Let's go through the Erasmus plus We are the Makers project together

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School of Robotics for three years took part in the European project Erasmus+ *We are the makers*, in collaboration with six partners from all over Europe: France (e-nable), Germany (Johannes-Kepler-Gymnasium secondary school), Denmark (Create It Real), Greece (Edumotiva) and Romania (University Valahia din Targoviste). The project website is in the languages of the Partners and in English (https://www.wemakers.eu).

The objective of the project was to demonstrate how the Internet of Things, 3D printing and interactive objects can become the protagonists of learning scenarios for school lessons.

For each year of the project, the partners hypothesized and realized different Learning Scenarios, creating, finally, manuals that can be downloaded free of charge from the wemakers.eu website.

The first year was dedicated to 3D printing, then to learn the basic concepts of CAD drawing Tinkercad.

The topic of the second year has been that of programming and coding; in this case several software have been used to create, for example, socially useful games with educational value. Why socially useful? Because the primary objective of the project is to create interactive and socially useful objects that can help someone in their everyday life and actions.

Finally, in the last year such interactive and socially useful objects have been realized, putting together the concepts of 3D printing, learned in the first year of the project, with those of programming and coding developed in the second year of activity.

In this regard, first of all we mention the 3D prosthesis. Among the partners participated in the development of the project the association e-nable France, born thanks to an American maker who thought to make available to anyone who needed 3D aids for children and young people suffering from agenesis of the upper limbs, i.e. missing hand and/or fingers.

Just in the project *We are the makers* we have taught how to modify, customize, print and assemble such prostheses; all this information has been enclosed in learning scenarios, experimented and tested in lessons with children and teachers.

Subsequently, thanks to the first two years of the project, in the third year we went to create real interactive 3D printed objects. Here are some examples.

Myoelectric Prosthetics

Reconnecting to the above mentioned prostheses and to the concepts learned on 3D printing in the first year of the project's life, Lesson Plans have been created to build three-dimensional myoelectric prostheses: thanks to these, electronic components and more technological parts have been added to the simple 3D prostheses to make these prostheses interactive.

Participating students learned, through learning scenarios, the concept of electromyography and which sensors can be applied to make a prosthesis interactive; they learned what muscle sensors are and how they can be used and programmed through Arduino cards. On the basis of this knowledge, a tutorial has been developed, for the realization of this device, within one of the Manuals of the project.

Directional indicators for the bike

Always talking about interactive objects, which are the cornerstone of this project, thanks to other partners of the project We are the makers, in particular the Romanian partners, other wearable devices that could be useful to all those kids who are passionate about bicycles and sustainable mobility have been realized. These partners have thought of a solution to make it easier for motorists to see the children cycling. In particular, their goal was to create a device that could be applied to a bicycle helmet in such a way that it functions as a directional indicator, activated through the movements of the head.

Experiments

The Italian students who have worked on these projects have experienced the learning scenarios thanks to presence lectures and webinars.

The webinars were realized during the lockdown period; at Scuola di Robotica, given the great interest on the project topics, we decided to carry out two webinars a week dedicated to the project We are the Makers, where these scenarios were experimented.

In addition, ad hoc lessons were held for schools that requested them. The first school with which we should have started the experimentation in presence was the middle school IC Santa Margherita Ligure.

In the first two lessons in presence was materially used a 3D printer, present in the school building, to print and study the 3D bridges; then the last two lessons, which would have been dedicated to the realization of real interactive objects, then application of electronics and 3D printing, were realized online. In spite of this, the students showed great interest and participation; using the padlet they had the opportunity to share their ideas and projects of 3D prosthesis customization. Their interests in history, comics, cartoons and cartoons emerged. It was very interesting to follow their interests, very varied.

The second school with which the experimentation was carried out is the IC Vigevano, elementary school; in this case we calibrated the activities according to the knowledge of the young students and so we focused more on programming on Scratch.

Thanks to the birth of this project it has been possible, also through meetings prior to this project, to approach the e-nable world, the world of prosthetics. Thanks to this a child, Diego, was the first to receive the 3D aid, customized by Ironman. After Diego's, we continued to deliver other aids to two other girls, Letizia and Sofia.

Traineeships

In this last year of the project, 2020, thanks to two trainees, Lorenza Saettone and Giorgio Gasparini, trainees of a university project *Epict,* we were able to experiment through webinars some lesson plans made during We are the makers. Thanks to their collaboration, other activities have been realized for the project.

Lorenza, teacher of philosophy and history, built three scenarios: one dedicated to 3D printing, in particular to Gutenberg and mobile printing; in the second one she proposed a smart bottle that reminds people to drink and uses low cost programmable cards. We checked how many times the bottle was raised and tilted to calculate how many drinks should be made. Estimating how many drinks should be done to empty the bottle, once this number of drinks was reached the smart bottle warns if enough was drunk in a given time frame and if the bottle should be filled. It doesn't work very well if the bottle is in a backpack on the go but we had in mind that the bottle would stay still on a desk. We will improve it.

The last scenario realized with Lorenza was to develop a smartwatch dedicated to this period of pandemic and emergency, which reminds people not to touch their faces with their hands. The person, thanks to the magnetometer, which is equipped with the micro:bit, and a magnetic necklace, if he brings his hand closer to his face is warned by an acoustic signal that reminds him not to touch his face.

Giorgio used more than one card to make the boys communicate through secret messages and images. In this case it has been realized a case for the programmable card to be applied on a backpack, so that

the boys distant from each other can, through the buttons on the micro:bit, communicate a secret message or a secret face. The second scenario realized by Giorgio was dedicated to prosthesis: he studied how to equip a *Halocode* card prosthesis, in order to make the prosthesis even more interactive and personalized. For example, this one was programmed so that by using the microphone on the card the children could perform magic tricks by turning on the LEDs (for example, if the child had personalized his prosthesis with Spiderman, when the child pronounces a certain secret word, the LEDs with Spiderman colors would light up).

Material and conclusions

All three project manuals have been translated into all partner languages and English and published on the We are the Makers website. On the manuals there are all the activities carried out by the partners (creation of a smart leaf to control when it is necessary to wet a plant; construction of a myoelectric prosthesis; realization of a cube to control the heart rate and control through different files the vital parameters; a weather station on the web and more).

Last July there was the final closing event of the project (the multiplier event) which was supposed to be held in Germany but which took place online. Many teachers (about one hundred) from all over the world also registered from countries outside the project, including one person from Albania who became aware of the event through Facebook pages.
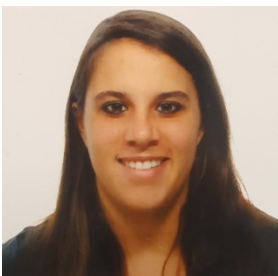
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Degree in Biomedical Engineering at the University of Genoa (2019), works at the School of Robotics (www.scuoladirobotica.it) with Pepper and Nao humanoid robots and for the project that sees the realization of 3D aids for children and teenagers.