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Title:	D6.4 Reports on graduates profile improvements and correspondence to industry needs
Lead Organization:	UC3M
Participating Organizations:	UC3M, UCU.
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Deliverable data	Work Package and Outcome ref.nr	WP6 D6.4
	Title	Reports on graduates profile improvements and correspondence to industry needs
	Type	☐ Teaching material ☐ Event ☐ Learning material ☒ Report ☐ Training material ☐ Service / Product
	Description	In this report, the QB will assess the impact of project actions on increased employability of the graduates and correspondence of the acquired skills with the job market requirements.
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Participating Organizations	UC3M, UCU.	
Task	T6.4 Monitor graduates profile, improvements in the skills, correspondence to industry needs	

Revision History				
Version	Date	Author(s)	Organization(s)	Brief description of change
1	28.11.2023	Nicole Imbert	UCU	Super draft. Chapters 1 and 2.
2	10.01.2024	Nicole Imbert, Lianet Méndez and M. Julia Fernández-Getino	UCU, UC3M	Chapters 3, 4, 5 and 6. Final revision.

Table of Contents

1. Introduction

In the following deliverable, **D6.4** "Reports on graduates profile improvements and correspondence to industry needs", the Quality Board (QB) will assess the impact of project actions on increased employability of the graduates and correspondence of the acquired skills with the job market requirements. This report takes part in the **WP6**: "Quality Control and Monitoring" which is led by UCM3.

The authors and contributors of the report are Universidad Católica del Uruguay (UCU) and Universidad Carlos III de Madrid (UC3M).

Other deliverables within WP6 related to this report are listed below:

- D6.5 Report on tools for monitoring student enrolment and employability/employment/entrepreneurial statistics of graduates.
- D6.6 Reports on stakeholders reached beyond the project consortium.

2. Objectives

The purpose of quality control and monitoring (QCM) is to ensure the recollection of data and evaluation of the project‘s activity progress. The assessment will focus on the following items:

- Offered new courses, and improved teaching and lab facilities.
- Training of teaching staff.
- Student feedback.
- Achievement of objectives.
- Impact of the project at the single universities and regional/national level.

The external assessment members will be asked to verify the content of the QCM reports and to give recommendations on areas that could be further developed and improved. Indicators will consider report analyses, surveys, and questionnaires.

This report will be particularly focused on the correlation between the acquired skills on IoT and the job market requirements focusing on seeking career development and improvement of employability. Most of the analysis that is made within this report was gathered through surveys on deliverable D6.5: “Report on tools for monitoring student enrolment and employability/employment/entrepreneurial statistics of graduates”.

This report collects all NEON activities that have contributed to influencing and improving the profiles of graduates on IoT topics, and analyses their impact and outcomes. Surveys will continue beyond the lifetime of the project to collect further data and monitor the fulfilment of NEON's objectives.

3. Job Market Requirements

A survey was designed to set market needs in the IoT industry (see report D6.5). This survey is aimed at employers, and it was designed to assess the needs of companies related to IoT in the industry, specifically the needs that are required in this area.

It was specifically designed to gather information about the skills and knowledge regarding IoT that are required in the industry. Participants will be prompted to identify the company's areas of strength in IoT competencies for designing and implementing IoT projects, as well as the IoT domains they consider essential for their company activities.

Subsequently, the focus of the survey will shift to IoT courses. Participants will be asked to share their opinions on whether the company employees have sufficient practical skills in IoT topics, and whether they had the opportunity to work on IoT projects or courses related to a specific industry area (such as agro-industry, medical industry, smart grids, etc) in the company. Lastly, they will be requested to indicate the essential topics that should be covered in an IoT course, and whether they are interested in further enhancing employees' IoT competencies by pursuing additional relevant courses.

This questionnaire should conclude on the skills that are required to work on projects related to IoT. These results could be used to develop academic material such as specific courses aiming at graduates to reach these industry requirements.

4. Employability of the Graduates

Another survey was designed to gather data on employability and graduates' profiles (see report D6.5). This survey aimed to evaluate the needs of graduates about IoT based on their experiences in the industry. For this purpose, an in-depth analysis of the abilities and knowledge that graduates acquired during their studies on the topic was conducted.

Initially, the participants were requested to provide details concerning their academic background. Subsequently, they were required to describe their present professional engagements, and specifically, whether they have been involved in any activities related to the IoT. In such instances, the respondents will be requested to assess their competencies in IoT before taking the said activities, and also, after having gained experience. The participants will indicate whether their university provided them with knowledge about IoT and in which academic degree occurred. Finally, they will be requested to indicate their willingness to work in the field of IoT, and whether they are inclined to further enhance their IoT competencies through the pursuit of relevant courses.

From this questionnaire, it was concluded that 44% of participants had experience in the IoT industry. Most of the respondents reported having an average level of ability in the areas of digital competencies in IoT, innovation management, and the capacity to anticipate future trends. However, regarding project management skills, a greater number of participants indicated a lack of ability in this area before their involvement in the IoT industry.

Furthermore, they were asked about the areas in which they needed to enhance their skills in IoT. The results showed that every topic is a must to develop IoT competencies, but certain topics were highlighted as more crucial for the participants. These included security, distributed architecture, operating systems for embedded systems, data analysis, as well as communication, networks, and protocols.

Additionally, respondents were free to declare which specific areas they had lack of capacities, and the most repeated topics were the development of new technologies applying security practices, training in technologies (such as LTE-M, LoRa or 5G), communication protocols for IoT, software development and data management.

Afterwards, 83.3% of participants showed to have interest in working in the IoT industry and enhancing their IoT competencies through the pursuit of certain courses.

In summary, the results above showed that less than the half of participants had experience working on IoT, probably most of them not directly working on IoT companies but in specific projects related to the area. This determines what kind of jobs and expertise the graduates have and helps as an input to better correlate industry needs with graduates' skills. Even though there are topics already known by graduates, it is noticed from the results that there is still a huge gap between what the industry needs or will need in the near future and the competences that students acquired during their studies. Contributing to minimizing this gap is part of the purpose of the actions that the project proposed within its duration.

For this reason, the NEON project has focused on organising activities (courses, labs, hackathons, workshops, etc.) aimed at improving graduate profiles in a way that minimises the gap between industry needs and students' competences. The following section in this report (Section 5) is dedicated to analysing these activities and their impact.

5. Impact of Project Actions

5.1. Project Activities and IoT Topics

Several activities were carried out within the project duration aiming to enhance improving IoT skills, specifically for students, graduates and employees who were currently facing IoT projects. The main activities of the project that have an impact on the graduates' profile are gathered in Table 5.1, along with their corresponding reports, which contain detailed information about the impact of the activities. Additionally, the table gathers the main IoT topics covered by each event.

Table 5.1: Events and their corresponding report

Event	Organizer	Date	Report	IoT Topics
Hackathon	UCU	Oct. 2022	D5.3	The students had to find a technical and economic solution to problems about: Water Quality, Forest Industry, Livestock Industry and Rice Industry. Some proposed solutions: • Control and maintenance of drinkers remotely and with low supervision. • Detection system for possible sources of fire, with historical data dashboards and immediate notification by email. • Implement a strategy to mitigate the pollution problem and validate it through a study by affected sectors. • Livestock control by GPS. • Monitoring of watercourses in real time. • Intelligent dosing system for herbicide spraying machines using Artificial Intelligence technology, applied in the forestry industry in the pre-sowing stage.
Workshop in Klagenfurt, Austria: Workshop on teaching methodologies for IoT.	UNI-KLU	May 2022	D5.5	• Didactical Aspects and Teaching IoT. • Industrial IoT and Fog Computing Support of Digital Twins. • NEON Working Groups to discuss Ideas, Proposals, Issues faced & Solutions arising in the areas of Teaching, Student Engagement, Internships and Labs & Continuous Education. • General information about by the IoT recent technologies and market. • RADAR, Time-of-Flight (ToF), CO2 sensors used in IoT applications. • Mobile robotics. • Infineon facilities tour.
Workshop in Madrid, Spain: Workshop on communication technologies for IoT	UC3M	Nov. 2022	D5.5	• IoT via 5G and Beyond 5G Satellite Systems • Ultra-Reliable and Low Latency Communication (URLLC) for 5G, IoT, Time Sensitive networking and V2X communication • Visit to the Nokia facilities in Madrid. • AI based Machine-to-Machine Communications in 6G
Workshop in Montevideo, Uruguay: Workshop on IoT technologies for agriculture market	UdelaR	Jun. 2023	D5.5	• IoT in Agriculture: Creating Access and Opportunity. • Why IoT is set to revolutionize the livestock grazing industries? • Discussion panel devoted to the demand perspective was done, integrating members from Uruguayan agriculture research and professional environments. • Industry panel. • Agricultural Internet of Things: From Low -data-rate Underground Sensing to High-data-rate Autonomous Operations to Grow More Crop for Drop.

First Webinar on IoT in Universities	UNC	Dec. 2021	D7.5	• What is IoT, and why is it important for prospective engineers? • Academic offer related to IoT at NEON partner institutions
Second Webinar on Presentation of NEON	UdelaR	Apr. 2023	D7.5	• What is the proposal of the NEON project to strengthen the connection between the academy and local industries? • What is the value NEON project offers and how to become a member? • Success stories achieved at the two-year last of the Neon project (benefits of being a NEON member)
Third Webinar on IoT in Universities	UNMDP	Oct. 2023	D7.5	• Presentation of the material developed in the project that is accessible through a GitHub repository. • Courses and laboratories at Latino American (LA) NEON institutions • New practices in exponential organizations (from Incutex)
First NEON Open Event	UNMDP	Oct. 2021	D7.4_1	• Companies Panel discussion "How should training be to enter the IoT revolution? • Academics Panel discussion "How should training be to enter the IoT revolution?" • Cyberphysical and Internet-of-Things Systems: Educational and skill requirements
Second NEON Open Event	UCU	Oct. 2022	D7.4_2	• IoT opportunities in Uruguay • NEON project and summary of the actions taken so far. • Robots for the Agroindustry with IoT
Third NEON Open Event	UNS	Sep. 2023	D7.4_3	• Neural accelerators for low consumption portable systems • Connecting People and Devices Through Mixed Reality • Challenges in Circuits and Systems for IoT • Application of antenna technologies in the context of IoT • Experiences and learnings from the design and deployment of Atheling IoT system • Smart energy meters • A clean future: how IoT technology revolutionizes waste management • Meteorological station network: example of a successful public-private agreement • IoT as support for electronic payment in transportation and parking
Carintian EU-Project Day" (DE: 5. Kärntner EU-Projekte-Tag)	Europahaus Klagenfurt	Oct. 2023	Link to website post	• Presentation about NEON project. • IoT fundamentals.
Meeting IoT MDP-Tandil 2021 (virtual event)	UNMDP	Jul. 2021	Link to website post D7.4_1	• IoT products with Mesh technology. • Edge processing with mobile devices. • Agro-IoT. • Electronic engineering, electronic security, embedded hardware, software, and firmware. • Smart cities. • Industrial processes. • Domotics.

Modernization of IoT Courses	NEON LA Partners (WP3)	-	D3.4	Delivered NEON courses, each one related to a topic (some names in Spanish, in italics): • Antenna Design • Hands on IoT • Communication Systems based on Software Defined Radio • IoT in Agribusiness • *Fundamentos de Comunicacion* • *Diseño de IoT y Sistemas Embebidos* • *Fundamentos de Sistemas de Comunicaciones* • *Tecnologías celulares de IoT* • *Radio-localización y Radares* • *Sistemas de Comunicaciones Inalámbricas* • *Posicionamiento y Seguimiento* • *Informática* • *Dispositivos IoT* • *Conectividad y Protocolos IoT* • *Aplicaciones y Visualización en IoT* • *Redes de Sensores Inalámbricos* • *Tecnologías para la Internet de las Cosas* • *Diseño digital de bajo consumo* • *Sistemas Embebidos para Tiempo Real* • *Comunicaciones Digitales* • *Radios cognitivas definidas por software* • *Experimentando en un Laboratorio Remoto de Radio Definida por Software. Caso de Aplicación: Modulación LORA* • *Comunicaciones Inalámbricas* • *Hardware and Microwave Circuit design for IoT* • *Medios de Transmisión* • *Introducción a las Comunicaciones Digitales* • *Antenas*
Joint industry-academia labs	NEON LA Partners (WP4)	-	D4.2	• Signal Processing for Communications laboratory (UNS) – Modernized lab • Communications Technology applied to IoT (UNdMP) • Digital Communications Laboratory (UNC) • IoT for agribusiness Laboratory (UCU) • IoT Laboratory (UdelaR)

5.2. Impact of the Activities of the Project on the Graduate Profiles

The activities identified in Section 5.1, Table 5.1 were intended to improve and influence the profile of students about topics on IoT, in the context of project NEON. This section provides a brief analysis of the impact of every activity. The following bullets summarize the impact and satisfaction results from each activity of Table 5.1. For a more detailed analysis, refer to the associated reports indicated in the table.

- **Hackathon**: Regarding the organized hackathon at UCU, a total of 36 participants took part (between students and professors from universities participating in the NEON project). From these participants, 24 of them were students. The participants had the opportunity to listen to speeches by business-people who presented their work and posed problems for the students to work on. Later, the students worked in groups to find a technical-economic solution to the problem. The satisfaction results are shown in Fig. 5.1, where the students rate the event from 1 (worse) to 5 (best). The results show a good feedback from the students. In particular, the question "To what extent do you think the event helped you develop as a future engineer?"

was answered by 66.6% with a score of 5 (indicating maximum agreement), and the rest with a score of 4.

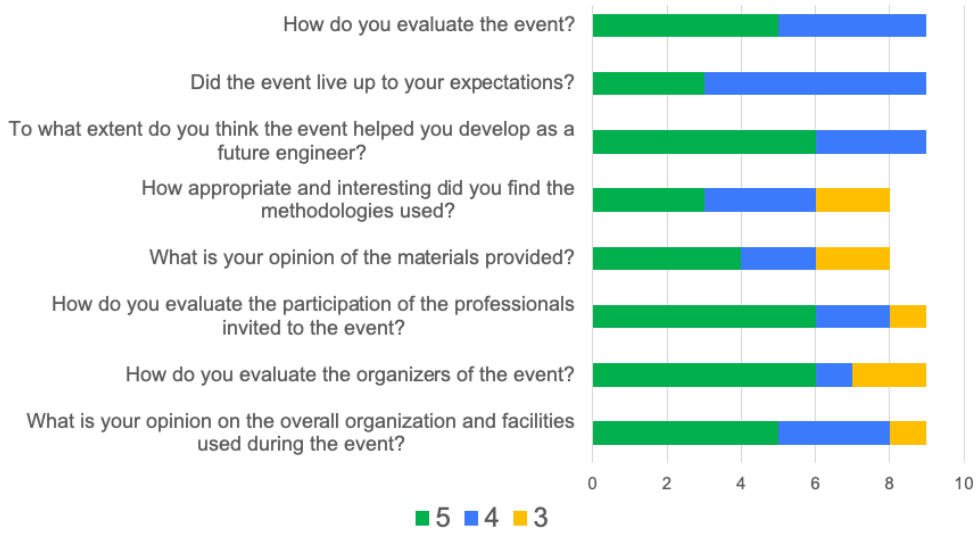

Fig. 5.1: Satisfaction survey results for the hackathon (D5.3).

- **Workshops**: The workshops were organized together with the NEON meetings in Klagenfurt (Austria), Madrid (Spain) and Montevideo (Uruguay). The first and second workshops were attended by 23 members of the NEON project, and the last by 27. In this case, the workshops focus on training NEON members from the participating institutions. The training of NEON staff is important to enrich the curriculum of the participants on IoT subjects and thus contribute to the development of the partner institutions on these topics. Definitely, reinforcing the training of the academia on IoT will result in improved graduate profiles on IoT capabilities. It also enables interaction between members of academia and industry. In this way, academic institutions can influence their IoT programs to meet the needs of industry. The results of the satisfaction surveys are shown in Figs. 5.2 – 5.4. They show a good level of participant satisfaction.

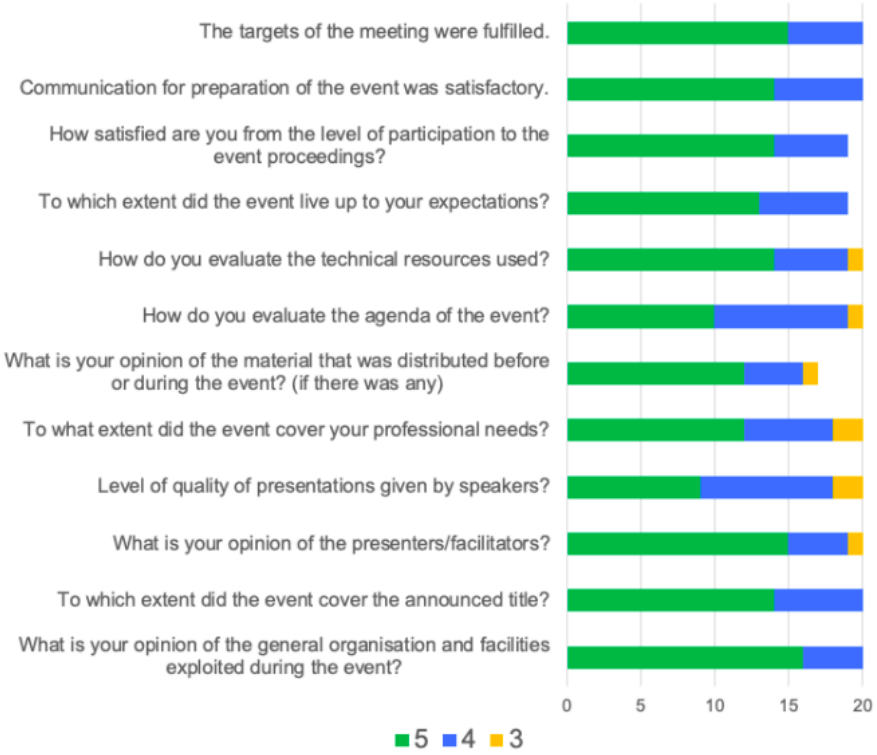

Fig. 5.2: Results of the evaluation survey for the Klagenfurt Meeting & Workshop May 2022 (D5.5).

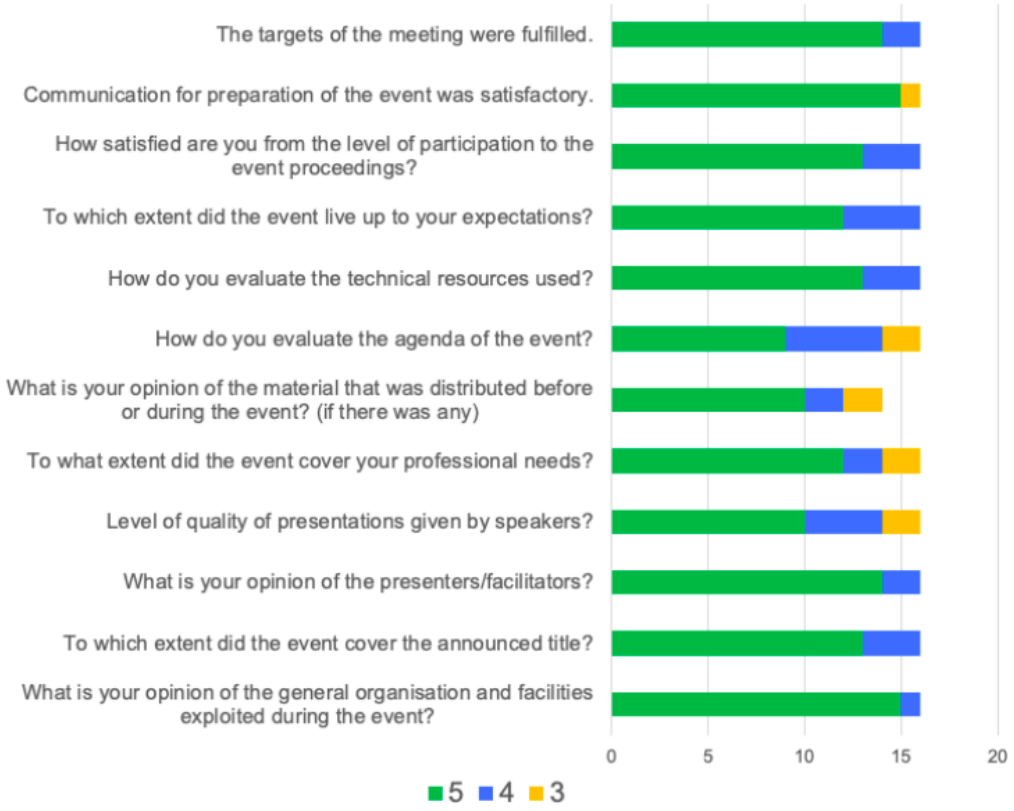

Fig. 5.3: Results of the evaluation survey for the Madrid Meeting & Workshop Nov. 2022 (D5.5).

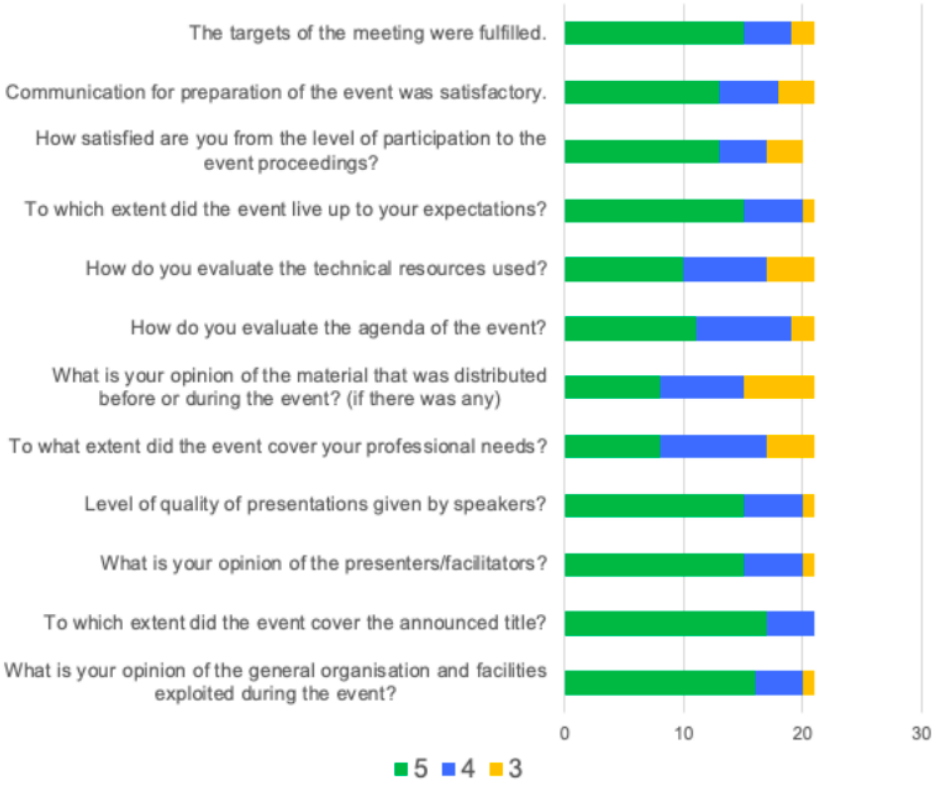

Fig. 5.4: Results of the evaluation survey for the Montevideo Workshop July 2023 (D5.5).

- **Webinars**: The webinars were key activities to present the project NEON to the students, introduce opportunities to learn on IoT and show the benefits of NEON and the network of competence. Sharing the knowledge on NEON outcomes with the students, specifically those related to the novel materials on IoT developed in the framework of the project, will contribute to improved graduate profiles.
    - For the first webinar, an email tracking tool was used to analyze the success of the webinar invitations. 176 email invitations were sent, of which more than 50% were successfully received. However, attendance was higher than expected with 133 participants (98% from Latino American (LA) countries). All these participants attended the presentations on several IoT course plans from NEON partner institutions.
    - The second webinar focused on presenting the structure of the NoC. There were 62 registered members at the event.
    - The third webinar was dedicated to the presentation of the courses developed or modernized in the NEON project. This helps to make new students aware of the newly developed NEON material. This time there were 15 participants.

- **Open Events**: One of the aims of the NEON project is to present and promote the main aspects of the project during open days at each university. This dissemination will have an impact on the graduate profiles, since the students will be aware of the new possibilities that NEON can offer them to improve their knowledge on IoT topic.
    - Regarding the first open event, it was mainly intended for students, industry and society at large, along with other stakeholders such as the Chambers of Commerce, from Argentina, Uruguay, Spain and Austria. It was virtual. There were 180 participants, 30.5% from companies, 62.5% from universities and 7% of unknown origin. From these registrations, the participants voted on their knowledge of IoT: 48%

voted that they already knew about IoT, 40% voted superficially, and 6% had no knowledge.

- The second open event was face-to-face. There were 72 inscriptions, with 20% from companies and 80% from universities.
- The third open event was offered in both face-to-face and virtual modalities. This time the registration had two versions, one in English and another in Spanish, with 21 and 82 responses respectively (103 participants). There were two sessions: morning and evening. From the registration in English, most of the audience had an academic background, they mostly preferred to attend the afternoon talks and came not only from Argentina but also from other LA countries. From the registration in Spanish, most of the audience was local, they had a broad educational profile (students, professionals and a smaller number of academics) and in terms of participation, the preference was virtual (almost 60% in the morning and afternoon). The surveys show satisfactory results from the participants in the face-to-face format, with an overall punctuation between 4-5 out of 5.

- **Courses**: Regarding the courses, deliverable D3.4 contains a detailed analysis about the modernized and created courses in the context of NEON project by the LA partners. These courses are the core elements to shape the profiles on IoT of the graduate students. A brief summary is presented here. Table I shows the results of each course that was delivered, including the number of deliveries, the total number of hours, the number of students, the number of academic programs associated with the course, and the number of teachers involved in its delivery. A total of 27 courses were proposed to be delivered using the developed materials. The delivery period was during the project timeline (2021-2023), resulting in a total of 47 deliveries that reached 1037 students distributed in 5 universities (UCU, UDELAR, UNC, UNMDP, UNS). The impact of different teaching methodologies adopted in the courses is illustrated in Fig. 5.5, giving an overview of the satisfaction with the delivery of each course. As an example, satisfaction surveys of some of the courses are shown in Fig. 5.6 and 5.7.

Table I: NEON Courses (D3.4)

#	Course	Deliveries	Hours	Programs	Students	Teachers
1	Antenna Design	2	150	3	19	3
2	Hands on IoT	2	120	2	61	4
3	Communication Systems based on Software Defined Radio	1	96	2	4	3
4	IoT in Agribusiness	2	200	5	27	9
5	Fundamentos de Comunicacion	2	300	3	28	1
6	Diseño de IoT y Sistemas Embebidos	1	200	3	11	3
7	Fundamentos de Sistemas de Comunicaciones	1	120	1	15	3
8	Tecnologías celulares de IoT	3	240	2	12	3
9	Radio-localización y Radares	2	240	2	5	1

10	Sistemas de Comunicaciones Inalámbricas	1	80	2	5	1
11	Posicionamiento y Seguimiento	1	80	2	8	1
12	Informática	1	126	8	118	1
13	Dispositivos IoT	1	20	0	231	7
14	Conectividad y Protocolos IoT	1	20	0	81	7
15	Aplicaciones y Visualización en IoT	1	20	0	64	7
16	Redes de Sensores Inalámbricos	5	600	4	55	5
17	Tecnologías para la Internet de las Cosas	2	180	4	8	5
18	Diseño digital de bajo consumo	2	240	5	4	8
19	Sistemas Embebidos para Tiempo Real	6	450	6	121	8
20	Comunicaciones Digitales	2	188	5	110	3
21	Radios cognitivas definidas por software	3	204	6	11	3
22	Experimentando en un Laboratorio Remoto de Radio Definida por Software. Caso de Aplicación: Modulación LORA	1	20	3	6	2
23	Comunicaciones Inalámbricas	2	240	2	8	2
24	Hardware and Microwave Circuit design for IoT	1	72	1	10	2
25	Medios de Transmisión	1	200	1	15	4
26	Introducción a las Comunicaciones Digitales	0	-	-	-	-
27	Antenas	0	-	-	-	-
		47	**4406**	**-**	**1037**	**96**

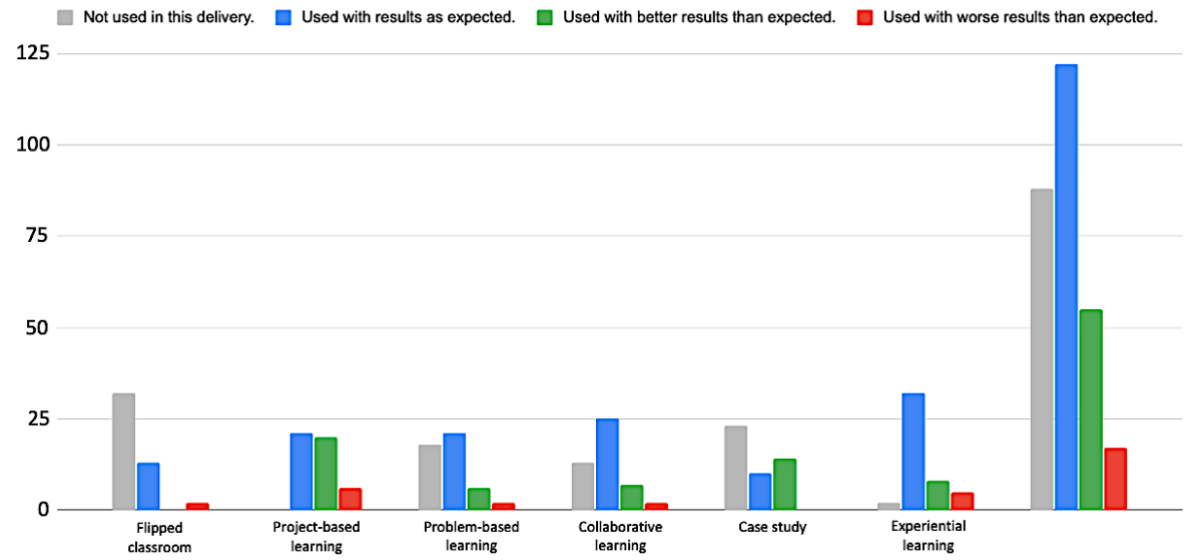

Fig. 5.5: Impact of the delivery actions of IoT courses (D3.4).

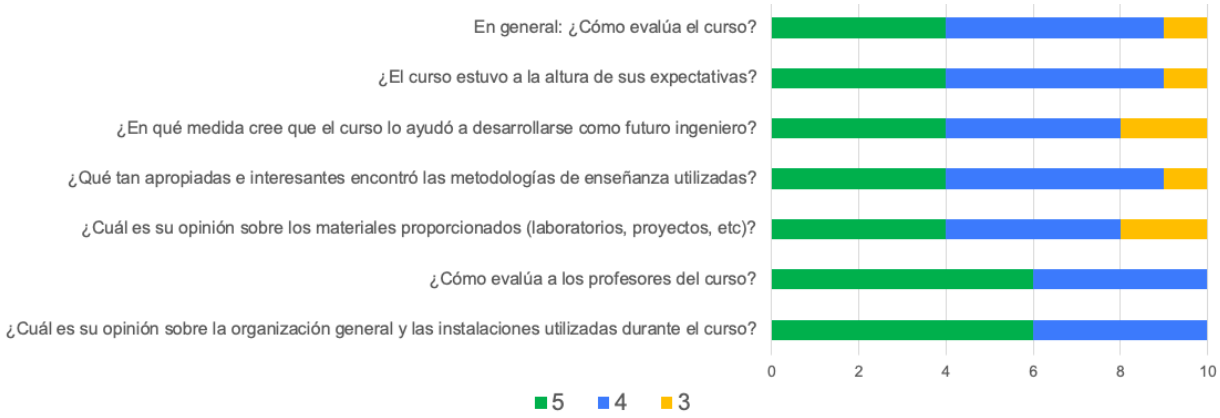

Fig. 5.6: Hands on IoT Course 2022 satisfaction survey.

Fig. 5.7: IoT for Agribusiness Course satisfaction survey.

- **Joint Industry-Academia Labs**: The NEON project has developed five modern industry-academia labs. The equipment was purchased with the financial support of the project and installed to reinforce the LA partners's labs. The equipment has been used in various project activities, primarily for teaching and training, but also for some more advanced research involving graduate students. Specifically, the lab equipments at each of the five universities are:
    - UNS installed the equipment in two specific laboratory areas that are intended for both undergraduate and graduate students, with an emphasis on teaching and research.
    - UNMdP is using the equipment in two designated lab areas primarily for teaching, within the Department of Electronics and Computer Science. These areas are specifically designated for use by both undergraduate and graduate students.
    - UNC has placed the equipment in the Laboratory of Digital Communication (LCD) to facilitate for both undergraduate and graduate students. The software defined radio (SDR) lab provides continuous remote access through a VPN and a Jupyter server, allowing students to perform a variety of experiments. One IoT lab is designed for classroom use, while another IoT network is set up at the LCD with local access.
    - UCU installed the equipment in the engineering department's "design lab," which is dedicated exclusively to the development of IoT projects and applications. Additional equipment will be installed in the Agribusiness sector, specifically in a "Test Site" operated in collaboration with a company.
    - Udelar has implemented the equipment in two labs dedicated to undergraduate practice and one for postgraduate research activities. However, the majority of the equipment will be used by courses that either adopt or have already adopted lab-at-home methodologies. As a result, electronic kits, equipment, and instruments will be made available to students or student teams throughout the duration of the courses.

Other events of interest, which were important to promote NEON objectives objectives and influence on the graduate profiles are:

- **"Meeting IoT MDP-Tandil 2021 (virtual event)"**: This event connected 15 companies and 5 academic groups from Mar del Plata and Tandil (Argentina), which presented their advances in IoT. There were 122 inscriptions.
- **Carintian EU-Project Day" (DE: 5. Kärntner EU-Projekte-Tag)**: The NEON project activities were presented at the Carintian EU-Project Day. NEON partners had the opportunity to learn about other ongoing projects in the Carinthia region, inform event visitors about the project activities, discuss personal experiences, interests, and challenges in IoT with some of the participants and disseminate the core objectives and the achieved results of the project.

Feedback on graduates will continue to be collected through the project's social media accounts, with the aim of constantly updating data on graduates' skills and employability. In addition, it is likely that other types of events aimed at training in IoT skills will be implemented after the lifetime of the project. Nevertheless, the courses that were developed will have an impact beyond the project lifetime. Each time any of these courses is delivered, the graduate profiles on IoT will be improved.

6. Conclusions

In conclusion, during the project it was proposed to define the needs of the IoT industry and correlate them with the skills of the graduates. As a result of the conducted surveys, it was possible to evaluate which IoT areas the graduates have knowledge about, and which areas require learning. Consequently, the activities carried out in the NEON project were designed to improve the graduates' profiles in accordance with the analysed industry needs. In particular, the developed and modernized courses, as well as the joint industry-academia labs, are the main activities aimed at improving students' IoT skills to better meet industry needs. It is hoped that these tools can continue to be used to improve students' skills as the industry grows and evolves.

This report provides an overview of all these developed NEON activities that have influenced the profile of future graduates and analyses the impact of these activities in terms of the number of students involved and satisfaction surveys. The impact of the NEON project will be long term and will hopefully reach a wide range of students in the LA region and enhance their curriculum in IoT.

7. References

[1] NEON project proposal, 2020.

[2] D6.5 Report on tools for monitoring student enrolment and employability/employment/entrepreneurial statistics of graduates.

[3] D6.6 Reports on stakeholders reached beyond the project consortium.