Educational Making Activities

From 6 to 12+ years

Makerspace for Inclusion

Makerspaces4Inclusion project over a period of two years we will produce one set of open educational resources which are based around the maker field and digital fabrication.

Who made this compilation?

This compilation has been made by the consortium of the European Project, Makerspace for Inclusion Nº 2018-I-BE0S-KA205-002425, with the participation of the following associations:
Digijeunes (France), Timelab (Belgium), Horizonlab (Italy), Nod Makerspace (Romania), MakerConvent-Tràsit Projectes (Spain).

Digital Edition

CONTENTS

ACTIVITIES

6 to 10 years

Educational making activities

Name of the activity	Makey Makey and music
Original source	http://www.makeymakey.com
Ages	6+
Pedagogical objectives	- Teamwork - Communication - Understand the connection between digital software and phisical objects
Maker objectives	- Circuitry - Scratch code
Topics #hastags	#scratch #makeymakey
Expected Time to be devoloped	1,5h
Brief description	We mix in the table a makey makey board, some crocodile wires and some electric conductive objects. With different interactive projects builts in scratch we create circuits to interact with the computer and with the objects to play music.
Tools and materials	- MakeyMakey board - Crocodile wires - Conductive elements (fruits, people, play-doh paste, conductive ink...)
Description step by step	1- Build in scratch some musical program like a piano or similar. (we can find examples in the scracth projects database). 2- We connect the makeymakey board via USB to the computer. 3- Use the crocodile wires to connect the board with the conductive elements. 4- Start to play music. 5- We can change from fruits to people. It's an interesting moment when they discover that as people we are conductive and serve as musical pieces.

Project n° 2018-1-BE05-KA205-002425

Co-funded by the Erasmus+ Programme of the European Union

Makerspace for Inclusion

Description step by step	9- Build the piece in which you will place your hand. A cardboard bridge that we will use to pass the hand. We will glue it to the cardboard hand. The fingers must be free to tie the rope. 10- Connect the fingers with the rope passing the rope inside the straws. Make a simple bond to get your finger inside.
Evaluation	With this simplistic "robotic" hand we can explain themes like tensors and talk about what type of hand you can build.
Expected results	Operative "robotic" hand build in cardboard.
Pictures	

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Makerspaces are playing a key role in supporting young people in learning about values, civility, good attitudes, competences and skills, especially around education for coexistence and personal development. These inclusive aspects of makerspaces and the attention they give to encourage diversity, make them increasingly attractive to young people as a space where they can be creative and participate in a range of activities. Therefore, we believe that personal attention, organisation of activities and the adaptation of spaces are all incredibly important in successfully generating an inclusive environment.

This guide is intended to introduce you to helpful ideas and guidelines for designing makerspace activities and spaces that are inviting to young people of all abilities. The idea of inclusive design is explored, as well as how to design a makerspace or educational making activity that all children, regardless of their strengths, weaknesses or social situation, can enjoy.

By designing for inclusion, and beginning from a perspective of "strengths", you can create a makerspace that is designed with everyone in mind and that challenges and supports children with a wide range of abilities. For example, a blind child's strengths are their heightened sense of touch, hearing and smell. How can these senses be better used in a makerspace for both sighted and non-sighted children?

For an inclusive activity or space, you must consider how you might create spaces of "intersection". "Intersections" create opportunities for children of all abilities to interact together. The work and the words of Sylvia Martinez are inspiration for this consortium.

The idea of inclusion is not only important for community organizations or schools serving underserved populations. Every makerspace should be aware of their capacity to serve all people: children and adults, all genders, all backgrounds, and those who are interested in the arts, engineering, or both. Even in the best-resourced maker environments, there should be constant vigilance about the assumptions that are made about the people who might want to use them.

T*o create inclusive experiences in*

2 http://bit.ly/inclusive-makerspace

Educational Making Activities

Methodology for educational making activities

"The role of the teacher is to create the conditions for invention rather than provide ready-made knowledge".

Seymour Papert

What do we mean by educational making activities?

Methodology for educational making activities

An educational making activity is one that brings together creative and innovative processes with an educational perspective, emphasising practical learning during the process, and includes, technology in all or some part of the process. It has long been argued that children and youth can learn by playing and building with interesting tools and materials (Montessori, 1912).

These are activities that work under a framework of cooperation, respect for one another, teamwork, inclusion, promotion of creativity, learning by doing and innovation.

Doing and creativity are not new concepts, but focusing learning on doing has introduced a new type of practical pedagogy. A pedagogy that fosters communication, community and collaboration (a DiT mentality “let’s do together”), distributed learning, crossing boundaries and receptive and flexible teaching practices.

Physical creations can also enable social engagement through a shared endeavor. This can bring more- and less-experienced participants together around a common task—a configuration that often proves fruitful for learning (Lave & Wenger, 1991; Vygotsky, 1978). We have organised this guide to be based on different areas where particular care must be taken.

Facilitation: Every activity with learners must have facilitators that encourage the activity to run and achieve its pre-defined goals.

Environment: Activities are carried out in spaces, but sometimes these spaces are not well-equipped to receive them. Space is important because it helps the activity to develop.

Materials I Resources: Choosing the materials to develop the activity is key. Working with recycled, reused materials and doing so in a sustainable way with the environment adds values.

Expendable material: Recycled materials help expand creativity, respect the environment and improve experimentation skills.

Non expendable material: The non expendable materials are the ones suitable for an activity and that fit the fungible materials that will be used.

Facilitation
Environment
Materials I Resources

Methodology for educational making activities

Facilitation

Every activity or space has a team behind the scenes that imagines it, prepares it, carries it out and evaluates it. And in some cases, depending on the complexity of the activity's learning content, this team may also receive the activity from outside facilitators due to their higher level of expertise and understanding of a subject.

Different functions for the facilitators:

- Responsible for programming activities, schedules, etc.
- Responsible for giving the activity or workshop, usually the facilitator, educator.
- Depending on where the activity takes place, there will be personnel responsible for the children or young people who participate in that said location. It is important to involve them as an important part of the process.

Environment

The environment is the place where the activity will take place. An activity of this type can be developed in any environment that meets the logistical needs of the activity. (Sometimes we need electricity, wide spaces for tables, areas for demonstrations…).

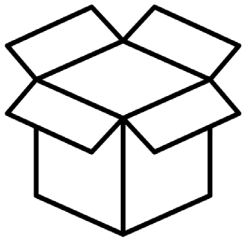
Usually these types of activities can be produced and developed in:

- A classroom or space within a cultural center, library or civic center.
- A classroom or space within a school.
- A space within a larger event (Maker Faire, festivals, congresses, etc.).
- A Makerspace (Hackerspace, FabLab…).
- The street (Mini-Maker Faire, demonstrations, Technological Faire's…).

To choose the space we usually take into account:

- Available plugs, lighting, electricity.
- Tables or spaces for working in groups.
- Workshop area: ensure that it is sufficient for the number of participants, monitors, technical equipment, etc.
- Possibility of organizing the tables or the space according to the dynamics of the workshop.
- Space to organise and take care of the material for the activity.
- Internet or WiFi.
- Number and type of computers.
- Sound equipment, microphones, etc.
- Board.

See more explanation at Annex 1 and 2.

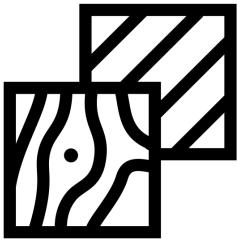


Materials I Resources

Boys and girls have almost innate creative potential with almost anything, creativity is also a trained skill. Working with different materials and new tools can enable empowerment. At the same time, one must be careful when introducing materials and tools so that they do not become overwhelming.

Raising some educational making activities which focus exclusively on materials or tools can lead us to errors. We must work with efficient, versatile and inspiring materials and tools whose use are well known to us. Recyclable or reusable materials, such as cardboard or building sets, can help us create new interests and provide transformative experiences.

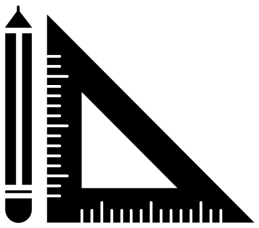
In any activity we can find and use resources and materials donated by the organisation of the event, the institution, civic or cultural centre and complement these with our own resources.



Expendable material

It is the material, whether it is stationary or technical, that by completing the activity will end up creating the final prototype and therefore will be consumed and will need to be replaced for subsequent activities. As an example we mention:

- pens and markers
- papers and cardboards
- post-its, clips, labels
- blue tag, zeal, glue
- clay
- plastic cups
- American tape
- wood, cardboard
- cables
- batteries
- silicone
- battery holder
- mini engines
- LEDs



Non-expendable material

This is the material that is worked with that can be reused in subsequent events / activities. Examples include:

- Welding gun
- Hot silicone gun
- Cables connectors with the computer
- Adapters
- Network cables
- Laity
- Electronics kits: Arduino boards, Makey Makey, etc
- Hard Machines (Dremel, Drill, CNC, 3D printer…)

Educational Making Activities : Step by Step

Methodology for educational making activities

"The Maker Movement has developed in out-of-school spaces and has mostly involved adult participants, there is growing interest among educators in bringing making into education to enhance opportunities for students to engage in design and engineering practices, specifically, and science, technology, engineering, and mathematics (STEM, or STEAM when art is included) practices, more generally."

Lee Martin [3]

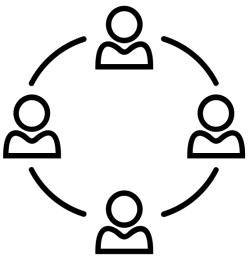
3 Martin, Lee (2015) "The Promise of the Maker Movement for Education".

Step by step Organisation

Methodology for educational making activities

Educational making activities start from an environment that include; open source resources, affordable electronics and technologies, crowdsourcing and participatory culture, a focus on STEAM education, information access and DiWO methodologies for inclusion.

The environment where the activity takes place can become an aid to the process and motivate expression, creation and communication. A friendly space allows people to explore. Here, we will give some advice on how to create such a space, as well as providing some technical information that can help in the organisation and development of a model activity which are available in the annexes.



Organisation

To organise ourselves well, we must ask ourselves the necessary questions so that all the requirements of our activities are met or resolved, and establish who will be responsible for carrying out each part. Some examples of things to keep in mind include:

Participants: we must take into account who our participants are. Activities for children or young people are not the same as for adults or the elderly. In any case, people are the key element of every workshop.

Contents: the workshop activity step by step. Pedagogical program with clear aims and detailed development.

Calendar: time of preparation, dissemination and realization.

Place: contact and organisation with the headquarters where the place is given.
Materials: list of needs, selection of suppliers and place of purchases, sufficient time to obtain the specific materials.

Budget: personnel, materials, transportation, per diem, etc.

Communication: communication plan, prior, during and after the activity. Broadcast material, pictures, videos. Have signed authorisation for the use of the images by the participants.

Documentation: who will take the record of the activity, videos, text and photos, and in what formats.

It is also useful to know what our strengths are to take advantage of them and be aware and prepared for our limitations.

Step by step Typologies of events

Methodology for educational making activities

Typologies of event organisations for youth to get together and experience maker education and maker culture.

Not all activities have a defined beginning and end. Within the field of educational making we have many different formats that lead to a large variety of possibilities.

Hackathons

A Hackathon is any event in which people get together to engineer solutions to real-life problems, possibly involving technology. Hackathons generally have parallel tracks for educational workshops and/or conferences.

Essentially, during a hackathon, young people can be invited to work in groups (from 2 up to 5 people) on a project of their choice. Usually hackathons last for a whole day (from morning to evening).

Here are some basic goals to keep in mind when organizing a hackathon:
Be welcoming to newcomers of the community.

Provide an opportunity for participants to learn something new.

Provide a space and a time for participants to make headway on problems they are interested in.

The ultimate goal of a hackathon should not be to actually solve any problem as real-life problems are typically too hard to be tackled effectively during such a short period of time.

Instead, hackathons should be thought of as a pit-stop on a long journey to solving these problems or as a training session helping to prepare participants for solving problems in the future.

Here are some useful practical guidelines to follow when setting up a hackathon:

Low barrier to entry: Attendees should be able to walk in, figure out what's happening, and be able to quickly find a way to be involved (whatever their threshold for involvement).

Pro-amateur and pro-expert: Attractive to attendees with different technical skills and of different levels.

Easy to stay, easy to leave: No one should feel trapped during the event
Interactive — offline and online: Everyone should have the opportunity to play, build, or otherwise contribute to one or more of the tech-related projects presented (emphasis on everyone), without opening a laptop. (Not everyone would have a laptop with them, nor are laptops perfectly suited for social engagement or essential for all types of tech.)

It is also recommendable to include artistic activities, besides tech-oriented ones.

Step by step Typologies of events

Methodology for educational making activities

For one thing, relying on art allows more people to feel included, even those who might feel uncomfortable around technology.

Moreover, exploring the relation between technology and the arts can be informative and inspirational for tech's potential impact.

When thought of as a variety of methods for creation and expression, art becomes essential for understanding how technology is created and how it could be used.

Maker faires and mini maker faires

A maker faire is an event somewhat along the lines of a science fair. Thus, visitors move around different stations which each introduce a new concept, typically related to maker culture, digital DIY or classic DIY. Users can choose which station they want to visit and dig further into it by engaging with the presenter.

Where maker faires differ from traditional science fairs is the greater degree of interaction between user and presenter. Rather than a one-way learning channel with presenters and presentees, stations at a maker faire are required to be interactive. Some stations are about skill sharing, others invite users to engage with hands-on activities. For example, activities about coding or electronic prototyping are common; whilst others can be more open-ended, providing opportunities to contribute data, or be a maker.

Makerspace / Fablab : Ephemeral places

Ephemeral places can refer to a facility/set of equipment or to a scenario in which a public space (can be any place) is temporarily turned into a makerspace-like environment.

Transforming a classroom, a civic centre or any other public space into a makerspace for a short period of time can serve to gather young people together and help them to experience maker education.

At an ephemeral makerspace, users are invited to drop in to experiment with cnc machines, computer aided design and other tech-related activities. The objectives of such spaces are typically to give participants a taste of what sort of activities/projects are possible to undertake at a fablab or makerspace.

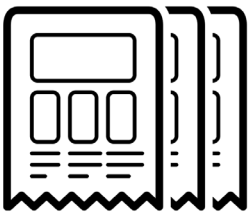
See more explanations at Annex 3.

Step by step Themes from maker education

Methodology for educational making activities

"*There is only knowledge in the invention, in reinvention, in the restless search.*"

Paulo Freire



It is not easy to establish the motivations behind wanting to start educational maker activities. There are usually many factors that influence this. Starting in a space focused on digital fabrication, community engagement and impact. Some key factors which may motivate the creation of a fablab include:

- to help regenerate places, communities and neighbourhoods
- to provide services to the local community
- to educate new makers
- to advance knowledge of digital technologies and explore new possibilities
- to support research and development and upgrade knowledge in existing disciplines
- to provide services to existing industries, especially in prototyping and innovation

The role of technology has a preponderant weight, however without connecting to the real world, everyday activities and day to day problems can seem daunting and frustrating. It is necessary to link more technical activities to creative practises, for which the STEAM methodology calls Arts, and what for us is a way of thinking outside of the world which surrounds us.

The STEAM approach proposes integrating interdisciplinary knowledge in response to new challenges in the formation of responsible citizen-related contexts and makerspaces are physical sites for sharing resources and knowledge to be able to do such tasks. Both methodologies complement each other well, bringing the possibility to participants of resolving a variety of problems through fun and engaging methods.

Traditional education, basically divided into disciplines, does not contemplate the situations present in everyday life. For example, for the construction of a home, problems of thermal insulation, energy, physical construction, material science, costs and project management are brought together. Therefore, it is also important to develop skills in which a higher level of knowledge and organisation of activities is achieved. This allows each of the disciplines to bring their expertise to a project, achieve their individual missions, whilst also collaborating successfully.

When considering how an individual is taught and the processes of learning they go through, it is important to consider the problems that are selected for activities to be based around. This is to ensure that a project's problem statement for participants, motivates them to construct ideas and develop knowledge. Therefore in Maker Education, when creating the framework of a project, it is essential that the educator does not improvise, and instead takes time to carefully plan the project themes and their objectives.

Step by step Themes from maker education

Methodology for educational making activities

Makerspaces are self-directed, practical learning areas, which are open to the interaction of teachers, students and diverse multidisciplinary learning staff that enrich a dynamic collaborative learning environment which encourages teamwork.

Makerspaces share the characteristics and benefits of the STEAM approach which are an active and eminently practical methodology that empowers students through; a trial and error system; facilitating inclusion; improving concentration and fostering creativity, curiosity and entrepreneurial culture; encouraging investigation; being accessible for all ages; helping to contribute to the development of problem solving, critical thinking and soft skills.

Through this, it opens up a range of possibilities and interesting topics. Here, we propose some examples but there are also many more outside of these.

Computer Aided Design

Young makers are introduced to computer aided design tools, which they can be encouraged to employ for any engineering design project that they may wish to undertake in the future. Computer aided design tools which can be covered by an educator in a makerspace environment, include; open source and free graphic design softwares such as inkscape, online 3D modeling softwares such as tinkercad, and offline 3D modeling softwares such as Sketchup and 123D Design.

An advanced version of the computer aided design module would introduce young makers to softwares specifically tailored for the production of AR/VR application for smartphones and games.

Electronic prototyping

This topic provides an introduction to coding, in which young makers can be invited to explore a number of existing tools for electronic prototyping. Primary learning outcomes can start with circuitry and electronics, with challenges around building simple electric circuits. Participants will then also be able to tackle more advanced electronic prototyping using educational tools specifically tailored for their age range (ex. mBots). They will be able to learn what an electronic device is, which are the basic components of electronic devices (capacitors, resistors, switches, buzzers etc.) and how these function.

Coding

Young people can become acquainted with computer programing as well as with the computational way of thinking. An introduction to coding enables learners to explore visual/block coding softwares such as Scratch for Arduino, or mBlock. These coding softwares are specifically designed to suit young individuals through being user friendly and do not require technical or advanced

Step by step Themes from maker education

Methodology for educational making activities

knowledge skills, focusing on a playful approach to learning. The introduction to coding shall provide the young makers with the necessary skills to add a layer of interactivity to their electronic creations, thus, eventually, they will be able to program simple electronic devices to produce sound, light and other effects.

Digital fabrication techniques

Through digital fabrication techniques, young makers can explore practises such as 3D printing, vinyl cutting and laser cutting. Through hands-on experiences of these topics, learners shall be able to understand what digital fabrication is and what are its advantages over traditional fabrication methods.

Robotics

Robots are electro-mechanical systems designed typically to help people with tedious, repetitive and sometimes dangerous tasks. Robots are comprised of actuators (e.g. servo motors, motors) and sensors.

Engaging with robotics allows young makers to couple electronic prototyping with robotic components. Through a mixture of project-based activities and small challenges, young people can explore the different components that can go into building a robot, such as belts, pulleys, gears and bearings.

Creative activities

Technology has a huge transformative potential in terms of educational practices. However for this, implementation must be accompanied by accessible and well thought out teaching methods. Methodologies such as the Project Based Learning and SCRUM project methodology, focus on the learner taking a lead role in their learning process. It should be encouraged that the learner acts as a co-creator and co-constructor throughout activities which support the exchange of ideas, creativity and collaboration.

Other themes involved in an educational making activity:

- Cardboard construction
- Prototyping
- Woodworking
- Textiles and sewing

Step by step Making activities materials and supplies

Methodology for educational making activities

Makerspaces are collaborative places where all people, including young individuals, can gain practical hands-on experience with new technologies and innovative processes. They provide a flexible environment where learning is made physical by designing and building projects which apply science, technology, maths, art and creativity.

It is important to emphasise that every space will be different due to its size, its available resources and the makers who use it. Any kind of physical space can be used; from a classroom to a table, from a storage room to a freestanding building. These spaces then may support a handful of makers focused on a particular activity such as electronics, or offer a broad range of equipment and materials.

Given this range of possibilities it would be inappropriate to make a template for developing a Makerspace. Instead, this guide aims to provide an approach to selecting equipment, tools and materials which will help to develop a space as well as providing instructions and advice around possible educational maker activities that could be conducted within it. In Annex 4, further information about kitting out a space is also given, including possible space requirements, workbenches, storage, and maintenance materials.

Step by step Communication supports

Methodology for educational making activities

In the 21st century, communication is key to all activities. We need to use collaboration and communication to build our community and bring people together.

Communication within the field of maker education activities has two lines of impact:

An internal line orientated around the participants, focusing on the results and processes, to help the students involved to see how their actions are valued. In this line of work, communication channels which are shared among the users can be used, such as applications and social networks. An example is the use of the Instagram app to show what, who and how the activities are done and their results. This generates a spirit of belonging to a group and provides the possibility of spreading news and project results.

Also for internal communication within a Makerspace is it essential to ensure that the space is maintained and remains accessible to all users. For example, this could include differentiating and defining spaces, ordering equipment and setting up methods to organise activities as well as protocols to maintain safety and security.

An external line of communication, more with the aim to attract new makers, should be used to showcase the activities of the Makerspace to people who are not part of it. For this, both online and offline communication methods are very important and should be used.

Once the contents of an activity have been established by a Makerspace, for example by identifying how, where, with whom and when it will take place, it will then be necessary to put together a communication plan which will help the Makerspace to reach the public who may be interested in participating. It is necessary to take into account all stages of the communication plan including before, during and after the activity has taken place.

For the preparation of the plan it is important to take into account:

The public: if the participants are adults, we address them; for children or teenagers, it is more likely to need to address the parents. It also helps to identify whether the aim is to target local participants in a particular neighbourhood and if there may be particular methods in which the public in these areas may seek or receive information.

Contents: prepare a clear and brief explanation of the program, define to whom it is addressed, the objectives of the activity, dates and registration data. It is also helpful to include photos or illustrations which complement and demonstrate the activity in some way.

Dissemination material: Information can be presented through the use and adaption of brochures, flyers and posters, etc.

Step by step Communication supports

Methodology for educational making activities

Network and community: do not underestimate the word of mouth. It is also possible to spread information about an activity through staff of the center and any assistants or volunteers of the Makerspace.

Web: it is essential to have an entry on the web which provides detailed information on the project or center. By not having limited space, here we can place more photographs and expand more on the fundamentals and methodology of the activity or any information that may be of interest to future participants. The registration data (date, place, time, price and contact) must also be clear and easily locatable.

Social networks: once the information has been published on the web, it is best to disseminate it through social networks. Posts and messages should provide content giving information about the registration process. It is also important to anticipate having to answer any questions that may arise.

Permits: in some cases it will be necessary to follow certain rules of use and provide permits for completing a particular activity depending on where it is located.

Image rights: it is always necessary to verify in advance that participants are happy to have their photo taken. All participants have the right to refuse any image of themselves being shared or stored on public platforms. Therefore permission should be granted by all participants before an activity is started, to clarify whether they give consent to the dissemination of audiovisual elements. On the web you can find a model document for this.

Document: on the one hand, it is possible to disseminate the results of an activity through photographs and videos that were recorded throughout the activity itself. However, it can also be helpful to write down more detailed information such as; how an activity was developed, how the organisation of the activity was completed as well as details on communication methods used or any material or financial requirements. It is also useful to document how participants reacted to the activity; what particularly interested then, what queries they had and what degree of understanding and integration the activity was able to provide. Through critically documenting an activity, it can then help to identify how or why an activity may have failed or how it could be improved.

Once the activity is done:

Self-evaluation: it is important to evaluate the actions to help identify what particularly worked well and what could be changed for future actions. It is useful to conduct participation surveys to find out the opinions and observations of the participants as well as channel what they learnt through the activity and what they would recommend to help improve it.

Step by step Communication supports

Methodology for educational making activities

Communicate: with text, photos or videos, it is good to make a post on the web with the results, the process and perhaps some testimonies which can be spread online through a website and social networks.

How to build a Flyer

In order to communicate about an educational maker event, whether it's a week-long programme or a 2-hour long workshop, you will need effective communication supports, for example a flyer or a poster.

Here are some guidelines you may find useful when developing your own communication material.

Step by step Communication supports

Methodology for educational making activities

1 - Be colourful. Colours, especially warm colours, capture the attention of people, first and foremost youth. You may also want to use complementary colours. In the example above, we chose yellow and blue.

2 - Include at least the following details:
- name of the event
- time and place
- content (for example 3D modeling - and 3D printing, or electronic prototyping)
- target public (ex. young people aged 9 to 17 years old)
- whether it involves a participation fee or not
- how to make a reservation (ex. via e-mail)
- contact details of the organisers
- logo of the organising team and partners
- social networks where we can find more information

3 - Don't be afraid to use graphic items, such as icons. In the example above, we included plenty of icons that you can download from thenounproject.com.

4 - If you are planning to print out several copies of your flyer, you may find it more convenient to print in black and white. If so, don't forget to make sure that the text is visible. You may want for example to remove the background color and replace it with plain white.

Step by step Communication supports

Methodology for educational making activities

Publishing activity results using on-line platforms for makers

All maker projects are worth publishing. Makers learn from one another by building on each others failures and successes, which helps them to improve and grow in competence over time. Maker education is very much a creation of the 21st century, therefore all modern means of communication can be used to help document and disseminate projects and activities which the larger community of makers can benefit from.

A number of on-line platforms exist which are ideal for publishing maker projects. Platforms such as hacksters.io or instructables.com gather millions of projects in a huge range of thematic areas from cooking to electronics.

Here follows a description of the process for making a publication on instructables.com

First, You will need to login with a google or facebook account, or register with an e-mail address.

Before you start writing your instructable you will need to gather as many photos as possible that document each step of your activity. The first photo usually depicts all the tools / supplies / components / ingredients / materials which are needed. It is also essential, when making an instructable, that each step of the project is documented with notes.

Next up, you will need to start using the instructables editor. The first thing to do when you make an instructable is title it. The easiest way to do this is to ask yourself “How would someone Google for this?”

The next step is writing an introduction. The introduction is just as important as the main image and title - this is your “hook” that will get people to continue reading.

The introduction should tell the reader what the project is, why you made it, and how you made it. While this is often obvious from the title and photo, some projects need a little more explanation and this is the right place to do that. This is your story, so share all the details!
Once the introduction is done, you will need to break the project into clear steps.

Finally, you can go ahead and publish the instructables.
At publication stage, the website will prompt you to set a main image, set a category and channel, and choose keywords which will be associated with your instructable, to help others find it.

Step by step Budget and management

Methodology for educational making activities

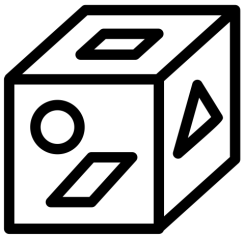
Normally in the maker field, there is a tendency to believe that the costs of digital technologies and recycled materials are relatively low. Although partly true, it is sometimes not the case. Whether it is an activity with either free or paid registrations there is a need to be cautious, clear and organised when making a budget and defining who is responsible for each section.

The management of the budget and activity will depend on its nature and organisation. Consideration should be made to who promotes it, the space which will be used and whether it is a one-time occurrence or a regularly scheduled activity.

In any case, the personnel, materials and transport of the activity will generally depend on the budget. It is always advisable to give an estimated margin on the production costs for any unforeseen event.

Step by step
Prepare the space

Methodology for educational making activities



Ideally, the space where your educational making activity will be, should be conducive to inspiration, collaboration, and conversation. Make sure the tools and materials you have on hand give your members the nudge to make projects in any or all of the content areas: arts, crafts, engineering, food, green design, music, science, technology. Also it may be necessary to section off different areas of the space for specific activities. Such as setting up a soldering station or sewing machine where it will not be affected by the sawdust from the wood working tools.

Make a wide variety of materials available, but also make sure that these are visible and easy-to-find. You might use clear or mesh containers that members can scan quickly to be able to visually see their contents when they're looking for specific items or just letting their imagination wander.

Choose well-placed shelves and wall spaces for showcasing examples of past projects and current activities to seed ideas and inspiration.

- Prepare the distribution of tables or workspaces, depending on whether the group will work in pairs, groups or individually.

- Establish a site to carry out prototype tests.

- Find a safe space to use tools that require electricity or more care such as a welding gun.

- In the organisation of the space it is also important to consider that people using the makerspace will take photographs or videos. Therefore, we must bear in mind how the person, who makes an audiovisual record, can use the space to do their work successfully. But above all be aware of what things should not be included in these images or if a family member has denied the permission of images to be taken of an infant or adolescent.

- Monitor the temperature and ventilation of the place depending on the materials and tools to be used.

Order and cleaning of the space

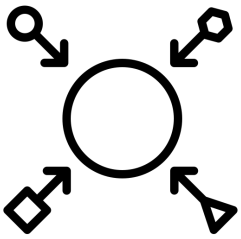
It is important, from the beginning of the activity, that participants are involved in maintaining an ordered and clean space with organised tools and materials. Once the activity is over, it is important that the space is cleaned and re-organised by all of those who have used it. For example, ensuring that appropriate recycling bins are used and the space is left as it was found.

Step by step Participants

Methodology for educational making activities

There will be many different types of participants. For example, those who may be highly motivated, others who simply follow instructions carefully yet rely on partners to do most tasks and others who need more individualised attention.

In the end, the important thing is to value each of the small achievements gained by each participant and to rely on them to set the pace of the workshop. If there are peaks and troughs of interest and progression, there will generally be more or less continuous attention from the participants.



Inclusion of youth at risk in maker educational activities

Maker education attempts to be as inclusive as possible: everyone, regardless of their gender, age or social economic background should be able to engage with maker education and benefit from the numerous learning outcomes it can provide.

Educators and facilitators, may however find it challenging to involve certain groups of individuals, notably youth at risk. Disadvantaged youth may for example struggle with open-ended and project-based approaches to learning, which is likely to result in them feeling frustrated, and consequently risks jeopardising their long term involvement in maker education.

Main possible causes of tension for youth at risk, in the context of maker education, include the aesthetic elements of design and creation (particularly when more complex machinery is involved, such as cnc machines). As well as this, the need to venture outside of comfort zones with multi-faceted projects, which could include interdisciplinary elements can also appear daunting. This presents a clear need for educators to be able to support youth throughout their projects, especially for those who may particularly struggle with these aspects.

Digital fabrication machines allow any user to produce nice looking, professional and meaningful gadgets. However, often, users can stagnate onto a relatively effortless work, which does not include any computation effort or complex constructive challenges.

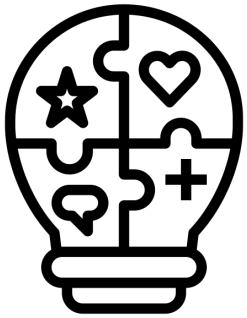
The point of maker education, as well as to educate on digital fabrication, is to highlight the importance of the process over the final product, and to encourage learners to engage in challenging learning experiences. The objective of the educator, especially when dealing with disadvantaged children, should be to encourage individuals to avoid settling projects that are more simple and trivial.

This said, the opposite extreme is just as undesirable. Projects which are too complex are generally conducive to learners experiencing frustration and disappointment. Educators should find a balance when figuring out which activities and creative processes work best to engage learners. They should aim to

Step by step Participants

Methodology for educational making activities

avoid trivialisation of processes or equipment whilst appreciating what degrees of complexity should not be surpassed to ensure participants are still able to engage and learn.



How to create an environment of inclusion

Throughout the realisation of our activities, we have always searched for the best methods to encourage participation and successfully share knowledge. In our case, the desgn thinking process is the one that best adapts to this type of activity.

1. Empathize
Generate expectation, emotion, interest.
If it is the first session, each participant, support staff and facilitator is presented.
Ask concept questions, to know the expectations of each participant. This gives an opportunity to listen and reduce any doubt.

2. Define
Explain clearly the development of the activity, step by step. (e.g that we will work with recycled materials, in groups. The tasks will be to an engine, attach a battery holder and a battery and connect them altogether before testing).
Give some instructions, precautions and processes that should be taken when in the space (eg, caution should be exercised with the 3D printer by ...)
Videos or prototypes could be shown to give an idea of the concept and what is aiming to be achieved.
If it is not the first session, it may be beneficial to analyse what happened in the previous session to be clear about what will be worked on during this session.

3. Ideate
The activity starts. Participants organise themselves into groups or pairs.
Materials are given to each group.
Participants begin to think, devise, draw and invent.

4. Prototype
Work with cardboard, wood, stationery and more, to allow them to develop their ideas and produce an initial prototype.
Participants should discuss their feelings, their results and what has been learnt among their groups as well as among the larger class. This can help them to receive feedback and advice on how to improve or how to identify which sections of their project have particularly worked well. The contribution of ideas must always be from a positive perspective and aim to motivate.
The final prototype should be real-sized so that it resembles as much as possible the final design.

5. Test
The prototype is tested and any necessary corrections are made.
If the activity will continue in another session, it is advised to define what has been achieved in this session, what stage the team has reached and devise a plan for how they will use their time in the next session.

Step by step Engaging young people

Methodology for educational making activities

Engaging young people in Maker Educational Activities

Makerspaces are providing more and more spaces for learning around the world, however the skills that the participants tend to learn in these spaces are outside of the required school curriculum. The traditional education system has difficulty recognising student achievements and skills which are learnt outside of the standard setup and procedures. However, there is a tried and tested way to allow participants to recognise their achievements in these makerspace environments which can largely benefit the young participants.

Introducing a badging system into the makerspace can provide students with a chance to be recognised for the skills and competences they have learnt and developed whilst working in the space.

Open badges are recognition and certification systems which can certify that a new skill or piece of knowledge has been learnt.

The badges are a combined empirical and conceptual effort, which when applied to the makerspaces and learning processes that occur in these environments, can help encourage the engagement of younger people in them.

This proposal for such a scheme is flexible and adaptable to any space and activity that is developed around Educational making activities.

M4Inclusion: Award System

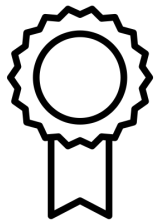
The award system is made up of three different elements; the level belt, competency badges and skill badges. These aim to work together to provide Youth workers with a tool to aid planning, facilitation and evaluation of activities for young participants, helping them remain interested and motivated within a Makerspace environment.

Skill Badges

Activities can be planned with the intention that they will help a young person gain a Skill badge. Skill badges are rewards that show that a certain skill has been developed, through completion of a task or activity.

Step by step Engaging young people

Methodology for educational making activities



Examples:

* A skill badge could be awarded after a young person has taken part in some form of training and been able to apply what they have learnt. Such as completing 3D printer training and being able to print their own design independently.

* A skill badge could be awarded after a young person has been able to apply a certain skill to a project or task, such as designing and building a project based on recycled materials.

* Several skill badges could be awarded after a larger project, where several skills have been developed simultaneously. A project such as the Mighty Maker Level Belt, which brings together textiles and electronic prototyping, could mean that participants are rewarded with a textiles badge as well as an electronic prototyping badge.

As part of this project, ten initial skill badges have been developed, each for a common skill that a Maker might need in a Makerspace.

These are:
- Textiles
- Laser cutting
- 3D printing
- Painting
- Recycling
- Wood work
- Independent work
- 2D design
- Electronic prototyping
- Workshop Safety

3D printable designs for these badges can be found on TinkerCAD following this link. After being printed they should be mounted onto a standard pin so that they can be worn by the young person or attached to their level belt.

These printable designs provide a template for other skill badges to be created by facilitators or the young people themselves by editing the TinkerCAD files. This allows skill badges to be made for young participants that are more specific and relevant to their Makerspace environment, as well as targeting exactly what they want to learn and improve on.

It is suggested that these skill badges are seen as achievable to the young participants. Learning a new skill should be exciting and encouraged by facilitators. By providing a reward which recognises the ability to learn and gain an understanding of a certain skill, young participants will hopefully be able to register the benefits of learning in a more hands-on and experimental way.

Step by step Engaging young people

Methodology for educational making activities

Competency badges

Competency badges are to recognise and reward young participants for their growth in certain areas which are thought of as being important to Makers. Competency badges are larger than skill badges and have space for level indicators to be added over time. Each competency badge has space for five level indicators, therefore giving young participants five levels to progress through. Again these level indicators can be awarded after a participant has completed a training, activity or project which has shown to the facilitator that they have progressed to a higher level in that certain competency.

In this project we have created designs for four different competency badges. These can also be found on the same TinkerCAD profile. These are 3D printable designs which can then be attached to a standard pin and worn by the young participant or attached to their level belt.

These competency badge designs can be changed or redesigned to be more suited to any specific Makerspace environment or members.

The table below provides an example of how competencies can be separated into different levels, which once reached, can be awarded by adding the level indicator to the badge.

Level	Competency			
	Problem Solving	Creativity	Community	Coding
1	Able to identify a problem and break it down into components.	Able to express creativity through aesthetic means (eg. decorate an object).	Able to work with others.	Able to use visual coding software to create basic programmes.
2	Able to identify a problem and dissect it into components. Able to brainstorm possible ideas for solving it.	Able to customize outputs that come from recipe-like making activities.	Able to engage and share with the digital making community.	Able to use visual coding software to create more complex programmes. Able to complete small tasks and challenges using visual coding software.
3	Able to identify a problem and break it down. Able to brainstorm possible solutions. Being able to work with others to identify what may be the most appropriate solutions.	Able to use items, objects and materials in novel ways to make a simple project more interesting or personal.	Able to support others and work together with those around them. Able to provide help and assistance when those around them need it and allow others to help and support them.	Able to use visual coding for more complex tasks, that can be integrated with a project or physical item. Able to understand lines of code written in more complex language such as C language (used with arduino).
4	Able to identify the problem, brainstorm ideas for a solution and imagine a strategy that would be able to test different ideas. Be able to complete the testing and implementation with support from those around them.	Able to connect projects to their own personal interests and experiences. Using tools and materials to create imaginative and personal outputs.	Able to collaborate and work well together with other makers on larger, more complex projects. Be able to share and discuss ideas and methods to others around them in the Makerspace.	Able to assemble lines of code to create a computer programme that is able to fulfill a simple task.
5	Able to identify a problem, break it down into necessary components and to identify where solutions need to be found. To be able to independently brainstorm ideas and solutions before testing and implementing them in a real life scenario.	Able to create and imagine their own projects, which use a mixture of elements and skills which have been learnt from previous projects or even outside of the Makerspace, helping them to create something original.	Able to support and teach others new skills or help them to solve new challenges. Be able to explain more complex ideas in a clear and understandable manner. Be able to share projects and methodologies clearly on online maker platforms.	Able to create and implement more complex computer programmes, and able to integrate these into a project for an output which is more advanced and interactable.

Step by step Engaging young people

Methodology for educational making activities

Mighty Maker Level Belt

The level belt hopes to bring skill badges and competency badges together and be a way for young people to register their overall progression as a Maker over time. The levels of a Mighty Maker Belt are used in a comparable way to Martial art belts, where a new colour is awarded once a certain predefined criteria is met.

based on a 3D printed holder. The belt uses an Arduino and RGB strips which are programmed to glow the correct colour to indicate what level the young participant has reached.

The Mighty Maker Level Belt is a making activity in itself. It should be a project that participants can work on and complete over time, whilst learning and developing maker skills which can help them obtain Skill and Competency badges.

Tutorials can be found online through this link, showing how to make the belt. There are two different designs; one based on a pouch made from fabric and one

The young participant progresses through the colours, by gaining more skill badges and achieving higher levels in the different competencies, as shown in the table below.

Step by step Engaging young people

Methodology for educational making activities

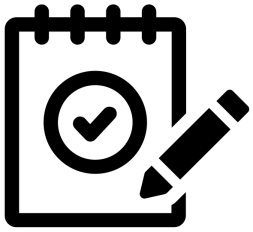
Belt colour	Skill and competency requirements
RED	- Level 1 reached in all 4 competences - 2 skill badges obtained
BLUE	- Level 2 achieved in all 4 competences - Obtained 2 further skill badges (4 in total)
GREEN	- Level 3 achieved in all 4 competences - Obtained 2 further skill badges (6 in total)
YELLOW	- Level 4 achieved in all 4 competences - Obtained 2 further skill badges (8 in total)
VIOLET	- Level 5 achieved in all 4 competences - Obtained 2 further skill badges (10 in total)

The Might Maker Belt should be a presentation of what each young Maker has achieved, by illuminating in the correct colour and being a place for them to pin their badges. The belt has been designed to be wearable by participant themselves, but should be a personal project that's adapted to their vision.

Together, this set of tools hopes to give facilitators a framework for praising good work achieved by participants and provide goals and objectives for young people throughout their time at a Makerspace. The requirements for each badge, level or colour is completely adjustable to become more appropriate to any group but hopes to provide an example of how young makers can gradually progress in developing their skills.

Step by step Evaluation

Methodology for educational making activities



Evaluation

Once the activity is over it is very useful to review the whole process, both production and communication as well as the techno-pedagogical development of the activity, in order to evaluate each step and improve on it for future activities.

Rethinking the production and communication process and identifying challenges that were met, can help to find actions which can help to develop and improve the activity. Some examples could be; if material from a particular brand did not work properly; if there was not sufficient room or light for the number of participants or if there was not enough information given about the activity which resulted in a lack of support from local partners.

Regarding the development of the activity itself, particularly if it will be completed more regularly, participants should provide insight and feedback. This could be achieved by anonymous surveys which ask about how participants found the process, the contents, the results and the overall experience.

The same technical file that guides us for the workshop is very useful when making evaluation notes for each section.

Below are some questions that could be asked during or after an activity, that would help to evaluate how participants felt a session went, and to help to understand what steps and processes they may have taken during the activity.

- What challenge are you working on?

- What ideas do you have to solve the challenge?

- Which ideas seem the best?

- How does the first prototype look? Do you think it will work? For testing, do you need more work? What have they learnt?

- What do you feel has impacted you the most?

- What has been the best part of the workshop?

- Have you learnt anything from other classmates?

- Important qualities that my invention must have to make it better.

- What did you find most difficult during the workshop?

- Do you want to improve something? Would you do something different next time?

- Description / drawing / photo / video

Educational Making Activities : Assessing learning in maker education

Methodology for educational making activities

“Imagine something never done before by a method never before used whose outcome is unforeseen”.

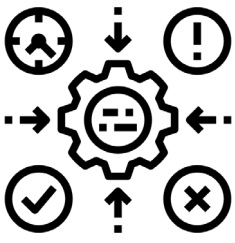
Allan Kaprow

Assessing learning in maker education

Methodology for educational making activities

Typically, teachers and educators find it very hard to assess and evaluate making activities. For one thing, the spirit of making activities consist of unleashing one's imagination and creativity to produce whatever gadget one feels like. The issue with project-based learning is that guidelines for making activities are kept to a minimum, however this means that it is not possible for the final creation to be evaluated against a system of pre-established standards.

In this section we aim to provide some methods and solutions for assessing the learning that would have been experienced by each of the participants. These methods each exemplify an intellectual approach (eg. focusing on the learning process, focusing on the finished product, focusing on content knowledge / technical skills, focusing on soft skills and context).



Focusing on the soft skills

One assessment method consists of focusing on the soft-skills that can be developed through maker education, and are regarded as critical outcomes of maker education. One model for identifying and thinking about them was developed by the Exploratorium Tinkering Studio.

They developed the concept of having learning dimensions in maker education, which can be simplified into 5 different areas: initiative and intentionality, problem solving critical thinking, conceptual understanding, creativity and self-expression, social and emotional engagement.
Each of these 5 dimensions are associated with a number of indicators that apply to makers and tinkerers.

1. initiative and intentionality
- actively participating
- setting one's own goal
- taking intellectual and creative risks
- adjusting goals, based on physical feedback and evidence

2. problem solving and critical thinking
- troubleshooting through iterations
- dissecting the problem components
- seeking ideas, tools, and materials to solve the problem
- developing work arounds

3. conceptual understanding
- making observations and asking questions
- testing tentative ideas
- constructing explanations
- applying solutions to new problems

4. creativity and self-expression
- playfully exploring
- responding aesthetically to materials - and phenomena
- connecting projects to personal interests and experiences
- using materials in novel ways

5. social and emotional engagement
- working in teams
- teaching and helping one another
- expressing pride and ownership
- documenting/sharing ideas with others

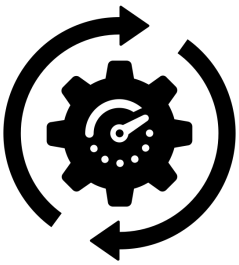
Assessing learning in maker education

Methodology for educational making activities

Focusing on content knowledge/technical skills

Another approach for evaluating learning in maker education consists of assessing knowledge and technical skills which are acquired by the young makers. Typically, focusing on hard skills is something which is reminiscent of traditional assessment methods, in other words standard classroom assessment methods.
There exists various frameworks for assessing technical skills and content knowledge relevant to maker education. One such framework has been provided by the raspberry pi foundation. They have identified 5 clusters of skills, namely: design, programming, physical computing, manufacture and community and sharing.

Design refers to developing 2D and 3D assets. Programming consists of using programming constructs to create simple programs. Physical computing is about using digital, analogue, and electromechanical components. Manufacture refers to using materials and tools to create project prototypes. Finally, community and sharing focuses on how an individual engages and shares with the digital making community.



Focusing on the process

One type of assessment that focuses on the learning process of young makers is the one which consists of documenting one's own maker project journey. This has been recognised as a means for students to reflect upon their learning process, and therefore assess their own work (self-assessment). Documenting projects can also provide educators with significant evidence of individual learning and understanding.

"Reviewing the photographs that the students make while documenting their work allows for a different insight into their thinking and their ideas. When looking at the projects through the eyes of our students, we discover what they think is important, what they are discovering, what is new and exciting for them. We also get to see the focus and concentration in their approach to the work that is often captured unexpectedly or in spite of the enthusiasm that is also displayed".

Another way of documenting maker projects and hence another method for evaluation, consists of setting up failure boxes.

Failure boxes are essentially stackable boxes that can hold items of different sizes. After each session, the learners are invited to put the items they have been working on into the boxes. The project/prototype has permission to stay out of the box only when the learners consider it shareable.

When that stage is reached, the educator asks the learners to empty the box and reconstruct the evolution of the project by using the previous prototypes/failures as chapters. They are allowed

Assessing learning in maker education

Methodology for educational making activities

to make photos, videos, write text, dramatise, dance etc, in order to explain what they did and how they feel about each step.

Assessing the final result: setting up a challenge

Challenges are a standard way of concluding a maker education learning session. Challenges allow participants to rate each other's projects, and achieve objectives.

It is possible to rate both functionality and aesthetic, thus the range of maker projects that can be assessed via challenges is quite vast.

Challenges are an obvious way to assess the final result, however it can also represent an opportunity for educators to have the learners reflect on the processes that were conducive to their creations. For example, during the presentation of the final result, educators could prompt students to introduce the rest of the group to different prototypes they worked on, the reasons for the changes/improvements they made, or even to present the technical problems they faced during the production process.

Tips

Design the space it's important to ensure successful and inclusive activities.

Design content is developed with the interests of the participants in mind.

Educational making activities is the key to understanding how children and young people explore their environment.

A friendly space allows people to explore.

We don't have all the answers.

We don't know all the steps.

We are here to stimulate with more questions, stimulate creativity, build bridges between knowledge and the physical world.

DiT: Do it Together is the best way to learn. We is more than me.

Circular economy: recycle, reuse, proximity materials, responsible consumption.

Flexibility: not everything will go according to schedule, it rarely happens. We must have room to change plans and adapt to the changes that may arise.

Celebrations: especially when working with children you have to balance the celebration of successes so that no one feels left out or discouraged.

Sharing concepts: this is a good time to include cultural concepts such as teamwork, knowledge sharing, the importance of recycling, collaboration, etc.

RESOURCES

Methodology for educational making activities

Thingiverse www.thingiverse.com

Wikifactory https://wikifactory.com

Instructables www.instructables.com

Inventables www.inventables.com

Makery http://www.makery.info/

EdSurge https://www.edsurge.com/

RaspberryPi foundation https://www.raspberrypi.org/education/

Make your life http://www.makeatuvida.net/

The Receipt book www.elrecetario.net

Edutopia https://www.edutopia.org/

Hackster.io https://www.hackster.io/

Makerspace for Education http://www.makerspaceforeducation.com/

Steam Minds https://stemminds.com/

... and all other websites who have lots of ideas, reflections, projects, activities.

The world of making is changing. A loose collection of individuals, groups and communities including, hackers, tinkerers, fabbers, and crafters, are emerging as something that can be identified as the ‘Maker Movement’, reflecting an increasing number of people’s desire to be defined through being creatively productive. Electronics and embroidery, ceramics and computing, printing and programming have become unexpected bedfellows.

Increasingly accessible and affordable digital technologies are central to a resurgence in making, opening up new opportunities for people to design, make, share, test, learn and sell in a global community. Fab Labs, Makerspaces and Hackerspaces and other types of open workshops bring different approaches to providing access and support in using a flexible and powerful digital toolset. Through this open provision of production, capabilities, that until recently were only accessible through industry or university research units, the Maker Movement claim to be lowering barriers and side-stepping gatekeepers, enabling people to ‘make almost anything’.

Justin Marshall from MakerNow

We recommend actions to develop robust, equitable and inclusive assessments of learning in STEAM learning-through-making environments.

#M4Inclusion Team

ANNEXES

ANNEX 1

Maker Manifesto

ANNEX 2

Related concepts with the makerspaces

ANNEX 3

Typologies of makerspaces

ANNEX 4

List of materials, tools and safety instructions

ANNEX 1
Maker Manifesto

Methodology for educational making activities

Do. Simply do. This is the key.

Do.
Manufacturing is fundamental for what it means to be human. Doing involves novelty, creation, and it's exciting. Doing is action and its meaning is multiplied through education, activating relationships, values, resources, tools and people.

Share.
We share the "doing", we share experiences. We care about the meaning of what we make or do. We share for ethics, for technology policy and for awareness.

Give.
Giving establishes a link, a link between those who give and those who receive. It helps us recover the value of what has been created. Its functionality, its cultural relationship between the aesthetic and the material.

To learn.
In the maker field, learning is more in the process rather than the result of the project or object. Try to learn not as automatons and individualists, but as individuals who are part of a network or a team.

Tools.
You have to have access to the right tools to 'do'. There is no list of tools to be a maker, nor a set of specific machines to define the person maker or space. In open technology development scenarios, the technologies go through changes, manipulations, improvements and adaptations for new unsuspected uses.

Play.
(Game) Play to discover how devices work, play to modify systems, play to try, play to invent, play to do. Not from ingenuity and loneliness but as creative thinkers. By playing we learn to develop our own ideas, we test the limits, we experiment with alternative ideas and it allows us to generate new ones.

Take part.
Just by doing, doesn't give the label "maker", this is just the one element of the process. If we want a society and an inclusive culture, it is necessary to innovate not only the technologies and elements we work with but also our relationships. It is necessary to go beyond participation - it should not be thought of as just a union between individuals but also as something which in itself exists, and therefore can be openned up to interactions without a predetermined end.

Support.
We speak of "co-responsibility" and a greater capacity for self-determination which allows us to also decide what we produce, how and why.

Change.
The processes of change have always been accompanied by a deep reflection that helps to redesign our way of building society. Change to change does not make sense, we need questions that motivate us to create new processes and debates, in order to feel that the change is synonymous with progress or improvement.

ANNEX 2
Related concepts with the makerspaces

Methodology for educational making activities

Maker Culture

The maker culture, sometimes also known as the “culture of doing”, “maker movement” or the “third industrial revolution”, is a contemporary culture or subculture that represents an extension of DiY culture (Do it Yourself), particularly with the inclusion of technology.

This promotes the idea that everyone is capable of developing any task instead of hiring a specialist to perform it. The DiT (Do it Together or Let’s Do It Together) or DiWO (Do it With Others) is increasingly present, where the sum of knowledge adds a very interesting factor to individuality.

FabLab

It is the abbreviated expression of “fabrication laboratory”. The concept was developed at the Bits and Atoms Center (CBA) at the Massachusetts Institute of Technology (MIT), thanks to a course called How to do (almost) anything, coordinated by Professor Neil Gershenfeld.

It has a set of digital tools for rapid prototyping, such as milling machines, laser cutters, vinyl cutting machines, with the support of open source software. Projects are conceived in 2D (on a computer) and converted into 3D (with machines).

A FabLab seeks to work with a community, based on the educational principle of learning by doing, which provides an ideal environment for invention and creativity.

Makerspace

It is a place where people with common interests in electronics, technology, science, the digital domain or electronic art (but also in many other areas) can meet, socialize and / or collaborate.

The makerspaces can be seen as open community laboratories where people can meet to share resources and knowledge to build and do things.

Hackerspace

It is a physical space where people who work in science, new technologies, and digital or electronic arts can collaborate. It provides amateurs and students of different levels to have access to the necessary infrastructure and environment to develop their technological projects.

The purpose of a hackspace is to concentrate resources and knowledge to encourage research and development.

ANNEX 3 Typologies of makerspaces

Methodology for educational making activities

Each makerspace is different, depending on the environment in which it has emerged: some specialise in electronics, 3D printing, large format art, creation of functional prototypes, etc.

The initial community can determine what the main focus of a Makerspace may be, however in most cases this will naturally emerge overtime.

Usually we will distinguish two types of makerspaces:

- **Institutional:** These spaces are promoted by an institution that houses them within their facilities. The sustainability of this type of space depends on the financing of the promoter institution.

- **Emerging (Grassroots):** These spaces arise when a group of interested and motivated people meet and are organised to be launched and financed by themselves. These are independent spaces.

Apart from those mentioned above, we also have:

BioHackerspaces (or Biohackspaces).
These are independent spaces, with more emphasis on understand from the point of view ecological and biological the environment where the space have their presence.

TechShop.
These are large makerspaces, driven by a company of the same name. They offer all kinds of manufacturing tools and are eminently orientated around a professional audience.

ANNEX 4
List of materials, tools and safety instructions

The space will need to have tools, equipment, and materials that makers can use in order to accomplish their projects.

You don't necessarily need a fully equipped space. In fact, sometimes an empty counter might be more valuable than a fancy new machine. You may be surprised at how many projects can be completed with a few hand tools, along with some simple power tools such as an electric drill, jig saw, and circular saw.

For engineering-orientated projects, an appropriate space would be a traditional wood workshop or space with digital fabrication machines.

However, for more craft-oriented projects, a space could consist of large tables, adequate light, a sewing machine, a quilt frame, and so forth.

We propose a list of equipment for each of these different sections according to its possible needs:

The Basics

- hot glue gun
- soldering iron
- soldering wire
- computers
- smartphones or tablets
- sticks for hot glue gun
- soldering iron stand

Electronics

- stepper motor NEMA 17
- Makey Makey boards
- 7 segments display
- RGB LEDs strip
- 9G servo motor
- buzzers
- male to make jumper cables
- potentiometers
- breadboards
- micro USB cable
- vibrating motors
- arduino uno boards
- light sensors
- arduino leonardo boards
- male to female jumper cables
- humidity and temperature sensor
- ESP32 boards
- push buttons
- transistors
- resistors pack
- distance sensor
- arduino nano boards
- PCBs
- pulse sensor
- female to male headers
- arduino lilypad boards
- adafruit motor shield V2

Electronic Textiles and fabrics

- metal snap buttons
- needles
- thread
- conductive thread
- sewable LEDs
- sewable battery holder
- sewable push button
- patchwork polyester

Digital fabrication equipment

- 3D pens
- 1.75mm PLA for 3D pens
- CNC
- 3D printer
- 3D scanner

ANNEX 4
List of materials, tools and safety instructions

Circuitry & electricity

- copper tape
- solid core wire
- electric wire
- alligator clips
- CR2032 batteries
- AA batteries
- CR2032 battery holder
- AA battery holder
- 9V battery
- 9V battery connector snap clip
- graphite powder
- CR1220 batteries

Office equipment

- duck tape
- paper tape
- scissors
- cutters
- pens
- pencils
- markers
- fluorescent markers

Tools

- screwdrivers
- precision screwdrivers
- pince à dénuder
- hammer
- metal saw
- Allen keys

Virtual Reality

- biconvex lens for VR headset
- cardboard lens

Citations

Methodology for educational making activities

Sylvia Libow Martinez (2014) “How to Build Your Makerspace” https://www.edsurge.com/research/guides/how-to-build-your-makerspace

Sylvia Libow Martinez (2015) “Making for All: How to Build an Inclusive Makerspace” https://www.edsurge.com/news/2015-05-10-making-for-all-how-to-build-an-inclusive-makerspace

Martin, Lee (2015) “The Promise of the Maker Movement for Education,” Journal of Pre-College Engineering Education Research (JPEER):
Vol. 5: Iss. 1, Article 4. https://doi.org/10.7771/2157-9288.1099

Sylvia Libow Martinez and Gary S. Stager, Ph.D. (2019) “Invent to Learn: Making, Tinkering, and Engineering in the Classroom”

Montessori, M. (1912). The Montessori method. New York, NY: Frederick Stokes Co.

Lave, J., & Wenger, E. (1991). Situated learning: Legitimate peripheral participation. Cambridge, UK: Cambridge University Press.

Vygotsky, L. S. (1978). Mind in society. Cambridge, MA: Harvard University Press.

García, C. (2017). Guia LADA Como hacer un espacio maker. http://laaventura-deaprender.intef.es/guias/como-hacer-un-espacio-maker

Johnson, L., Adams Becker, S., Cummins, M., Estrada, V., Freeman, A., and Hall, C. (2016). NMC Horizon Report: 2016 Higher Education Edition. Austin, Texas: The New Media Consortium

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Participating in a design and production project gives the students the opportunity to be responsible for their own learning process, improving their creativity, motivation and self-esteem.
Teachers and students learn from experience, interaction with others and technology processes.

Susanna Tesconi

Makerspace for Inclusion

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