

TECHNICAL SCHOOL PULA

1. Introduce your country and region of origin (an overview of a brief history and the economic situation to illustrate the size of the country).

Croatia is a European country, in geopolitical terms Central European and Mediterranean country geographically located in the southern part of Central Europe and the northern part of the Mediterranean. Croats belong to some of the oldest European nations. They have been living in their present homeland, Croatia, situated between the Adriatic Sea in the south and the Drava and Danube rivers in the north, for more than thirteen and a half centuries. Since they occurred to be living in a space where the conquering aspirations of two great states clashed - Byzantine and Franciscan, Croats have had a very tumultuous history. In its near history, Croatia was part of Yugoslavia, and in 1991 declared its independence. The capital is Zagreb with a population of 4,284,889 people. According to the European Union's living standard indicators, Croatia stands almost at the bottom of the ranking. The Croatian territory is divided into 20 counties and the City of Zagreb. Our school is located in the Istrian County. It is one of the most developed counties of Croatia. The largest city of the county is Pula, and it's exactly where our school is located.

2. Describe the institution where you work (mission and vision of the institution, number of students, curricula).

Pula Technical school is a four-year secondary school in Pula established as a unique and independent educational institution. It was founded in 1959. As of today, 460 students attend educational programs diversified in six curricula – engineering computer technician, electrical technician, mechatronic technician, geodetic technician, shipbuilding technician and architectural technician. Classes are held in two locations. The school employs 57 employees 49 of whom are professors. The mission of the Technical School Pula is to enable all students to acquire the necessary life competences in a positive environment, through quality education programs and curricula while nurturing collaborative relations. Quality education programs enable youth to properly look at the world around them, to make the right decisions and to make the best use of the opportunities that arise. For this reason, our mission is to train students for a competitive labor market, for further education, and encourage personal development and creativity of every single student. Our vision is the top-notch and safe school that follows and adapts to modern trends in science, education and

the profession. A school where one can learn and work with ease, in which new ideas are born and the knowledge upgraded. A school where both students and staff behave responsibly, a school in which individual and collective abilities are created and developed. We want students, teachers, parents and the community to recognize us as a modern school - the school for the future.

3. Briefly describe the way vocational education programs in your country (advantages and disadvantages).

The duration of vocational education in secondary schools depends primarily on the curriculum. After the completion of secondary vocational school, depending on the curriculum the student has completed, it is possible to start working and enter the labor market, provided that the conditions are fulfilled, or continue the education process at a secondary or higher education institution. In vocational education, students acquire knowledge, skills and competences necessary in the labor market with the aim of professional recognition of acquired qualifications which also offer the possibility to continue the education. Secondary vocational education programs are two: four-year programs (which terminate with the submission and defence of the final paper. After completing this education program, it is possible to start working or resume education at higher levels, which is subject to the state exit exam) or a three-year program preparing the student to work in industry, enterprises and crafts. The three-year programs also end up with the submission and defence of the final paper while the practical part of the program is realised mainly in the work process (with the employer) and a smaller part in the school premises. After completing the three-year vocational education program students have the possibility find employment or continue their education at a higher level of qualification, provided that complementary and/or bridging exams are taken, and provided that other necessary requirements of higher education institutions are met, it is also possible to continue the education at higher education levels. Reform of vocational education and the adoption of a new curriculum for vocational schools are ongoing in Croatia and hopefully, its implementation will start at the beginning of next school year.

4. How is the teaching in your institution organised (how many hours per week of practical training do the students have, is the practical training performed during the winter or summer holidays, where does the practical training take place, do the students do the practical training, what is the share of practical training hours in the whole curriculum)?

Practical training at the Pula Technical School is included in the total weekly teaching hours. Electric technicians in first grade have two hours of practical training while in higher grades practical training occupies four hours weekly. Mechatronic technicians in all grades have two hours of workshop training and exercises per week. Mechanical technicians have three hours of practical training (mechanical technology) in the first two grades. Geodetic technicians in all grades except in the first grade have three hours of practical training (surveying). The other two curricula, shipbuilding technicians and architectural technicians, also have practical training within the subject exercises. In addition to the abovementioned practical training, the program comprises also laboratory exercises, which as well as practical training take place in groups (each grade is divided into two groups). In the curricula electrical technician and mechatronic technician, almost all teaching subjects comprise laboratory exercises. All subjects are correlated and thus the synergy of the program is achieved. Students themselves perform exercises in all curricula, while the demonstration exercises are performed by the teachers. Practical training is not provided during the winter holidays, while during the summer holidays practical training continues for the curricula electrical technician, shipbuilding technician and architectural technician. Summer practical training is performed in craftsmen laboratories and companies in the surrounding area.

5. Status of your students after graduation (how many of them enroll in colleges and which, and how many are employed).

Approximately 100 students complete the education at the Technical School Pula every year. Since the introduction of state secondary school exit exam, schools can track the number of students who enroll in study programs through the National Centre for External Evaluation of Education, which is approximately 80 students per year. The remaining students are hired right after completing the secondary education for which we don't have specific data.

6. How much is the STEM area represented in your curriculum (in the plan and program)?

Developing STEM areas which comprise mathematics, natural sciences, technology and engineering, are certainly the mission of the Pula Technical School. STEM areas are represented in all curricula in the school through general and professional subjects.

The school systematically updates students about the STEM news and motivates and directs them towards the occupations of the future, i.e. occupations for which there will be a high demand in the labor market.

7. How do you supply new technologies used for practical teaching? What problems do you encounter? Do you receive any assistance or help from the ministry, local and county government, and private companies for the new technologies supply?

In the modern, digital age, it is almost impossible to achieve almost any significant result without providing and integrating technology into teaching. Because we live in a poor country that doesn't have the money to equip schools with the latest technology and equipment, the school has to take care of the supply on its own. Therefore, a number of obstacles often hinder the provision, and therefore the development of the teaching programs. The State or the ministry invest very little or almost nothing in the purchase of new technologies. The county helps more, but on the other hand being active in European projects, such as this one, brings multiple benefits to the school – from the procurement of new technologies to the education of teachers and students. An important role in the procurement of new equipment is played by private and state companies that very often donate IT equipment because the school does not have the means to buy and adapt to professional laboratories. New equipment is very important for technical schools, which includes new technologies to keep up with modern developments and to prepare students for the labor market or study enrolments.

8. Which professions will use 3D technology? How will you use 3D technology (implementation in regular classes, extracurricular activities, optional or additional classes)?

At technical school, we already have a Wanhao 3D printer. Through this project 3DforVet, our school will add another high-quality 3D printer and 3D scanner. In regular teaching, 3D technology will be used in the following cases:

Electrical technician: Technical drawing and documentation, Electrical engineering materials

Engineering computer technician: Technical drawing, Machine elements, Technical materials, Designing products using a computer

Mechatronics technician: Technical drawing, Machine elements, Technical materials, Designing products using a computer

Geodetic technician: Geodetic graphics

Architectural technician: Technical drawing, Drawing, Architectural structures

Shipbuilding technician: Technical drawing and design geometry, Technical materials, Laboratory exercises and practical training

In addition to regular teaching, we use 3D technology and we will use it to create the final works and in competitions.

9. How much do teachers and students know about 3D technology?

Students and teachers are poorly educated about 3D technology, although some students show interest and perform their own search for more information on the Internet. Interest in 3D technology is high, both by teachers and students. Today, students and teachers use the Internet as a basic mean of collecting information about additive technologies. There is a lot of information available online about additive technology. Teachers and students are not often informed about the possibilities that additive technology offers and what it could be used for and that the reason why it is very important to educate teachers who will pass on their knowledge to students. In addition to the advantages of additive technologies, it is also important to highlight shortcomings as well. 3D technology will be easily applied in practice, as it already is in many sectors. The same does not apply to mass production and serial production, but in specific areas such as medicine and similar, 3D technology is a new technology by adding materials, to the general public known as 3D printing. Day by day, as the technology advances, there is an increasing number of materials that can be printed in 3D technology while machines produce finished products of large dimensions. Additive procedures are useful for the production of products with complicated geometry in a relatively short time frame simply based on a CAD computer model. Additive technologies are also used for the manufacture of products in various materials as polymers, metal and ceramic products for consumer goods, electronics, automotive, medicine, architecture, military industry, aerospace, mechanical engineering, etc. It is also challenging to use it to create tools and molds

with large savings in production because it is possible to produce complicated tempering channels. To summarize: additive procedures can be used for almost everything, the imagination is the only limit. Although there are no restrictions in designing, the boundaries are possibly represented by the materials available with which objects are made. As for now, polymeric materials (acrylic resins, epoxy resins, PMMA, PA, PS, PA, glass fibre reinforced PA, starch, plaster, sand, ABS, PC, PLA, PE, PP, wood-plastic composites, PVC, paper, silicone), metal (zinc, aluminium, bronze, stainless steel, titanium alloys, cobalt chromium, beryllium copper, carbon steel, high-alloy steel, tungsten) and ceramics. Even precious metals such as gold and silver can be used for printing. 3D technology should be an upgrade to the basic knowledge in specific areas, therefore the basic knowledge shall not be neglected but shall be transferred to students in equal measure. In this sense additive technology should be the "icing on the cake", on top of basic knowledge from specific areas.

10. What do you expect from this project and how much will it contribute to the quality of practical training at your school?

We expect that the project will enable us to learn about the practical application of 3D technology (concrete examples in industry and economy), understand the benefits, but also the shortcomings of 3D technology (with real-life examples). The project is expected to contribute in some way to increase the quality of teaching, although teachers of vocational subjects strive to get students acquainted with this topic as much as possible. The project will for sure increase the interest of students and teachers towards additive technologies, and therefore increase competitiveness in the world market of today's students and future additive technology experts. It takes some time for the world to adopt new technology. This certainly boosts the belief that 3D printing has great potential to become one of the new and modern technologies. 3D printing is a technology that boosts design innovation in total freedom, while the process takes place at reduced costs and fast operation. Parts can be specially designed without the need for assembly, and despite the complexity of the geometric shape or the production effort requested, it won't increase the production costs. 3D printing is an energy-efficient technology that can reduce environmental pollution within the process itself using up to 90% of standard materials and shorter production time. In the future, the wide application of 3D printing can be expected to make major changes in our everyday life, which will greatly improve the accessibility of creating new items. The

project is also expected to give a broader insight into additive technology materials and an insight into the latest updates of 3D technology sector from all around the world. Concrete examples of application in science, technology and industry are expected to be highlighted. One of the expected outcomes is to learn about additive manufacturing and DIY that will contribute to a more comfortable life and general awareness about all the things that can be produced at home. It is expected to stimulate the curiosity of young people and students about new technologies, to engage them and create an entrepreneurial climate in the industry sector. The advantage of 3D technology is the availability of 3D printers (in the future perhaps 3D scanners) that can easily be bought on the Internet at a rather low cost. DIY 3D printer kits can also be easily found so students will be happy to learn how to build a 3D printer from scratch by themselves. The project also needs to provide an overview of the world's current technology and the possibilities of integration of 3D technology in significant manufacturing industries for the Croatian economy. The project is expected to raise the quality of practical training in the school, both in the field of mechanical engineering and in the fields of electrical engineering, mechatronics and architecture, as well as surveying with examples of specific applications. The project is expected to provide an example of areas in which 3D technology could be applied, in particular considering those areas which are important to our school. Furthermore, students expect that additive technologies can be used everywhere, which is true only if it presented this way. For this reason, it is important to familiarize teachers with the advantages, but also with disadvantages coming from this technology. At the same time, it is important to explain that modelling can be performed using various CAD programs available, from the simplest versions to the most advanced ones. Complex software gives students the opportunity to learn how to create objects of more demanding shapes and structures. In addition to designing, it is also necessary to teach them, to learn how to use the software for calculating (appropriately for secondary school students) the strength of materials used for items being modelled.