Educational Matters
Научно-методически статии

SOME PROBLEMS IN ENGINEERING EDUCATION WITH COMPUTER SCIENCE PROFILE DURING COVID-19

Dr. Georgi Tsochev, Assist. Prof.
Technical University of Sofia (Bulgaria)

Abstract. The COVID-19 pandemic introduced many limitations and changes in our lives and in particular in education. This article presents problems in distance learning in the field of computer networks and information security between March and June 2020 in the training of engineers with computer science profile.

Keywords: distance learning; computer science; COVID-19; digital competence

Introduction

The pandemic situation caused by the corona virus SARS-COV-19 (COVID-19) has necessitated radical changes to the education system. Educational institutions have temporarily suspended attendance classes, which impacts education in unprecedented ways. Based on statistics from UNESCO, at the height of the COVID-19 pandemic, nearly 1,480,292,206 were affected by the closure or partial closure of schools and universities in nearly 160 countries[1)]. In April 2020, nearly 90% of countries switched to distance teaching.

This data has forced countries to look for alternative ways of distance learning to reach all children, for example through teaching on TV, radio and other channels. According to research, this pandemic has had a significant impact on the performance of students in higher education (Gonzalez et al. 2020).

In the remote form of training, trainees and teachers can be in a virtual environment, creating a connection based on internet and communication technologies. Remote learning is a form in which trainees, teachers and administrators may be separated by location, but not necessarily at a time when the distance created is compensated by e-learning technologies, methods and means[2)]. Synchronous and asynchronous distance learning can be implemented. In order to perform synchronous training in an electronic environment, compliance with a pre-established learning schedule is required, there is an interaction between a teacher and a learner and ongoing feedback can be carried out.

The article presents a study related to the change of training during the COVID-19 pandemic in engineering specialties with a profile in computer science.

The study was conducted with students in full-time education at the Faculty of Computer Systems and Technologies at the Technical University - Sofia, in the discipline Network and Information Security.

Profile of the subjects

The study group consists of students at the Technical University - Sofia in engineering with a profile in computer science before and during the COVID-19 pandemic. As can be seen from fig. 1, 72% of the students are male and 28% are female, which is a traditional ratio for engineering specialties.

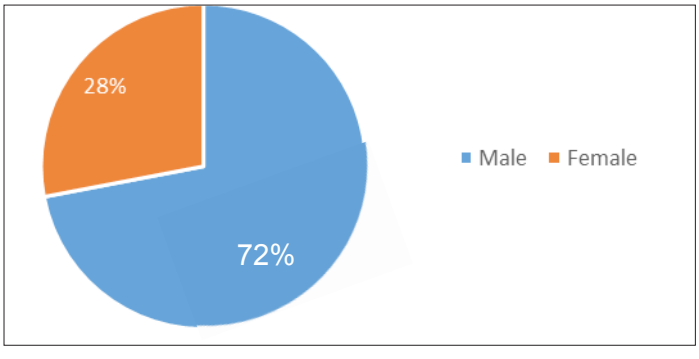

Figure 1. Gender distribution of the students surveyed

In fig. 2 the presented distribution by age shows that 96% of the surveyed students are in the age range from 21 to 25 years, only 4% are from 26 to 30.

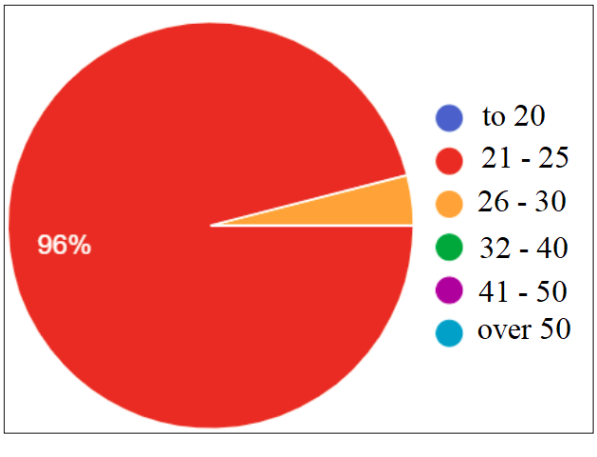

Figure 2. Age distribution of the students surveyed

The reason for this is that the majority of these students are bachelors: 64% are in Bachelor's degree, of which the workers are 28% (Fig. 3). The remaining 36% are studying Master's degree, of which 8% are working.

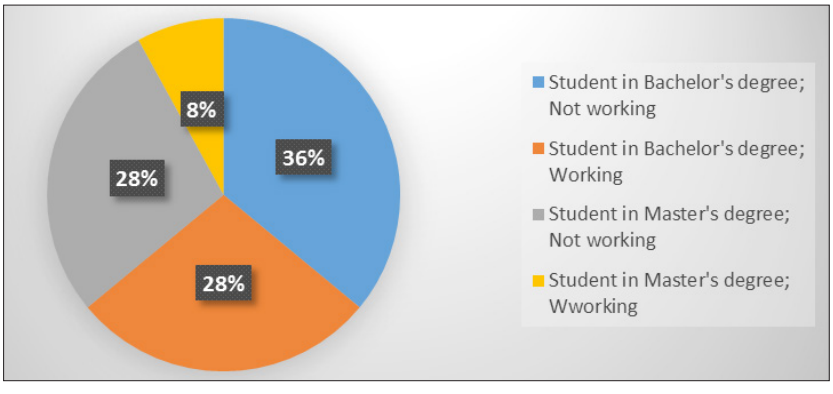

Figure 3. Educational degree

Training before and during COVID-19

The curriculum for specialty Information Technologies in Industry aims to prepare engineers in various industrial fields with in-depth knowledge in computer technology and modern industrial information systems[3]. Creative thinking and the development of digital competencies is a prerequisite for engineers to be successful in their field (Chehlarova & Gachev 2021). Until the advent of the COVID-19 pandemic, classes in the discipline of Network and Information Security were conducted in the traditional way - presented in a lecture hall equipped with an interactive whiteboard and laptop. The work during laboratory exercises is carried out in a laboratory room with computers. Each student has a workplace and a field for successful implementation of the tasks assigned to him (Fig. 4).

Figure 4. Setup for wireless network security analysis

Laboratory exercises can be performed through simulations or through real experimental setups (Fig. 5).

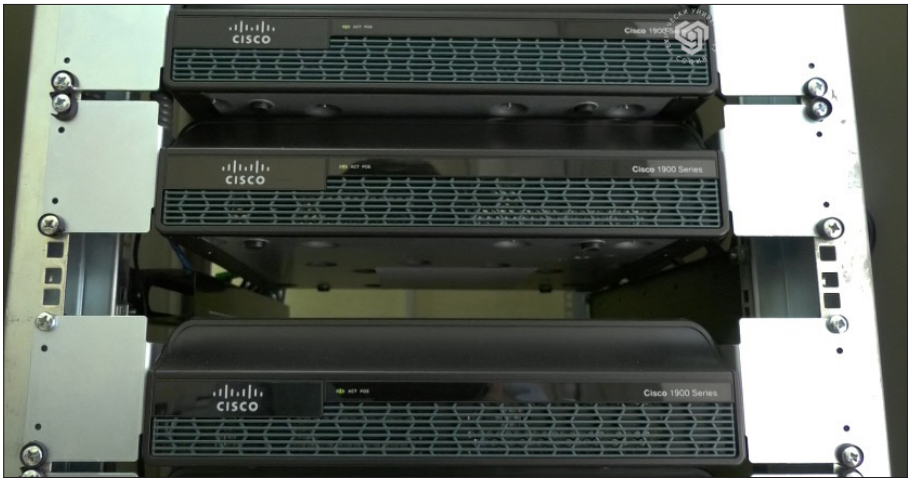

Figure 5. Part of the equipment in a network and information security laboratory

For laboratory exercises in the field of computer networks, they may use simulators that are close to reality (Fig. 6). This enables the use of own devices and the implementation of distance learning.

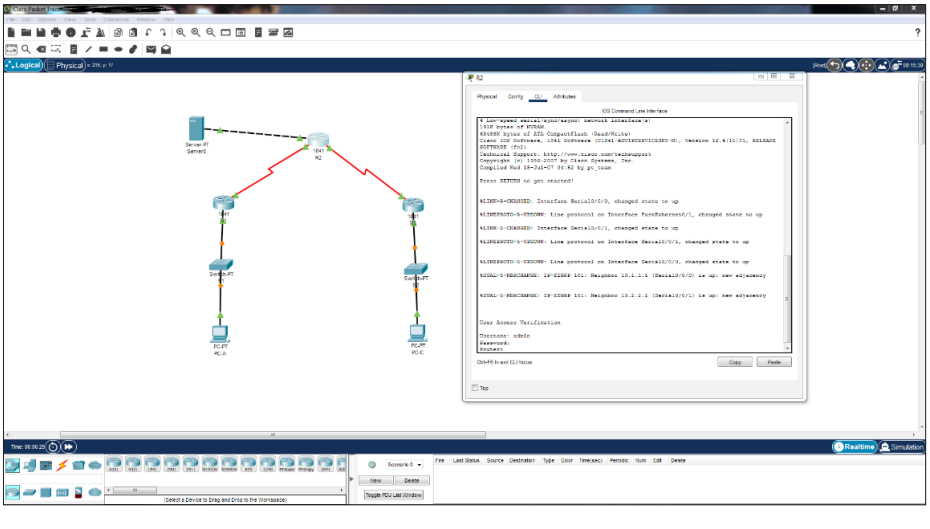

Figure 6. Simulation of an exercise for the construction and configuration of AAA

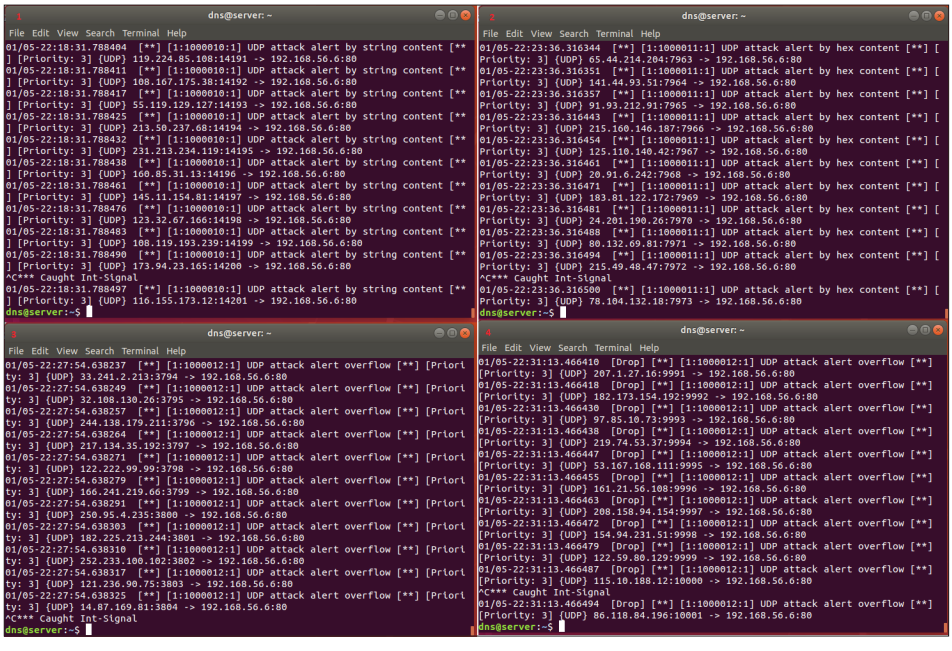

Figure 7. Result of interception of UDP Flood attack by Snort system

In more complex simulations, such as conducting exercises related to network and information security, the resource is significantly larger (Fig. 7).

According to the university rules, lectures are not mandatory, only recommended. In real practice, the attendance of lectures is below 10%, which is also explained by the high percentage of working students. Laboratory exercises are mandatory, and the presence of everyone should be with its administrative subgroup. This was assessed as a disadvantage by students because of their difficulties of a different nature in terms of conditions.

During the COVID-19 pandemic, it was urgent to move to distance learning in an electronic environment. This led to the use of various means for remote synchronous lectures, seminars and laboratory classes. The teachers themselves chose how and by what means they would perform distance learning. The free version of the Zoom software product was initially selected for the sessions. In March 2020, the company developing this product allowed unlimited time for its use. After less than a month, the owners of the program put a limit on the duration of each session to 45 minutes. Difficulties were observed in providing learning materials suitable for distance learning in an electronic environment. Attendance during lectures increased 3 times due to the ability of students to work remotely. The possibility of attending laboratory exercises with another group was evaluated by the students because they were allowed more flexibility to participate in the learning process.

The process of conducting the classes in a distance learning form in an electronic environment allows flexibility in the participation of students (Kiryakova & Angelova 2021). During the laboratory exercises, difficulties were observed on the part of the students and conducting simulations. As described above, simulations require a greater technical resource, and not all students have this kind of technique. Many of them did not complete the simulations to the end and left the exercise with others who had already finished. During the laboratory exercises, the tasks performed by the students were checked on the spot. When a difficulty is found, attention is paid to each one, and the student is invited to share his screen with everyone so that others can see what the problem was. In the vast majority of cases, the problems are of a homogeneous type. A major disadvantage observed in distance learning in an electronic environment is the retention of students' attention, which was compensated by the use of a game and competitive approach. In order to stimulate students for self-preparation and possible discussions, the learning materials for this type of training had to be updated.

The results of the COVID-19 crisis also led to the creation of a virtual laboratory for computer networks and network security. With its help, students will be able to perform most simulations of the exercises in disciplines such as computer networks, network and information security, etc.

Moodle's resources were used to conduct a distance learning exams in an electronic environment. The exam was conducted by a test with 30 closed questions (with one correct answer) for 40 minutes. The results shown are higher than in an attendance examination conducted a year earlier (Figure 8).

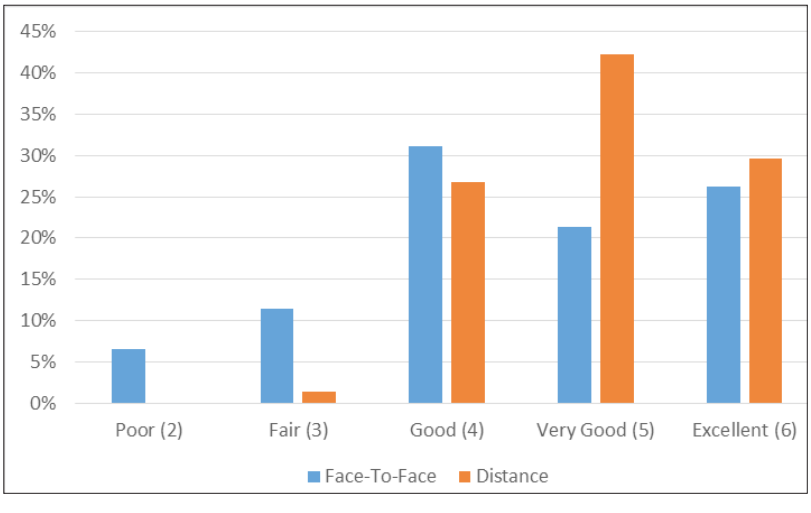

Figure 8. Exam results

Observations show that the COVID-19 crisis has triggered increased use of familiar and demand for new platforms to make conference calls, search and modify existing and create new educational resources for training in an electronic environment both in schools and in Universities (Ivanov et al 2019), (Yoshinov et al 2021; Chehlarova et al 2021; Radonov et all 2020). Specific decisions on distance learning were taken both at national level and institutionally.

Currently, Technical University of Sofia has a strategy for organizing and conducting of attendance training in an electronic environment, conducting exams and video-conference defense of diploma thesis. It states that face-to-face classes for full-time and part-time students, as well as for students in qualification programs, are held in an electronic environment using the Moodle or Blackboard e-learning platforms. Classes are done synchronously on one of the platforms MS Teams, Google Meet or BigBlueButton using a camera, microphone and/or shared screen according to the specifics of the discipline and type of class (lecture, seminar exercise, laboratory exercise), following the weekly schedule of the classes. These platforms also offer interoperability at different levels (Trifonov et al 2016; Petrova et al 2016).

In order to reduce the possibilities for replacing of students' identity and the authorship of their works when conducting of attendance exams in an electronic environment, teachers may comply with the following pedagogical and technological recommendations:

In the case of a written exam in Moodle or on the Blackboard, it is recommended to set an assignment, to set a time range according to the curriculum schedule. It is recommended to carry out a follow-up check by the head responsible for training in the primary unit.

In an electronic test, it is recommended to use MS Forms, Google Forms, Moodle or Blackboard to create a question database (so that each student receives a different version of the test), limiting the time to complete the test (so, to prevent the student from searching for the answer on the Internet, or in the learning resources, or to communicate with his colleagues, but to rely on his own knowledge). When using Moodle, it is recommended to use a browser that does not allow screen switching (Safe Exam Browser, Browser Security) or set the maximum number of screen switches, after which the exam is terminated by automatically submitting the questions for which answers are provided.

For exams based on projects, presentations, strategies, problem solving, reports, etc., which require protection of the prepared exam task, it is recommended that protection be carried out in a virtual classroom using MS Teams or Google Meet. The student should submit his/her exam work in advance at Moodle or Blackboard, and the teacher should have a discussion with the student, based on visual contact and on a shared screen, to facilitate the establishment of the student's authorship.

The work aimed at educating the younger generation should not be neglected either, because even in compliance with these recommendations, there may be manifestations of deviations and impossibility to ensure objective assessment.

Conclusion

Students in an engineering specialty with a computer science profile at the Technical University of Sofia dealt quickly and easily with the change in the form of training imposed due to the COVID-19 pandemic. In the study, the students expressed satisfaction with the online learning, as well as the preference for hybrid form of training (lectures and seminars to be conducted in an electronic environment, and practical attendance at exercises). As a result of the organization of distance learning – synchronous and asynchronous, educational resources were created, which can also be used outside a pandemic environment. There are problems with remote testing that can be partially overcome.

The created conditions for distance learning on *Network and Information Security at* the Technical University of Sofia led to a successful completion of the training.

NOTES

1. https://en.unesco.org/covid19/educationresponse
2. Ordinance on the state requirements for the organization of a remote form of training in higher schools, https://www.mon.bg/bg/59, Adopted by Decree No 78 of 05.03.2021. [in Bulgarian]
3. https://ects.tu–sofia.bg/package_bg/%D0%A4%D0%9A%D0%A1%D0%A2/%D0%91%D0%B0%D0%BA%D0%B0%D0%BB%D0%B0%D0%B0%B2%D1%8A%D1%80/ITI/blanka-specialnost_info_BITI_BG.pdf

REFERENCES

Chehlarova, N. & G. Gachev, 2021. Online contest "Mathematics and Art" for the development of key competencies. *Pedagogika-Pedagogy*, **93**(1), 87 – 99, ISSN 1314-8540 (Online), ISSN 0861-3982 (Print).

Chehlarova, T., D. Tsvyatkov & N. Chehlarova, 2021. First Week Distance Learning in "Ivan Vazov" Secondary School in Stara Zagora. *Strategies for Policy in Science and Education – Strategii na Obrazovatelnata i Nauchnata Politika*, **29**(2).

Gonzalez T, de la Rubia MA, Hincz KP, Comas-Lopez M, Subirats L, Fort S, et al., 2020. Influence of COVID-19 confinement on students'

performance in higher education, *PLoS ONE*, **15**(10): e0239490. https://doi.org/10.1371/journal.pone.0239490.

Kiryakova, G. & Angelova, N, 2021. Are modern learners ready for innovative forms of training? *Mathematics and Informatics*, **64**(1), 52 – 61, ISSN 1314-8532 (Online), ISSN 1310-2230 (Print) [In Bulgarian].

Petrova, T., Naydenova, I., Pironkov, L., Filipov, A., Tsochev, G. and Ganev, I., 2016 Implementation of CLP4NET in Bulgaria, *Proceedings of the Technical University of Sofia*, **66** (3), 241 – 248. [In Bulgarian].

R. Radonov, G. Angelov and R. Rusev, 2020. *"Remote Education Applications in the Technical University of Sofia"* 2020, XXIX International Scientific Conference Electronics (ET), Sozopol, Bulgaria, 1 – 6, doi: 10.1109/ET50336.2020.9238194.

Trifonov, R., Spassov, K., Vatchkov, P., Manolov, S., & Yoshinov, R. and Blagoev, L., 2016, *Interoperability of Information Systems*, Sofia: Avangard Prima, ISBN 978-619-160-721-1 [In Bulgarian].

V. Ivanov, L. Dimitrov, S. Ivanova and O, 2019. *Olefir, "Creativity enhancement method for STEM education",* II International Conference on High Technology for Sustainable Development (HiTech), Sofia, Bulgaria, 1-5, doi: 10.1109/HiTech48507.2019.9128255.

Yoshinov R., Chehlarova, T. & Kotseva, M., 2021. *The e-Facilitator as a Key Player for Interactive Dissemination of STEAM Resources for e-Learning via Webinar*. IMKL 2019. AISC 1192, Springer, Cham. 675 – 686.

✉ **Dr. Georgi Tsochev, Assist. Prof.**
ORCID ID: 0000-0003-2442-8311
Information Technologies in Industry
Technical University of Sofia
Sofia, Bulgaria
E-mail: gtsochev@tu-sofia.bg