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DEZVOLTAREA UNOR COMPETENȚE PROFESIONALE ȘI TRANSVERSALE PENTRU STUDENȚII DE LA FIZICĂ, PRIN INTERMEDIUL PROIECTELOR DE VOLUNTARIAT

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Rezumat. *Scopul acestui articol este de sublinia importanța implicării studenților de la Fizică în organizarea și desfășurarea unor proiecte de voluntariat care contribuie la dezvoltarea unor competențe profesionale și transversale pe care educația formală nu le poate oferi. Din perspectiva angajatorilor, sunt extrem de apreciate la absolvenți competențe precum lucrul în echipă, comunicarea la orice nivel și în toate mediile, gândirea critică, managementul de proiect, educația pentru mediu, spiritul antreprenorial, învățarea continuă și îmbrățișarea inovației și tehnologiei ca stil de viață. Din perspectiva comunității, se așteaptă de la absolvenți o gândire în beneficiul comunității, în favoarea celei la nivel individual, o adaptabilitate la nivelul provocărilor tehnologice actuale și al crizelor generate de un mediu într-o continuă schimbare. Vor fi prezentate perspective, implicații și avantaje ale dezvoltării unei rețele regionale de senzori în cadrul unor proiecte de voluntariat, focusate pe monitorizarea calității aerului. De asemenea, va fi realizată o scurtă descriere a activităților organizate în cadrul unor proiecte care aduc valoare adaugată educației formale.*
Cuvinte cheie: *voluntariat, competențe profesionale și transversale, rețea de senzori, monitorizarea calității aerului.*

DEVELOPMENT OF SOME PROFESSIONAL AND TRANSVERSAL SKILLS OF THE PHYSICS STUDENTS WITHIN VOLUNTEER PROJECTS

Abstract. *The aim of this paper is to highlight the importance of involving Physics students in the organization and development of volunteer projects that contribute to the development of some professional and transversal skills that formal education cannot provide. From the employers' perspective, are highly valued at graduates' skills as team work, communication at all levels and in all environments, critical thinking, project management, environmental education, entrepreneurship, lifelong learning and embracing innovation and technology as a life style. From the community's point of view, it is expected for graduates to think rather for the benefit of the community than from individual perspective, adaptability to the current technological challenges and crises generated by an environment in a continuous changing. Also, a short description of the activities organized in the framework of some projects that bring added-value to the formal education will be made.*
Keywords: *volunteering, professional and transversal skills, sensors network, air quality monitoring.*

Introduction

Sustainable development means to have an intergenerational equity, to preserve resources for future generations, long-term stability of the economy and environment [1]. The education plays an important role in achieving a sustainable development of each region/country. Higher education students are valuable because they represent the future human resource that will work for the existent companies or will start some new

ones. The environment where future graduates will evolve is in a dynamic change. For this reason, future graduates need to be aware of the effects of the environment pollution and climate change, to understand what are their effects on health and how they could adapt at all these effects. Education has the role of helping students to start thinking in terms of recyclable/reusable, circular economy, respect for environment and natural resources and embrace the innovation and technology as a life style. Anyway, the curricula of most specializations/branches, including Physics, do not include courses in fields like pollution, climate change, alternative sources of energy, advanced technologies in working with big data, open sources big data, circular economy, waste management, etc.

In the following, it will be shared the contribution of two volunteer projects (Clear Air Craiova and Clear Air Oltenia) [2,3] to the development of some students' professional and transversal skills. Moreover, it will be underlined the community engagement of the University of Craiova, during these projects. Clear Air Craiova and Clear Air Oltenia were implemented during pandemic and were sponsored by OMV Petrom Romania, in 2020 and 2021, in the framework of the volunteer championship, organized by this company. The target group of these projects was represented by Physics students, high school students and teachers from Craiova (in 2020) and from Southwestern Oltenia region (in 2021). Southwestern Oltenia region is one of the eight regions

Results and discussions

It is well known that people's exposure to large temperature variations induced by climate change and polluted air are two important factors in increasing the risk of mortality due to cardiovascular and respiratory diseases and have to be studied [5-6]. In agreement with the statistics given by the National Institute of Statistics, Southwestern Oltenia region is on the 2nd place at the incidence of ischemic heart disease and stroke, on the 3rd place at the incidence of obstructive pulmonary disease and on the 5th place at the incidence of asthma. Both implemented volunteer projects, have started from the same need of the community, to try finding the reasons for which Southwestern Oltenia region occupies such a undesirable ranking.

Volunteer projects with educational and environmental components might help Physics students to become more sensitive regarding environment issues, to understand the importance for community of a local independent network of particulate matters (PM) sensors which is able to monitor the air quality in real-time. Physics students

have found out which are the recommended by WHO limits for PM2.5 and PM10 concentrations [7-8] and how different are affected people from poor, average and well-developed cities by air pollution [9-12]. Also, developing awareness campaigns for the large public in mass-media about environment pollution and climate change issues, students from universities, teachers and students from high-schools might contribute to the visibility and involvement of the University of Craiova, as a vector of change in Craiova city and Oltenia region. These projects brought at the same table students from higher education, teachers, academic staff, specialists from meteorology, researchers in climate change, students and teachers from high schools, entrepreneurs, people from mass-media, volunteers to talk about important issues of the community and to act together.

The currently network of sensors from Craiova (Figura 1 (a)) has 13 sensors and 2 meteorological stations. Most important, the local community has contributed with another 10 PM sensors.

(a) (b)

Fig. 1. The map of the sensors (a) from the Craiova network (b) Oltenia network [4]

Fig. 2. The image of a sensor (a)type A3 (b) type Smoggie [4]

From those 13 sensors, one is more complex, type A3, (Figura 2 (a)) and measures parameters (Figura 3) like noise (analogue sound sensor), temperature (T), air pressure (P), relative humidity (using some micro-electro-mechanical systems) (RH), CO_2 (using a nondispersive infrared sensor), formaldehyde (using an electrochemical method), Ozone(electrochemical), volatile organic compounds (estimated for alcohol), particulate matter with a diameter size of 1.0 nm, 2.5 nm and 10 nm (using Laser scattering method).

Fig. 3. The graphs in time of the parameters measured by sensors type A3 (T, P, RH, VOC, Noise, CO_2, Formaldehyde, Ozone, PM1, PM2.5, PM10) [4]

Twelve sensors Figura 2(b)) are simpler, type Smoggie, and measure only particulate matter (PM1, PM2.5 and PM10), temperature (T), relative humidity (RH) and air pressure (P).

All sensors are certified by the laboratories of some prestigious national and international institutions and at the AIRLAB International Microsensors Challenge 2021, the manufacturer that produces these models of sensors (models A3 and Smoggie) for measuring outdoor air was one of the winners of the competition [13].

In the most important cities of Oltenia region (Slatina, Drobeta Turnu Severin, Râmnicu Vâlcea, Târgu Jiu, Horezu, Bălcești, Potcoava, Scornicești, Filiași, Balș, Novaci), another 20 sensors were installed (Figura 1 (b)). The colours of the sensors from the Figura 1 (a) and (b) are correlated with air quality index (AQI) value, calculated on the basis of the CO, NO2, SO2, PM2.5 and PM10 pollutant concentrations recorded by sensors. AQI is calculated based on the European quality standard, after a conversion of the unit of measurement transmitted by the sensor 'ppm' (parts per million) to 'µg/m^3'. A very low level of pollution is indicated by the green

colour (<25 µg/m3), an average level of pollution is indicated by yellow (50-75 µg/m3) and a very high level of pollution is given by red (>100 µg/m3). There are another two intermediate values, high level of pollution indicated by orange (75-100 µg/m3) and low level of pollution given by light green (25-50 µg/m3) [14].

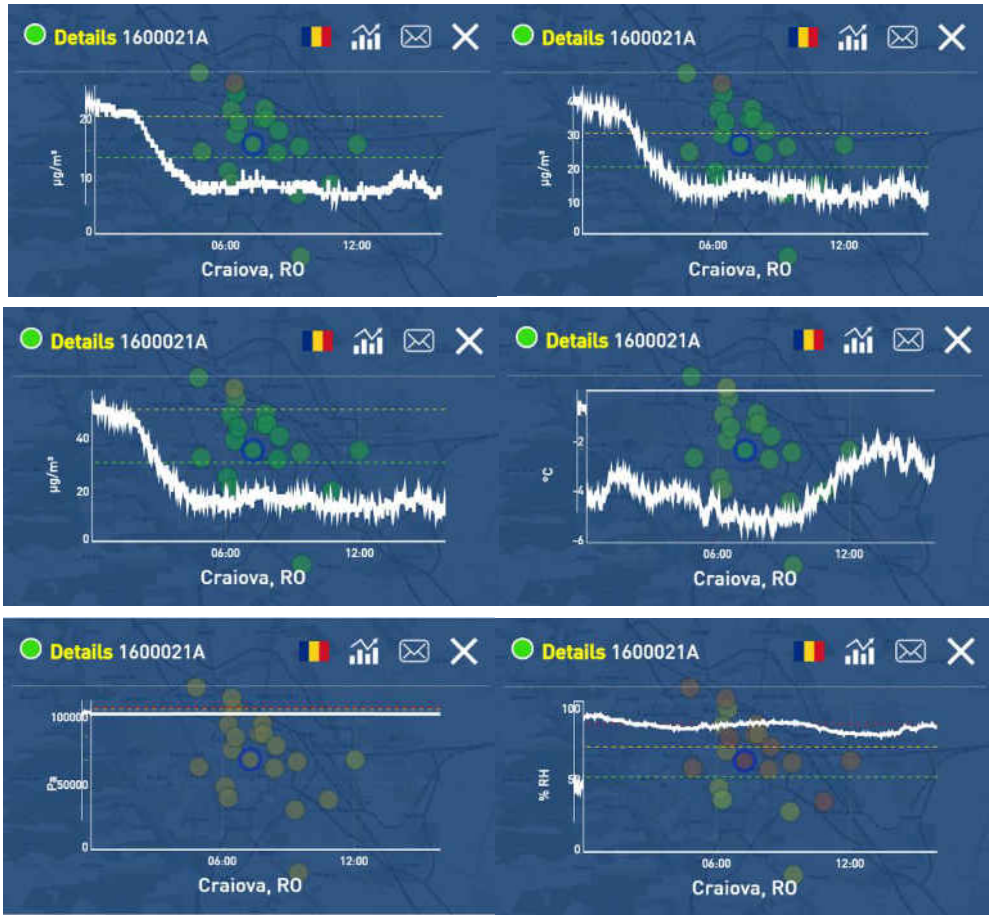

Fig. 4. The graphs in time of the parameters measured by Smoggie sensors (March, 06, 2022, values of the PM1, PM2.5, PM10 concentrations, T, P, RH) [4]

Into these projects were organized 33 meetings with students and teachers from the high-schools from Oltenia to show them why is important for their high school to adopt such a sensor, to explain them how is influenced their health by the air quality and to help them to understand how they can read the values of the parameters measured by sensors. Physics students that have participated to these meetings have developed their abilities to speak in public. Furthermore, students from those high schools represent an important source of recruitment for future Physics students.

Also, it was organized a virtual visit for students from University of Craiova to a Romanian start-up that produces PM sensors. Physis students watched in real time how is made a PM sensor, talked with the owner of a Romanian start-up about

difficulties encountered and main steps to start an innovative business. In this way, students have developed some entrepreneurial skills. Another idea, that was emphasized during this meeting, was to help students to understand why is important for them to learn Phyton programming language. They connected theory with practice because they understood that all these sensors are built using an Arduino microcontroller or a Raspberry PI small singe board computer and need small programmes. Moreover, Physics students heard about Internet of Things (IoT) as a number of sensors and their connectivity and have understood why the data base generated by the network of sensors is Open Source and valuable for the benefit of their community. Furthermore, Physics students have learned how useful might be some advanced technologies as Artificial Intelligence and Machine Learning in working with Big Data. The independent network of sensors generates a lot of data that might be used by students as subjects for their Bachelor or Master thesis.
Into the project Clear Air Oltenia was given a course to 100 teachers from high schools from Oltenia about climate change and pollution. Teachers might help in organizing presentations in their high schools of the branches of Physics (Medical Physics and Computational Physics), in the process of the recruitment of future Physics students.

Conclusions

Volunteering for community has helped Physics students to think for the benefit of their community, not only for individual. Students involved as volunteers in such projects have developed their transversal competences like working as a team, developing their ability to talk in public, communication at all levels, handling social-media communication, taking care of the network of sensors, entrepreneurial skills. Volunteer projects might contribute to the developing some professional skills (e.g. software and site development, data analysis, data infrastructure, networks) for Physics students. It is an alternative way to train Physics students for future professions like big data analyst, Machine Learning specialist, Web Developer, UX designer specialist, Artificial Intelligence ethicist, etc. [15-17]

The network of sensors is an independent one and for this reason there is more transparency for community related to the correctness of data offered by the official network of sensors [18].

These projects have improved the relationship between universities and high schools, between universities and graduates, companies, institutions and communities.

During time, the data given by the independent network of sensors may become valuable, especially when it is interpreted in relation with factors like weather conditions, fuels used to heat homes, urban traffic, illegal waste incineration, degree of poverty of the inhabitants, as a sequence of the students' education. There is an inherent limitation, places where the high schools are not always located in the busiest/polluted places from cities.

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