INDIRE ISTITUTO NAZIONALE DOCUMENTAZIONE INNOVAZIONE RICERCA EDUCATIVA

Maker@scuola

Educational innovation using 3D printers

"A problem is not solved by applying a rule,
it is reflection on an issue that stimulates learning."

(Seymour Paper, mathematician and educator)

Maker@Scuola
This is the observatory set up at INDIRE that, since 2014, has been monitoring the most interesting experiences involving Makers, above all in educational spheres. Makers are "digital artisans" who use their technical abilities creatively and collaboratively to produce objects or to open the way to a simpler, more modern future. The research carried out by INDIRE will look at potential interactions between the working methods of *2.0 artisans* and students' learning schemes. The goal is to check whether the "Maker model", used in the classroom, can help to transcend the traditional educational model and cultivate a more innovative state-of-the-art style of teaching where the students become actors in their own learning. With this approach, planning, experimentation and problem-solving are no longer something personal, but inspire collaboration and the sharing of knowledge.

Research Manager and Director of the Technology Area for INDIRE
Samuele Borri

Maker@Scuola contact person
Lorenzo Guasti

Maker@Scuola Research Group
Luca Bassani
Andrea Benassi
Margherita Di Stasio
Alessandro Ferrini
Maeca Garzia
Giuseppina Rita Mangione
Jessica Niewint
Giovanni Nulli
Elona Picoka
Alessia Rosa

L'Istituto
INDIRE is the National Institute for Documentation, Innovation and Educational Research. With a 90-year history, it is the Italian Ministry of Education's oldest research organization and is the benchmark for educational research in Italy. It was created in 1925 with the task of collecting and valorizing the work done by the schools of the time, accompanying the evolution of the Italian school system over the years. Thanks to its roots, INDIRE possesses a historical archive containing an abundance of documents from the 19th-20th centuries, specializing in the collection of documentary material of historical/educational interest. It is engaged in promoting innovation processes in schools: by developing new teaching models, trying out new technology for training courses, and seeking to redefine the relationship between space and time in both learning and teaching. INDIRE is also the Italian Erasmus+ Agency for Schools, Universities and Adult Education.

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Palazzo Gerini
Via M. Buonarroti 10 - 50122 Florence - Italy
Tel. +39 055 2380301

www.indire.it
www.indire.it/progetto/maker-a-scuola
makerascuola@indire.it

Makers

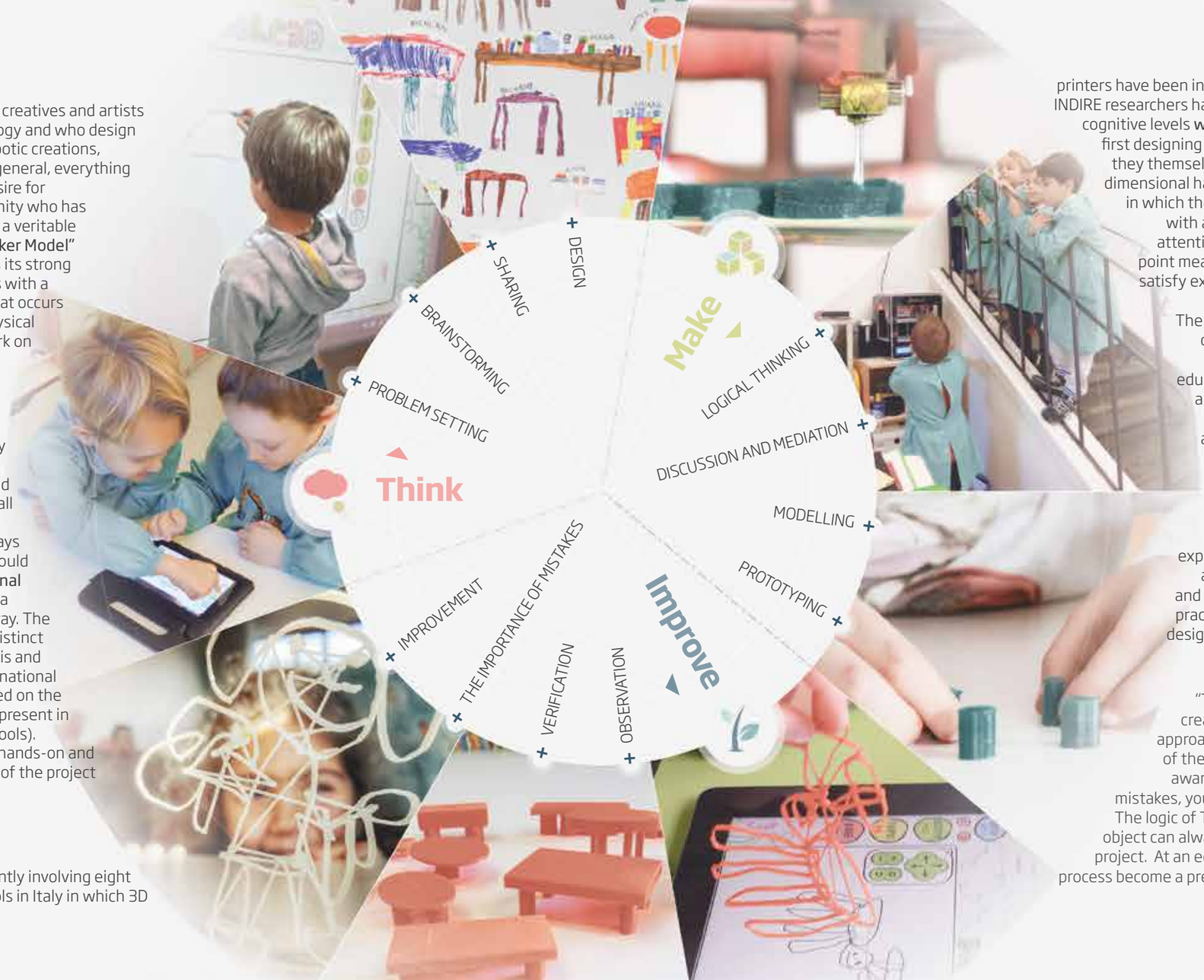
Makers are **"digital artisans"**, i.e. inventors, creatives and artists who are passionate about DIY and technology and who design and self-produce electronic equipment, robotic creations, prototypes, open-source software and, in general, everything that stimulates their curiosity and their desire for innovation. This is an international community who has brought to life something that has become a veritable cultural movement. When we speak of **"Maker Model"** we refer to a mode of production that finds its strong points in invention and prototyping, always with a view to sharing knowledge. This sharing that occurs in both networking and in **FabLabs**, the physical locations where 2.0 craftsmen meet to work on their projects.

INDIRE research and the "Maker@Scuola" project

The "Maker@Scuola" project was created by INDIRE in 2014 with the aim of analysing the characteristics of the "Maker Model" and understanding its specific features, above all its possible implications in the educational field. The initial insight was that Makers' ways of working, if replicated in the classroom, could help to **transcend the traditional educational model** by encouraging students to learn in a more participatory, aware and immersive way. The Institute's research has developed in two distinct areas: the first, theoretical, includes analysis and monitoring of the most important existing national and international educational projects based on the "Maker Model" (in fact, FabLabs have been present in many institutes, especially in technical schools).
The second research area, decidedly more hands-on and innovative, materialized with the activities of the project called *"Building Toys with 3D Printers"*.

"Building Toys with 3D Printers" and "3D Primary School"

These are two experimental projects currently involving eight preschools and about eighty primary schools in Italy in which 3D printers have been installed. Working closely with the teachers, INDIRE researchers have observed what happens at didactic and cognitive levels **when children of 4-6 years** find themselves first designing and then concretely realizing small objects they themselves have devised. Compared to other three dimensional handicraft systems such as Lego and Pongo, in which the ongoing project can be changed, working with a 3D printer requires children to pay special attention during the design stage: an error at this point means printing a "flawed" object that does not satisfy expectations, necessitating repetition of the whole **design cycle**.
The results obtained in the class with this type of activity are evaluated by examining their contribution to the level of the children's education, the development of meta-cognitive and relational skills, strengthening of logical thinking, and the capacity for abstraction and problem-solving. The teacher becomes a "mentor" who fosters dialogue between students and increases their influence on one another, letting the children copy, make mistakes, and be corrected by their companions. The approach used in this experimentation gives priority to such aspects as creativity and the sharing of information and allows a gradual learning process based on practical experience and the value of the initial design. This is, in jargon, the logic of *"Tinkering"*.



The *Tinkering* approach

"Tinkering" is a methodology that prioritizes creativity and collaboration among peers. This approach, which is expressed through application of the cycle *"Think"-"Make"-"Improve"*, raises the awareness that by studying, trying, and making mistakes, you will eventually achieve the desired result. The logic of Tinkering creates a cycle, since the finished object can always be improved by going back to the initial project. At an educational level, the object and its creation process become a pretext to employ analyses and self-analyses and put skills and knowledge into practice.