Project:	Boosting the telecommunications engineer profile to meet modern society and industry needs [BENEFIT]
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Work Package 4:	Training and internship implementation
Title:	D4.4 Implementation of teacher training modules
Lead Organization:	UB, CISCO
Participating Organization:	UNI-KLU, UL, FERIT, UBL, UNSA, UNTZ, UNI, UNS, ENT, BICOM, BIT, CISCO, NiCAT, RT-RK, AN, SE-DMS, ZM
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	Work Package and Outcome ref.nr	WP4 - D4.4
Deliverable data	Title	Implementation of teacher training modules
	Type	☐Teaching material ☐Event ☐Learning material ☒Report ☒Training material ☒Service/Product
	Description	The project BENEFIT planned teacher training modules to be offered to a tentative total of 200 teaching staff members (note that one teaching staff member may be exposed to several training modules). The teacher training modules were implemented and the total of 248 teaching staff members participated at six teaching events (workshop and seminars). The report describes the implemented teacher training modules organized by the participating universities and organizations, in collaboration with local ICT industries. Specifically the report gives short description on: - Three teacher training workshops organized by University of Klagenfurt, University of Ljubljana and FERIT (University od Osijek) - Three teacher training seminars organized by WB HEI, i.e. University of Banja Luka, University of Sarajevo and University of Niš.
	Date	03.02.2021.
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Target groups	☒Teaching staff ☐Students ☐ Trainees ☐ Administrative staff ☒ Technical staff ☐ Librarians ☒ Industry partners, WB Higher education authorities	
Dissemination level	☐ Department / Faculty ☐ Local ☐ National ☐ Institution ☐ Regional ☒ International	
Lead Organization	UB	
Participating Organization	UNI-KLU, UL, FERIT, UBL, UNSA, UNTZ, UNI, UNS, ENT, BICOM, BIT, CISCO, NiCAT, RT-RK	
Task	T4.5 Implement teacher staff training on ICT teaching tools and lab operations and modern prototyping tools (Task leader: CISCO).	

Revision History				
Version	Date	Author(s)	Organization(s)	Brief description of change
1	03.2.2021.	G. Marković A. Tolimir M. Koprivica J. Ćertić	UB, CISCO	Super draft
2	12.2.2021.	All	UNI-KLU, UL, UB, UBL, UNSA, UNS, UNI, UNTZ, FERIT	First version
3	18.2.2021.	N. Suljanović	UNTZ	Review
4	18.2.2021.	G. Marković	UB	Minor revisions
5	19.2.2021.	U. Burnik	UL	QB evaluation
6	19.2.2021.	M. Koprivica	UB	Minor revisions

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1. Introduction

The deliverable **D4.4 "Implementation of teacher training modules"** reports the results of the activities carried out in:

T4.5: Implement **teacher staff training** on ICT teaching tools and lab operations and modern prototyping tools **(Task leader: CISCO).**

The project BENEFIT recognized continuous training of teaching staff as an important prerequisite for the successful implementation of modernized study programs in telecommunication engineering by the involved Western Balkans higher education institutions (WB HEI), [1]. Hence, in the scope of the project BENEFIT the training on ICT (Information-Communications Technologies) teaching tools and lab operations and modern prototyping tools were planned and offered to teacher staff of six WB HEI and other participating universities. In total, six teaching staff training workshops and seminars have been prepared and delivered:

1. The professional training workshop, organized by the University of Klagenfurt (UNI-KLU), which was held in Klagenfurt in July 2019;
2. The workshop on new teaching methodologies and instructional approaches in ICT engineering education with emphasis on learning outcomes and competence development for engineering professions, organized by the University of Ljubljana (UL), which was held at Ljubljana in September 2019;
3. Teacher training seminar "*Deep Learning in a Classroom – Education, Research, and Industry Needs*", organized by the University of Banja Luka (UBL), which was held in Banja Luka in December 2019;
4. The workshop "*ICT Teaching Practice Training*", organized by the University of Osijek, which was held in February 2020;
5. Teacher training seminar "*Designing a Course for Stimulating Entrepreneurship in Higher Education*", organized by the University of Sarajevo, which was held in two parts due to the COVID-19 pandemic. The first part was organized as online event (webinar) in July 2020. The second part was held as the face-to-face seminar/practical workshop at Jahorina (Sarajevo) in September 2020.
6. Teacher training seminar "*Role of software in education, research and practice*", organized by University of Nis, which was held face-to-face for WB HEI from Serbia and online (due to the COVID-19 pandemic) for WB HEI from Bosnia and Herecegovina and other participating organizations in September 2020.

Also, within the framework of the Project BENEFIT, in the scope of WP6 activities, an additional traninig event "*Seminar on cloud computing research and teaching – collaboration tools in education*" was organized by University of Belgrade and CISCO on March 13th 2019. The lectures were held by Aleksandar Vulović, from Cisco Srbija, who gave lectures on several topics: "*Challenges in modern education and research*", „*Use of online collaboration tools in education*" and "*Practical case studies*". In total, there where 34 participants of this training event (29 teacher staff members of which 25 from WB HEI), of which 8 participants from UB (5 teacher staff members and 3 students) attended seminar in person (in Cisco office Belgrade, Serbia), while 24 participants (2 from UNI-KLU, 1 form UL, 1 from FERIT, 5 from UBL, 3 from UNSA, 3 from UNTZ, 5 from UNS and 4 from UNI) attended this seminar on line (using Cisco webex session whic was open for the event).

The overall result of the task **T4.5** activities that were reached through the implementation of the project BENEFIT are documented with the separate reports on the each of the implemented teacher staff trainings. This deliverable (report) presents the main information about the implemented training workshops and seminars. These teacher staff trainings were held in order to enable teachers

from six WB HEI to acquire needed skills and competences for the succesfull implementation of modernized study programs in telecommunication engineering, which were modernized in the scope of project BENEFIT in order to meet modern society and industry needs. Also, the implemented teacher trainings are designed to support the exchange and transfer of knowledge between WB HEI and other participating HEI and organizations regarding the teaching practice and methodologies, as a suitable approach for building new teaching skills and competences.

2. Objectives of the Deliverable

The main objective of the deliverable is to report on realized teacher staff training implemented in the scope of the project BENEFIT. These teacher staff trainings are recognized as a basis for teachers to acquire needed skills and competences for the sucesfull modernization and implementation of study programs at involved WB HEI, which is one of the main goal of the project BENEFIT. Therefore, the main topics of these teacher trainings were directed on:

- ICT teaching tools and lab operations,
- modern prototyping tools,
- the new developing technology areas,
- the effective teaching and training methodologies,
- as well as on the pedagogical area.

This deliverable provides a short description of six teaching staff training workshops and seminars that were organized through the project BENEFIT implementation, thus including the description of training topics and the overview of the training materials developed and relised to the participants during the teacher trainings. Also, the deliverable lists the main quantitative indicators of these teacher staff trainings, i.e. the number of participants from WB HEI and other participating universities, as well as the general assements of the participants on the quality of the implemented training events (which was acquired through the post-training questionnaires).

3. Overview of the implemented teacher staff training

In this section a short overview was presented for the each of the six teaching staff training workshops and seminars, including the training topics and materials, the number of participants from the participating universities, and the general conclusions regarding participants (teaching staff members that attendeed each of the training events) assements on these training events.

Notice: The more detailed overview and analysis on this matter should be given in the deliverable **D4.5 - Surveys and reports on training/internships**), while only the general conclusions are given here based on the participants answers on several general questions included in the questionnaires submitted after the training events, such as:

(1) Opinion on the general organization and facilities exploited during the event,
(2) To which extent did the event cover the announced title,
(3) Opinion onthe presenters/facilitators,
(4) The level of quality of presentations given by speakers
(5) To what extent did the event cover attendee professional needs,
(6) Opinion of the material that was distributed before or during the event,
(7) The evaluation on the agenda of the event,
(8) The evaluation of the technical resources used,
(9) The satisfiaction regarding the level of participation to the event proceedings,

(10) The satisfaction regarding the communication for preparation of the event, and

(11) The fullfilmet of the meeting targets.

3.1. Training workshop at University of Klagenfurt – July 2019

The professional training workshop, organized by the University of Klagenfurt (UNI-KLU), was held in Klagenfurt on the July 10th and 11th 2019 (M22), see Figure 3.1. This teacher training workshop was devoted to the joint training activities in the framework of the ERASMUS+ projects BENEFIT and SGT-MAP. The total number of participants (attenedees) at this training was 42 teacher staff members from the nine universities that participate in the project BENEFIT (the participants of project SGT-MAP were not included in this number), see details in Table 3.1.

Table 3.1 – The number of the project BENEFIT participants at training workshop held in Klagenfurt (UNI-KLU) in July 2019.

University	UNI-KLU	UL	FERIT	UBL	UNSA	UNTZ	UB	UNS	UNI
Number of participants	6	2	2	6	6	5	5	5	5
Total number of participants								42	
Total number of participants from WB HEI								32	

The training topics of this two-day professional training workshop were:

- **The first day**. Mr. R. Susini from National Instruments, company that produces automated test equipment and virtual instrumentation software, held a presentation on the data acquisition with hardware. The software and hardware developed by Nation Instruments such as NI-CompactRIO and LabView were also presented. A hands on lecture was offered to all of the participants, which enabled them to practice on National Instruments USRPs and LabView. These presentations and trainings were done in collaboration with company YottaVolt.

- **The second day.** Three sessions were realized devoted to the different research and teaching topics: IoT and 5G (prof. G. Gardašević from UBL presented a lecture ”*Experimental IoT Testbed for Testing the 6TiSCH and RPL Coexistence - Modernized teaching/research methodology implemented at UNI BL*” and prof. M. M. Elmesalawy from Uni. of Helwan presented “*Software Defined Radio for 5G Testbed Deployment*”), Research and teaching in ICT courses (prof. D. Ćirić from UNI presented a lecture ”*Audio signal based machine learning applications in smart houses and industrial monitoring*”, prof. A. Tonello from UNI-KLU presented a lecture “*Prototyping Tools for Radio and Power Line Communication*”, prof. M. Y. ElNainay from Uni. Of Alexandria presented a lecture “*CRC: Collaborative Research and Teaching Testbed for Wireless Communications and Networks*”, prof. A. Nešković from UB lectured on “*Research, Teaching and Applied/Commercial Activities in the Field of Radio Communications*”, prof. N. Doncov from UNI presented a lecture “*Specialized Teaching and Research Tools for Experimental Applications in Signal Processing and Microwave Engineering*”, prof. V. Križanović from FERIT held presentation on “*Teaching and Research Activities at Department of Communications at FERIT*”, prof. M. Mehic from UNSA presented “*Overview of Radio and SDN Laboratories*”, prof. N. Suljanović from UNTZ presented “*Enhancement of Telecommunication Studies at University of Tuzla Utilizing Joint Laboratory Resources*”, prof. M. Zajc from UL held presentation “*Overview of education activities and selected research activities at ICT department*”, and prof. M. Narandžić from UNS presented a topic “*BENEFIT extension of UNS experimentation*”), and Smart Grids (prof. N. Galal from Arab Academy

for Science, Technology & Maritime Transport presented a lecture "*Artificial Intelligence in Smart Grids*").

Figure 3.1 – Pictures of the participants of the joint training activities in the framework of the ERASMUS+ projects BENEFIT and the SGT-MAP project, held in Klagenfurt (UNI-KLU) in July 2019.

The complete training materials (for all the presentations and lectures held at this training workshop) were released during and after the workshop, and are available to all the participants of the project BENEFIT through the project collaboration platform. After the event certificates of attendance of the workshop have been delivered to all the participants.

Feedback from the participants acquired through the means of the post-training questionnaire is very positive on all previously listed questions, which indicates that the training of this kind was very well accepted by the university teaching staff members.

3.2. Training worskhop at University of Ljubljana – September 2019

The training workshop on the new teaching methodologies and instructional approaches in ICT engineering education with emphasis on learning outcomes and competence development for engineering profession, organized by the University of Ljubljana (UL), was held in Ljubljana on the September 25th and 26th 2019 (M24), see Figure 3.2. The total number of participants at this training workshop was 34 teacher staff members from the all nine universities that participate in the project BENEFIT, see details in Table 3.2.

Table 3.2 – The number of the project BENEFIT participants at training workshop held in Ljubljana (UL) in September 2019.

University	UNI-KLU	UL	FERIT	UBL	UNSA	UNTZ	UB	UNS	UNI
Number of participants	3	5	2	4	2	4	5	4	5
Total number of participants									34
Total number of participants from WB HEI									24

Figure 3.2 – Pictures of the participants of the workshop held in Ljubljana (UL) in September 2019.

An intensive two day program included higher education experts: Klara Skubic Ermenc, Marija Božić, Judita Peterlin, Marko Radovan, Borut Mikulec, Nina Vombergar and the members of the BENEFIT team. The workshop contributors and participants were educators of ICT and telecommunication departments of: University of Belgrade (UB), University of Novi Sad (UNS), University of Niš (UNI),

University of Tuzla (UNTZ), University of Banja Luka (UBL), University of Sarajevo (UNSA), University of Osijek (FERIT), University of Klagenfurt (UNI-KLU) and University of Ljubljana (UL). The workshop activities were interactive, and it was crucial for sucesfull implementation of this training event that all HEIs prepare input materials - which was done by all BENEFIT partners.

The topics covered during this training workshop were:

- **The first day**. The first segment consisted of four lectures related to the teachnig metodologies (M. Zajc from UL lectured on *"Introduction to Teaching methodologies in ICT engineering"*, A. Mujičić from UNTZ lectured on *„Modernization of study programs"*, V. Delić from UNS lectured *"Modernization of teaching methodologies"*, and M. Božić from Serbia lectured on *"New instructional approaches in engineering education"*). The second segment was specific *Workshop on teaching entrepreneurship* that consisted of several parts and presented the main activities, conclusions, and results of Erasmus+ project BLUES (N. Vombergar from UL presented topic *"Introduction to Erasmus+ project BLUES"*, M. Radovan from UL lectured on *"Blended learning"*, and J. Peterlin from UL presented a lecture *"BLUES methodology"*).

- **The second day.** A *Workshop on learning outcomes* was held by K. Skubic Ermenc and B. Mikulec form UL consisting of two parts: The Part I (*Approaches to curriculum planning, Competencies vs. learning outcomes, Learning outcomes in the Framework for Qualifications of the European Higher Education Area*, and *Principles of forming learning outcomes*), and the Part II (*Analysis of selected syllabi*, *Writing learning outcomes* and *Panel Discussion*). The final lecture *"Competence development for engineering profession: what and how do we teach?"* was given by M. Božić.

The complete training materials (for all presentations and lectures held at this workshop) have been released during the workshop to the participants of the project BENEFIT team. After the event certificates of attendance of the workshop have been delivered to all the participants.

Feedback from the participants acquired through the means of the post-training questionnaire is very positive, indicating that such trainings are well accepted by the academic teaching staff.

3.3.   Teacher training seminar at University of Banja Luka – December 2019

The teacher training seminar "Deep Learning in a Classroom – Education, Research, and Industry Needs", organized by the University of Banja Luka (UBL), was held in Banja Luka on the December 19th to 21st 2019 (M26), see Figure 3.3. The total number of participants (attenedees) at this training workshop was 52 including students from UBL (that attended the second day of the training event), of which 32 teacher staff members from the nine universities that participate in the project BENEFIT, see details in Table 3.3.

Table 3.3 – The number of the project BENEFIT participants at teacher training seminar held in Banja Luka (UBL) in December 2019.

University	UNI-KLU	UL	FERIT	UBL	UNSA	UNTZ	UB	UNS	UNI
Number of participants	0	0	1	8	3	5	4	6	5
Total number of participants								32	
Total number of participants from WB HEI								31	

This training seminar brought together project BENEFIT partners FERIT, UB, UNS, UNI, UNSA, UNTZ and UBL, while the lecturers were from the Imperial College at London, United Kingdom, and the University of Banja Luka. Besides academia, the industry representatives from Croatia and Bosnia and Herzegovina presented topics related to the industry needs in modern technologies, including machine learning technologies, applications and solutions. The second day of the seminar was open to students.

Figure 3.3 – Pictures of the participants of teacher training seminar held in Banja Luka (UBL) in December 2019.

The training topics were mostly related to the artificial intelligence (AI) and machine learning (ML) technologies in education and research, as well as on industry needs in this area. The training activities at this workshop lasted for two days, and the given lectures and training sessions included:

- **The first day**. V. Risojevic from UBL presented a lecture "*Machine learning in multimedia systems teaching*", M. Cvetković from UBL presented "*Erasmus+ project Vitalising ICT Relevance in Agriculture Learning – VIRAL presentation*", S. Dušanić form UBL presented a lecture "*Interactive teaching techniques*", Z. Babić from UBL and N. Kezić, from HCR CTRO, Croatia, presented a research "*Deep learning research: Biological Method (Bees) for Explosive Detection project*

presentation", while Z. Gajić and V. Lekić from company HOLOSCOPE held a presentation "*WB industry needs in machine learning"*.

- **The second day.** D. Mandić from the Imperial College in London presented a lecture on teaching machine learning and signal processing as the introduction of student to innovations "*Innovation starts with education: Bringing research into the curriculum"*, while the company AlfaNum from Novi Sad presented their experience in the ML research and application, and the collaboration with the university partners in that field, i.e. the lecture "*Speech technology progress based on advanced signal processing and AI-ML paradigm - Experience in collaboration with university partners"*.

The complete training materials (for all presentations and lectures held at this workshop) were released during the workshop to the participants of the project BENEFIT team.

Also, the assesments of the training event participants acquired through post-training questionnaires were extreamly positive, which lead to the conclusion that the agenda (i.e. covered training event topics), training session organization and implementation, as well as the training materials and presenters (trainers) have been broadly accepted by the participating teaching staff.

3.4. Training workshop at University of Osijek – February 2020

The training workshop "ICT Teaching Practices", organized by the University of Osijek (FERIT), was held in Osijek on the Februaty 12nd and 13th 2020 (M28), see Figure 3.4. The total number of participants at this training workshop was 33 teacher staff members from the universities that participate in the project BENEFIT, see details in Table 3.4.

Table 3.4 – The number of the project BENEFIT participants at training workshop held in Osijek (FERIT) in February 2020.

University	UNI-KLU	UL	FERIT	UBL	UNSA	UNTZ	UB	UNS	UNI
Number of participants	2	2	6	3	5	5	5	0	5
Total number of participants									33
Total number of participants from WB HEI									23

The training topics were related to the application of MikroTik router boards in the scope of the university teaching, coupled with the hand-on approach, the role of ICT in the automotive industry with the specific insight on training practices related to the image processing (i.e the research, development and implementation on embedded platforms). The specific training activities at this workshop lasted for two days, and the given lectures and training sessions included:

- **The first day**. K. Grgić from FERIT held a training session on MikroTik router board in university teaching and internetworking, as well as hand-on approach on building a local network with the MikroTik boards. After that, there was an open discussion about the training sessions.

- **The second day.** M. Vranješ from FERIT held a training related to ICT in the automotive industry and university roles in creating the healthy business environment. M. Vranješ and D. Vajak from FERIT held training on the topic "*ICT Teaching Practices – ADAS Algorithms Based on Image Processing – Development and Implementation on Embedded Platform"*. Finally, I. Lukić and Z.

Krpić from FERIT held a presentation related to the some of current results of the project BENEFIT *"BENEFIT e-platforms for engineering education"*.

The complete training materials (for all presentations and lectures held at this training workshop) have been released during and after the workshop and are available to all the participants of the project BENEFIT through the project collaboration platform.

Feedback from the participants acquired through the means of the post-training questionnaire is very positive, indicating that this type of training was interesting, suitable and needed by the teaching staff members of the participating universities.

Figure 3.4 – Pictures of the participants of the workshop held in Osijek (FERIT) in February 2020.

3.5. Teacher training seminar at University of Sarajevo – July 2020 and September 2020

The teacher training seminar "Designing a Course for Stimulating Entrepreneurship in Higher Education", organized by the University of Sarajevo (UNSA), was held in two parts:

- The first part was held as the two-day online training session due to the COVID-19 pandemic, realized on the July 15th and 16st 2019 (M32), and was hosted by the University of Sarajevo (UNSA). The total number of participants at this training seminar was 50, of which 49 participants were from the universities that participate in the project BENEFIT, see details in Table 3.5.

- The second part (the practical part) was held as a follow-up face-to-face seminar (with exercises) at Jahorina on the September 23rd to 25th 2020 (M36), see Figure 3.5. The total number of

participants from the universities located in Bosnia and Hercegovina (UNTZ, UBL and UNSA) that participate in the project BENEFIT at this part of the teacher training seminar was 19, see details in Table 3.5.

The first part of teacher training seminar, which was held online in July 2020, has been dedicated to didactics and the teaching product development within engineering courses (based on experiences in collaboration of industry and university). This part of the training included several topics:

- **The first day**. M. Zukić from UNSA (Department of Pedagogy) presented a lecture "*Teaching for Entrepreneurial Competences*"). The main idea of this lecture was that entrepreneurship is quite often considered only in the narrow, commercial form, but that it could also be social, public and corporate. The latest form is focused on internal innovation, endeavor and strategic renewal what is all important for a modern engineer. Since the specific competences and skills demands specific assessment approaches, the training was focused on elaboration on the constructive alignment between competences-teaching-assessment. Assessment tool Rubrics was explained, and several Classroom Assessment Techniques were demonstrated.
- **The second day.** N. Borovina, the external speaker from company BH Telecom, presented a lecture "*Teaching Product Development within Engineering Courses*". This particular training session was based on experiences in collaboration within the course Human Computer Interaction using the Product Market Fit canvas at UNSA (this course is part od modernized curricula in scope of the project BENEFIT).

Figure 3.5 – Picture of the participants of the second part of the teacher training seminar (practical part - exercises) held at Jahorina (hosted by UNSA) in September 2020.

This teacher training seminar is extended with practical part (second part of seminar held at Jahorina in September 2020), i.e. the exercises related to the creation of Rubrics as assessment tool, and teaching Product-Market-Fit canvas for designing engineering solutions in a form of a product

fulfilling the needs of the future user. The first day of the second part of the seminar was devoted to the exercises in didactics, lectured by D. Bošković from UNSA on topic "*Teaching for Entrepreneurial Competences*". The presenter at the second day of second part of the seminar were A. Nikolić from UNSA (Vice-rector), who is agro-economist. She conducted the exercises linked to the Teaching Product Development within Engineering Courses.

Feedback from the participants acquired through the means of the post-training questionnaire is very positive, indicating that such trainings are well accepted by the academic teaching staff.

Table 3.5 – The number of the project BENEFIT participants at teacher training seminars held online (hosted by UNSA) in July 2020 and face-to-face seminar at Jahorina in September 2020.

University	UNI-KLU	UL	FERIT	UBL	UNSA	UNTZ	UB	UNS	UNI
Number of participants of online part in July 2020	0	0	1	9	12	8	7	9	4
Number of participants of face-to-face part in September 2020	0	0	0	6	6	7	0	0	0
Total number of participants – online part in July 2020								50	
Total number of participants – face-to-face (exercise) part in September 2020								19	
Total number of participants from WB HEI								49	

3.6. Teacher training seminar at University of Niš – September 2020

The teacher training seminar "*Role of software in education, research and practice*", organized by the University of Niš (UNI), was held in Niš on the September 7th to 8th 2020 (M35), see Figure 3.3. This training seminar was held as a face-to-face meeting for the teaching staff participant from WB HEI located in Serbia (the total number od 32 participants were present at UNI), while the attendees from the other participating universities (other countries), due to the COVID-19 pandemic, joined the training seminar through hosted online session (the total number of online participants was 34). The total number of participants at this training seminar (i.e. those present at UNI and those connected online) was 57, of which 53 were the teacher staff members from the universities that participate in the project BENEFIT, see details in Table 3.6.

Table 3.6 – The number of the project BENEFIT participants at teacher training seminars held online (hosted by UNSA) in July 2020 and face-to-face seminar at Jahorina in September 2020.

University	UNI-KLU	UL	FERIT	UBL	UNSA	UNTZ	UB	UNS	UNI
Number of participants present at UNI	0	0	0	0	0	0	7	11	14
Total number of participants present at UNI								32	
Number of participants connected on-line	4	0	0	7	3	9	0	0	2
Total number of participants connected online								25	
Total number of participants								57	
Total number of participants from WB HEI								53	

The first day, seminar was devoted to software tools that have been developed at UNI - Faculty of Electronic Engineering (UNI-FEE) within the Telecommunication group and the tool that is applied in education and in company Pogled Telekomunikacije, a member of NiCAT cluster and UNI industrial partner on the project BENEFIT. The second day of this teacher training seminar, prof. B. Gerazov, the external speaker from Faculty of Electrical Engineering and Information Technologies at University of Skopje, Macedonia, held a presentation related to free software and Python programming language. Moreover, the participants had opportunity to visit Start-up center and Science technology park at UNI, and M2M communication laboratory at UNI-FEE that is partly equipped in the project BENEFIT.

Figure 3.6 – Pictures of the participants of the on site teacher training seminar at University of Niš (UNI) held in September 2020.

The two-days training sessions included several topics:

- **The first day**. Prof. V. Marković, Head of Department for Telecommunications at UNI-FEE, presented current experience at UNI regarding "*Online teaching during pandemic –Department of Telecommunication at FEE UNI experience*". After that, prof. N. Dončov from UNI presented a

lecture "*TLM method - tool for research and education in the field of microwaves*", prof. Z. Marinković form UNI and M. Ćirić from company Pogled Telecomunikacije (NiCAT member) presented a lectures "*Artificial neural network applications in RF and microwave communication systems: Education and research at fee-UNI*" and "*TeleCAD-GIS: Professional and educational use*".

- **The second day.** Prof. B. Gerazov, external presenter from Faculty of Electrical Engineering and Information Technologies at University of Skopje, Macedonia, presented a lectures "*Python and free software in higher education, science and engineering*", "*Introduction to Python for science and engineering, interactive demo session*", and "*Machine Learning in Python Tutorial, interactive demo session*".

The training materials (for all presentations and lectures held at this training workshop) were made available after the training seminar, and are available to all the participants of the project BENEFIT through the project collaboration platform.

The general assesment on this training event, aquired through the participants feedback collected through the post-training questionnaires, gave very positive results. Thus, despite the complex seminar organization (due the pandemic restrictions) and the fact that many of the participants and some presenters were connected online, the training seminar is assesed as the interesting, suitable and meaningfull by the teaching staff members of the participating universities.

4. Conclusions

The final goals of the task "Implement **teacher staff training** on ICT teaching tools and lab operations and modern prototyping tools" are the implementation of six teacher staff trainings with the relevant topics and presenters/trainers. In total, all planned six teacher staff trainings were organized:

- The professional training workshop organized by the UNI-KLU (in July 2019), on the remote lab tools (data acquisition with hardware, presentation of the software and hardware developed by Nation Instruments, and hands on lecture with practice on National Instruments USRPs and LabView), as well as on different topics in the filed of IoT and 5G, research and teaching in ICT courses, and smart grids. The training event had 42 participants (32 from WB HEI).
- The teacher training workshop organized by UL (in September 2019) on advanced teaching methods, i.e. the new teaching methodologies and instructional approaches in ICT engineering education with emphasis on learning outcomes and competence development for engineering professions. The training event had 34 participants (24 from WB HEI);
- The teacher training seminar, organized by the UBL (in December 2019), on artificial intelligence (AI) and machine learning (ML) technologies in education and research, as well as on industry needs in this area. The training event had 32 participants (31 from WB HEI);
- The teacher training workshop organized by FERIT (in February 2020), on ICT-based teaching practices, specifically to the application of MikroTik router boards in the scope of the university teaching, and the role of ICT in the automotive industry with the specific insight on training practices related to the image processing. The training event had 33 participants (23 from WB HEI);
- The teacher training seminar, organized by the UNSA (in July and September 2020), on didactics and the teaching product development within engineering courses (based on the experiences in collaboration of industry and university). The training event had 50 participants (49 from WB HEI). The training event was organized in two part due to the COVID/19 pandemic, the first part as online training and the second part (with only 19 participants) as the face-to-face practical training.
- The teacher training seminar, organized by the UNI (in July 2020), on ICT software tools, and the tools applied in education and industry, as well as on free software and Python programming

language in education and practice. The training event had 57 participants (53 from WB HEI). The training event was organized partly as the face-to-face meeting (for participants from Serbia), and partly as the online event (for participants from other counries).

In total, the offered training sessions were attended by total od 248 teaching staff members from the universities that are participating in the project BENEFIT, of which 212 teaching staff members from WB HEI, which is more than a planned total of 200 teaching staff members (it should be noted that the one teaching staff member may be exposed to several training modules).

The appropriate training and supplemental materials were prepared and distributed during the training events, with the most of these being constantly available to the teaching staff of all the participating universities and organizations. Also, assesment on all implemented training events that was aquired through the participants answers collected through the post-training questionnaires, gave a predominantly positive results regarding different aspects of the organized training sessions. Thus, despite the complex organization of several teaching training modules (due to the COVID-19 pandemic in 2020), and the fact that many of the participants and some presenters in some events were connected online, the training events are assesed by the attended teaching staff member as the interesting, relevant, well organized and suitable to set goals.

The project BENEFIT recognized continuous training of teaching staff as an important prerequisite, a basis for teachers to acquire needed skills and competences, for the successful implementation of modernized study programs in telecommunication engineering, [1]. Thus, the project BENEFIT set a goal to offer and implement the teacher staff training on: ICT teaching tools and lab operations, modern prototyping tools, the new developing technology areas, the effective teaching and training methodologies, as well as on the pedagogical area, to teachers of all participating universities. The all planned teacher training modules were implemented.

This deliverable presents short description of all implemented teaching staff training workshops and seminars, including the description of training topics and materials, as well as the main numerical results of these teacher staff trainings and the general assements of the participants on the quality of the implemented training events.

5. References

[1]   BENEFIT project proposal, 2017.