O1 - fun@science report

Working sheet – Collection of interesting practices
Rev. 01 **Date** 14.12.2017

BEST PRACTICES

Brief description	This dissertation wants to provide an overview of the potential educational methodologies and strategies that can be implemented for letting the youngest generation discover the possibilities given by the industry evolution, involving 3D printing at first. This could also pave the way for a better inclusion of the student (from infant school to university) into the evolving society, providing a sort of "first orientation" for his future potential role inside it. Starting from the infant and primary school the little student can exploit the “learning by doing” methodology by the imagination and the successive realization of toys that they will produce in the final step of the experience. The educational path is designed also for the secondary and high schools, where the growing student can acquire awareness and skills able to guide him into his future work and/or his University studies. The latter are involved in this set of didactic strategies too, by means of high formation courses and contacts with industries.
Reason behind the project/practice	The lack of people with technical education in the labour market is currently a burning issue that affects the production constraints in many industries and also hinders a number of innovative projects. It is therefore crucial to educate children in the field of technical education using the latest technologies including 3D printing. Previous studies demonstrate that within a few years, technically educating pre-school children is meaningful. During the growing process it is also essential to bring pupils closer to science by playing and doing activities, so to develop an interest in this subject. Another key point is the students introduction to the process of sharing knowledge, of collaborating and being transparent and appreciating the transparency of the tools we use for our activities.
Aims and objectives	• Infant School Development of personalities, crafts, interest in technical and natural sciences. The model is based on the natural needs of the pupils, curiosity and supports the active discovery of the world, competition and, above all, the use of everything new, the use of modern media, technologies and games. In 3D modelling and 3D printing, children use their fantasy, imagination and support creative processes. • Primary School Understanding the functionality of instrumental technology (tablet, iPad and LIM). At the same time they can develop specific competences about geometry: with reference to solid forms, to the management of a worksheet in the software, and to projection to the interactive whiteboard (IWB). Step by step the pupils reach the tasks of designing and creating different types of objects like turtle, table, the plate with their name and a mobile sculpture. Another possibility is the building of the printer itself, duringwhich pupils learn how to work with a technical manual and follow its instructions. In addition, working with 3D printers can support group work that develops

Proj. n. 2017-1-PT01-KA201-035929
This project has been funded with support from the European Commission.
This communication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

	social and personal competencies. Working with a 3D printer consists of three phases: model preparation, printing itself and subsequent product editing. • Secondary Junior School Since 3D printing allows fairly rapid transformation of individual assignments into real objects, the interactivity of learning is enhanced, making it more visible and fun.The main goal of the students' involvement in the work using 3D printing is to improve their professional skills, prepare for the examination (where present) and develop the skills of cooperation in a group. • High School ○ Teaching the students how to benefit from Open Source content in the process of learning. ○ Motivating the student to share their contributions to help others ○ To know if they have basic mathematics knowledge required to learn about 3D design. ○ To know if they have experience with Open Source software The purpose is not so much to "learn to use the tool", but above all to bring the students, at all levels, to have a "problem solving" approach, thus stimulating the development of key competences as an essential tool for individual and social growth of target group. • Other (adult education/university) ○ To promote the University research and to stimulate students and professionals creativity, both at personal and at common level. ○ To share knowledge and competence about the innovative universe of digital fabrication: this is why this network is bases on Share, Learn and Make criteria. The mission can be pursued through workshops which involve several fields and subjects, such as: design, architecture, information technology, engineering and several areas of local craftsmanship (leather, fabric, metals, wood and ceramics).
Implemented activities and final outcomes	• Infant School One task is to use 3D printing to produce toys. Primary school children print simple 3D works on 3D printers, which are then used by preschoolers to assemble different models, first known and usable as toys, later on a unique design. Older children produce parts as toothed wheels or bolts for younger pupils who use them for example for assembling trains, pendulum clock or machines. • Primary School Pupils can start by imagining the object and its story, then continue by drawing both on the classic sheet and then with the use of specific software (TINKERCAD), and finally they could realize it by using 3D print. At the end, the pupils could verify if and what they did wrong in design phases and eventually rectify it.This process gave to pupils the possibility to develop skills about design, analysis and problem solving thanks to the realization and testing of their ideas by 3D printing. Another possibility is that pupils led by the teacher gradually assemble and set off the printer during first months of the group. After 3 months, they perform the first calibration and trial prints. • High School The educational methodologies can be oriented according to the various areas of interest, for example:

This project has been funded with support from the European Commission.
This communication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

	○ about science, parts of the human body can be realized to help the study of anatomy and biology; ○ in math, it is possible to create solids to be used for the study of geometry; ○ in physics, components for experiments can be realized. Those one graphically illustrate magnetic and electronic properties as well as parts of drones; ○ in design, 3D printing allows to acquire knowledge and skills of three-dimensional modeling for reproducing artistic sculpture. These activities require a lot of commitment and creativity from all of the participants. In order for the whole project to be done carefully and reliably, the students together with the teaching staff has to first create 3D models, print them and assemble the whole construction. • Other (adult education/university) The project can allow creating a center with specialized figures and individuals that together realize their projects, and also it gives the possibility to everyone to experiment and produce products low price. Moreoverit is adviced to offer courses and workshops dedicated to design, printing, automation. Moreover, in order to accomplish comprehensive and satisfactory outputs, the choice of organisations leading each output has to be based on their knowledge and expertise in the field, but at the same time the cooperation and feedback from other partners is also taken into account. Hence, all the results are thoroughly tested and looked at from different perspectives. Partners are consulted at every stage of outputs development. The course materials and curricula have to be adjusted to different levels of proficiency.
Approach and methodologies	• Infant School Every project implements the methodology of “learning by doing”. Teachers encouraged children to adopt a problem solving approach, in order to stimulate the development of key competences. • Primary School During the project the teacher used methodologies such as framework supplement and TMI (Think/Make/Improve), problem-solving and scaffolding.In these situations, the role of the teachers is only to “direct”, in fact pupils are free in the choices and in designing the objects to realize. Teacher as the leader of the group uses an active and participatory methodology and encourages pupils to adopt a problem solving approach, in order to stimulate the development of key competences as an essential tool for the individual and social growth. • Secondary Junior School Project and team work as principal characteristics. Interesting approach is the supervision of the project by two teachers, one responsible for technology aspect, and the other for visual aspect and aesthetics. An interdisciplinary approach on teaching is required. • High School Teachers encouraged students to adopt a “problem solving” approach, in order to stimulate the development of key competences as an essential tool for the individual and social growth. Additionally, during classes students can follow the pattern of PPP (present, practice, produce), first they show younger colleagues the basics of 3D modelling and printing, then they practice together and finally print the model. • Other (adult education/university)

This project has been funded with support from the European Commission.
This communication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

	Learning by doing and problem solving approaches are necessary. Use of pilot tests. The feedback arising from this pilot test will be used to improve the course content to explicitly make it relevant to adult learners and trainers. Feedback will be collected on the basis of questionnaires, if necessary, by individual interviews, addressing the following major issues: - General impression and remarks - Which training sections/units did the evaluators like, which not - What was the learning outcome - Feedback on the digital content developed - Suggested changes to the course content.

Proj. n. 2017-1-PT01-KA201-035929
This project has been funded with support from the European Commission.
This communication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.