25 TRAINERS
116 ATTENDEES
22 INSTITUTIONS
2 UNIVERSITIES
9 COMPANIES

XII BOOTCAMP OF FAB LABS,

FINAL MESSAGE:

The collective of the Lab Aberto - Fab Lab brings together professors, engineers, programmers, designers, entrepreneurs and students who, after the four formidable days of the XII Bootcamp of Fab Labs in Torres Vedras, had to return to their lives, breathe a little, and face the countless situations that were suspended during the preparation and development of the meeting.

The organization of this meeting of Fab Labs explicitly sought to create bridges between worlds, companies, schools, FabLabs and Makers. It was, therefore, more than a meeting of creators linked to the fablabs, and more than a training action for teachers.

The numbers show the success of the event, but the quantifications are not the most important. The most relevant was the constant smile on the face of all the participants, over two intense days of sharing and learning. It was for this reason that we worked, in the long process of preparation of this moment, so that Fab labs, manufacturers, companies and professors could share experiences and knowledge, exchanging ideas and projects.

We believe that education has a lot to gain by opening up to maker culture, to the network of fablabs, essentially to the idea that moves us: **"it is not the equipment, it is the people, at the crossroads of their knowledge and projects, that make a fablab". (01)**

We managed to unite education and fablabs, placing teachers and makers in the same space, discussing and proposing how the maker culture can contribute to the school. We have counted on the precious help of **Liz Whitewoolf,** coordinator of the **Carnegie Science Center's fab lab (Carnegie Mellon University), Miquel Carreras,** professor of the **Liceu Politecnic de Barcelona, Gonçalo Oliveira,** coordinator of the **Foco-Cinema em Ação!** artistic project of community intervention in a school context **(ATV),** of **Paulo Teixeira,** coordinator of **Fablab EDP-Labelec** and **Francisco Mendes, "Sunset Hackathon 2018",** creator and entrepreneur, founder of the pioneering company in 3D printing in Portugal, **BeeVeryCreative,** and **Tauan Bernardo,** who brought from the other side of the Atlantic, the experience of the **Fablab São Paulo** to the **Fab Lab in Porto - OPOLab. (02 - 10)**

At the same time, a variety of workshops occurred, some dedicated to makers and companies, others to teachers, where each participant was able to discover different and innovative technologies and pedagogical approaches. It was in these two areas, of reflection and learning, that this meeting was built, that we hope to have left in our professors and educators the sparkle of the maker culture. We know that this goal has been achieved, thanks to the smiles and private reactions that we received. **(11 - 28)**

01

02

03

04

05

06

07

08

09

10

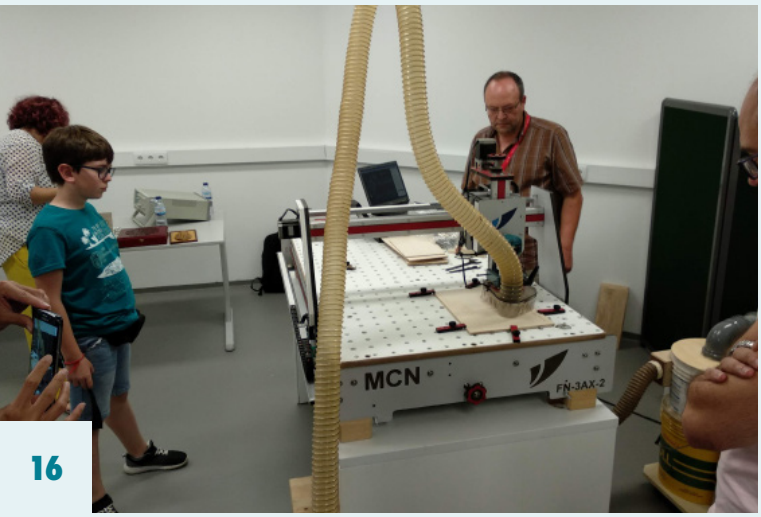
11

12

13

14

15



16

17

18

19

20

21

22

23

24

25

THE ACKNOWLEDGMENTS

The bootcamp would be impossible to realize without the precious help of all those who supported us. The first word of thanks goes to our **volunteers**, who were always present to accompany the participants throughout the event. Also without the availability of the **formators,** who come from schools, fablabs, universities, institutions and companies, we could not have offered such a rich variety of formative experiences. **(29 - 31)**

29

30

31

Institutional support was essential to carry out this project to good port. We thank the **Embassy of the United States,** in Portugal, for its support in getting **Liz Whitewoolf** to meet us. The **Torres Vedras Municipal Council** supported us in the financing of the presence of **Miquel Carreras,** as well as in our meetings, offers and invitations for the participants. **(32)**

We also counted on the presence of the Director of the **Lab Center, Jorge Dias,** of the Representative of the President of the **Municipal City Council of Torres Vedras, Laura Rodrigues**, of the President of the **City Council of Torres Vedras, Carlos Bernardes,** of the Representative of the **United States Ambassador in Lisbon, Krystle Norman** and of the **Secretary of State of Science, Technology and Superior Education, Fernanda Rollo. (33)**

32

The entire teacher training component was made possible by the partnership with the **Centro de Formação de Escolas de Torres Vedras e Lourinhã**. . The **ATV** provided us with projection fabrics and projectors, as well as Inforpuzzle. The **Escola de Serviços e Comércio do Oeste, ESCO,** also provided us with screens and projectors, standing out especially for the sympathy, availability and competence of its students, who were responsible for hosting the participants. The **Freiria Sport Club** assisted in the assembly and availability of the video projector of the main hall. Finally, the **Torres Vedras LabCenter** opened the doors for us, making their spaces available for the different moments of the bootcamp. **(34)**

34

The following **entities** allowed the presence of the **trainers** who made the workshops and demonstrations more dynamic:

Fablab Castelo Branco, Carla Dias and Cristiana Silva;

Lab Aberto Fab Lab, Diogo Gomes, Rodrigo Simões and **Rafael Gonçalves;**

Associação Nacional de Professores de Informática with the presence of Fernanda Ledesma and Ana Gato;

Walking Camera Project, João Barrinha;

Agrupamento de Escolas Venda do Pinheiro, Artur Coelho;

Associação Lab Aberto Fab Lab, Paulo Cabrita;

HPModelismo, Hanniel Pontes, for the formation in programming in drones;

Escola S. Gonçalo, Fátima Mira and Jaime Rei for training in robotics;

V!VALAB, Alexandra Baltazar and Miguel Almeida, for training in creative environments;

Fablab Évora, João Rodrigues, for training in electronics;

DHOLETEC, Jorge Guimarães, for training in cutting;

SICAM, Fausto Cardoso, for DIY CNC training;

Nesto.io, Michael Memeteau, by the formation in advanced CAD in Onshape;

3D ways, with Francisco Tenente, for the training in printing and 3D printing in the industrial context;

Arte Transformer, Manuel Moreira, formation in engraving;

Timothy Mendes, freelance in technology, training in intercompany laser; face with the ARDUINO;

André Alves, one of the 12th grader of the Madeira Torres Secondary School, for the workshop in IoT;

THE ACKNOWLEDGMENTS

Fablab of the Instituto Politecnico, João Rocha and Jorge Santos, for the training in 3D scanning;

Agrupamento de Escolas Gil Paes, Arlindo Oliveira, for training in robotics;

Polytechnic Institute of Leiria, António Pereira, training in IoT;

ISCTE, Pedro Sebastião, for the formation in DRONES;

Lab Aberto FAB LAB, João Simões, for the training in CNC DIY.

Thanks to the presence of **Filipe Silvestre** and **Paulo Marques**, respectfully from **FCT FAB LAB (Universidade Nova) and FAB LAB Lisboa.**

A special thanks to **Vitor Vilela** and **Rita Peixoto,** professors at **Henriques Nogueira Secondary School,** and **Madeira Torres Secondary and Third Cicle School,** for the co-organization and dynamization of the formation of professors.

There is also a special note of condolence for **Arado, Associação de Radioamadores do Oeste,** whose collaboration was impeded due to the death of its president, to which we express our sincere condolences.

We also count on the precious collaboration of the **companies:**

FOCO Criativo, Fernando Fidalgo, for prints on vinyl and rollups;

Inforpuzzle, on loan of a canvas and video projector;

XYZLAB, with Nuno and Cláudia, for the support and demonstration of their capabilities in the digital manufacturing;

ISICOM, with Carlos Moreira, for providing a large size 3D printer, Delta Wasp;

BEEVERYCREATIVE, for participate with an demonstration of their capabilities in 3D printing technologies:

THE SUPPORTS

Without these supports, partnerships and collaborations, the team of Lab Aberto Fab Lab would not have been able to dynamize this event, which we consider to have been remarkable for everyone present. As Fernanda Rollo, former State Secretary of Science, Technology and Higher Education, observed in the closing ceremony, "this is, above all, a project of affection". It is for this reason that we like to say that what makes a fablab are the people, the experience they bring to share, in this XII Bootcamp of Fab Labs, that was especially visible. **(35)**

Thank you to everyone, and we challenge all of you to get back together with us in the next Bootcamp that will be organised, in July 2020.

OCTOBER 2018

LAB ABERTO - FAB LAB ASSOCIATION FOR THE PROMOTION
OF SCIENCE, ART, TECHNOLOGY, CREATIVITY AND RESEARCH.

LABABERTO@GMAIL.COM
HTTPS://LABABERTO.PT/
HTTPS://BOOTCAMP2018.WORDPRESS.COM/