With the support of the Erasmus+ Programme of the European Union

Education for Digitalization of Energy

Deliverable 6.7

Analysis of skill gap mitigation

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Abstract:

This report aims to present the methodology for the assessment of the pilot activities, the methodology for the analysis of the feedback obtained from the participants in the pilots. Moreover, it contains preliminary feedback from industry, considering the contents of the pilot activities. Then, the results from the surveys are analyzed, leading to key findings and recommendations for the update of the Blueprint Strategy, establishing an active feedback loop for the update of the Blueprint Strategy

Keywords:

D6.7, Assessment, Evaluation, Digitalisation, Energy, Survey, Analysis, Methodology, Feedback, Blueprint, Recommendations, education, pilots

DISCLAIMER

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05	Politecnico di Milano – METID	POLIMI	Italy
06	Kungliga Tekniska Högskolan	KTH	Sweden
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08	Centrul Roman al Energiei	CRE	Romania
09	REPSOL SA	REPSOL	Spain
10	IBERDROLA	IBERDROLA	Spain
11	GE Energy Products France SNC	GE	France
12	DNV Business assurance Spain SL	DNVGL	Spain
13	EDSO for Smart Grids	E.DSO	Belgium
14	NTT Data Italia SPA	NTT	Italy
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17	Institute of Energy Economics at the University of Cologne	EWI	Germany

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Definitions, Acronyms and Abbreviations

BSDE – Blueprint Strategy for the Digitalisation of Energy

EQF – European Qualifications Framework

ACS – Institute for Automation of complex Power Systems

IoT – Internet of Things

AI – Artificial Intelligence

RES – Renewable Energy Resources

MOOC – Massive Open Online Courses

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Executive Summary

The process of digitalizing the energy sector presents both significant challenges and tremendous opportunities for enhancing energy efficiency and sustainability. To fully seize these opportunities, it is crucial to have a skilled workforce equipped with the necessary expertise for driving this transformation. The primary objective of the EDDIE project is to develop an industry-driven Blueprint Strategy that identifies and addresses the skill requirements of the European energy sector in relation to digitalisation.

The Blueprint strategy for the Digitalisation of Energy (BSDE) was designed during WP5. The Strategy development utilized inputs from the work conducted in other WPs. WP2 provided the identification of current and future skill needs in the Energy Sector, while WP4 contributed to the assessment of policies and requirements for VET and beyond. In WP3 the stakeholder mapping and strategic network building was created. All this effort served as input for the Blueprint Strategy, which is tested through a roll-out and action plan in five individual pilot sites in Aachen (Germany), Cologne (Germany), Athens (Greece), Milan (Italy) and Madrid (Spain).

The pilot activities, which encompass different EQF levels and target various skill gaps, are followed by an assessment procedure, that aims to measure the impact of the activities and provide feedback to the Strategy. The goal of the assessment is to continuously update the Blueprint and ensure the long-term sustainability of the strategy, both throughout the project and beyond its completion. The conclusion of this procedure signifies the finalization of the Blueprint Strategy.

This assessment aims to incorporate multiple components, including questionnaires to participants, interviews with activities presenters and feedback from industry stakeholders regarding the activities. The initial step of evaluation begins with a survey of activities participants. The survey covers various topics, starting from demographics in order to test the wide coverage of profiles in responses. The main part of the survey focuses on evaluating the impact of the activity regarding the awareness of the topic, as well as the extent of the skill gaps mitigation. It also assesses the level of motivation for the activity and the future preferences of the candidates. The survey concludes by providing participants with the opportunity to offer recommendations and comments.

In parallel a concise survey is distributed to industry partners of the consortium to gather their feedback on the content of the activities, mainly to assess to what extend the activities are aligned with the industry needs and to recommend adjustments.

The results of the questionnaires are analyzed utilizing a customized analysis methodology, aiming to extract valuable insights about the extension of the various skill gaps mitigation, the attractiveness and motivation of the activities and the preferences of the participants. The analysis yields key findings, categorized on the pilot sites and in some cases across different activities. The same analysis procedure is applied to industry survey responses.

The aim of the analyses is to result into cumulative action points, to serve as recommendations for the update of the Blueprint Strategy and for the adjustment of the pilot activities at the same time. This step is crucial for the success of the project, as it establishes the active feedback loop for the Blueprint, enabling an iterative approach to its development. By incorporating the insights gained from the analyses, the project can ensure continuous improvement and alignment with the evolving needs of the industry and related stakeholders.

1. Introduction

The purpose of the EDDIE project is the foundation and establishment **of a Sector Skills Alliance to develop an industry-driven Blueprint Strategy for education and training in the energy sector, which is continuously affected by digitalisation. This Blueprint is an industry-driven strategy that will meet and anticipate the skills' demands for the sustainable growth and digitalisation of the European Energy sector.**

To establish the active feedback loop of the Blueprint strategy, which is of high importance for the success of the project, a concrete procedure has been designed for obtaining feedback and valuable insights from the pilot activities. This procedure includes the methodology for the assessment, the analysis of the responses and the extraction of key findings and recommendations for the Strategy.

These findings serve as a foundation for refining and updating the Blueprint strategy, so it improves the effectiveness, relevance and impact of the implemented actions. Recommendations derived from the analysis offer actionable insights for enhancing the content, design, and delivery of future activities. This iterative feedback loop will allow the project to align the strategy more closely with the evolving demands of the industry and the changing landscape of digitalisation in the energy sector.

This deliverable presents the methodology used for the assessment of the pilot activities, followed by the analysis of the survey results for the various pilot sites, concluding with key findings and recommendations for the update of the Strategy. By providing a comprehensive overview of the assessment process and its outcomes, this deliverable serves as a valuable resource for informing future decisions and improvements within the project.

1.1. Structure of the document

The integral part of this document consists of 4 chapters. Chapter 2 presents the methodology for the assessment of the pilot activities including the structure of the assessment survey and the methodology for the analysis of the results collected from the survey. Chapter 3 presents the survey results and the analysis separated into 5 sub-chapters for the different pilot sites in Aachen (Germany), Cologne (Germany), Athens (Greece), Milano (Italy) and Madrid Spain, followed by the key findings. Chapter 4 pertains to the feedback from the industry regarding the content of the pilot activities. Chapter 5 summarizes the mentioned outcomes into concrete recommendations for the update of the Strategy. Finally, in a conclusion the main points of the document are summarized.

2. Methodology for the assessment of the pilot activities

The methodology for the assessment of the pilot activities involves a variety of actions, as well as feedback from the industrial stakeholders, to validate the connection of the activities to the needs of the labor market. The first and major step of the evaluation of the activities is the engagement of the participants in the procedure.

In this context, to evaluate the pilot activities and align them to the goals of the Blueprint, a draft questionnaire was created, that was then customized to fit the pilot's needs. In order to be distributed to the participants of the activities. Till the development of D6.7, the questionnaires have been delivered for 11 activities in the four pilot sites. Regarding field test Cologne have not been yet deployed. The questionnaires will be distributed also to the ongoing and future activities and the results and analysis of the responses will be used to update the current deliverable.

The purpose of the questionnaire is twofold. Firstly, it aims to provide valuable feedback to the designers of the pilot activities. regarding the impact, acceptance, and participants' level of satisfaction. Secondly, it serves to assess the extent to which the activities address skill gaps, as perceived by the participants, combined with comments for further improvement.

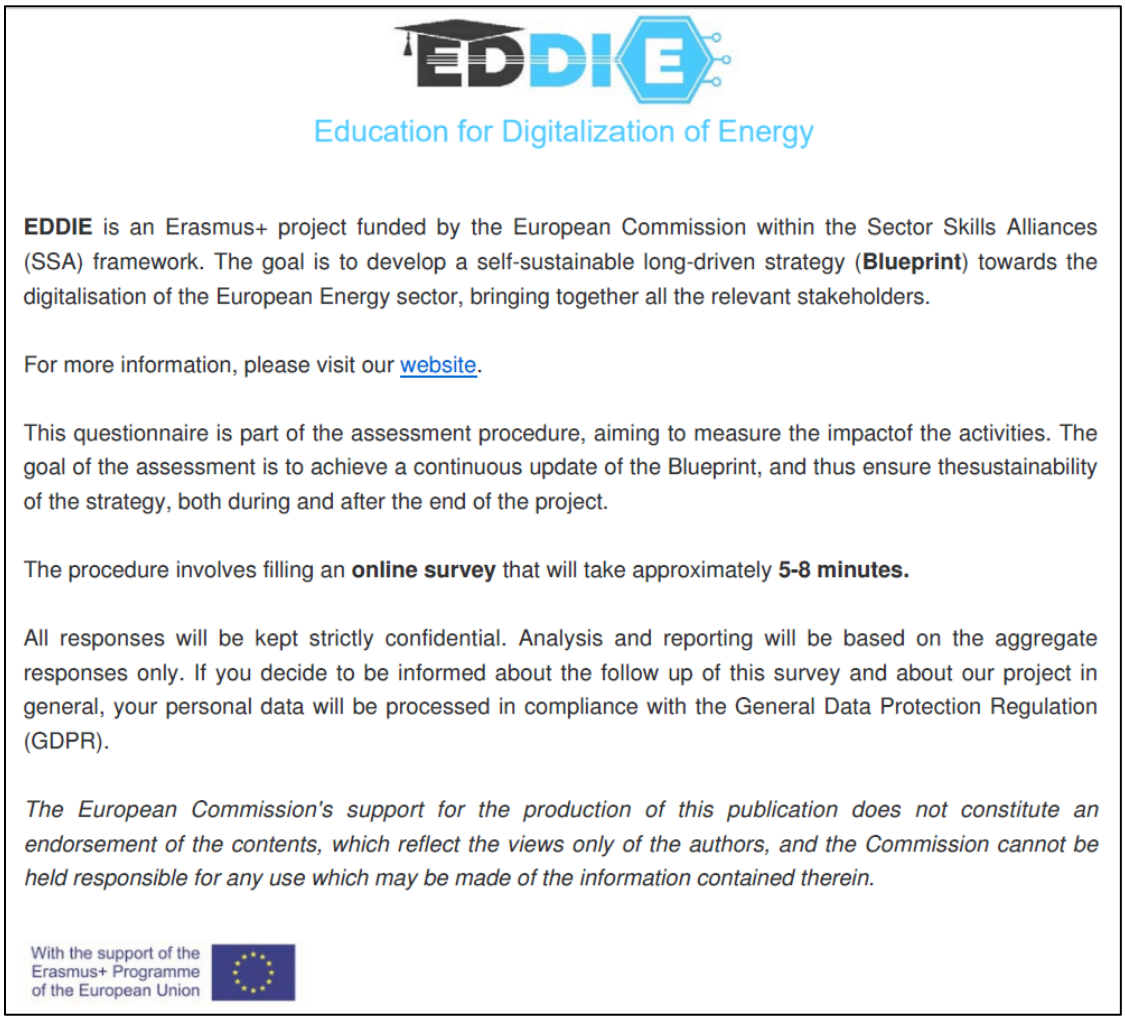
The EU Survey platform was selected as the preferred choice for creating the draft survey and distributing some of the pilot activities surveys distribution. EUSurvey is an online system designed for managing surveys, allowing the creation and publication of forms that are accessible to the general public. EUSurvey can be accessed through its dedicated website at https://ec.europa.eu/eusurvey.

The questionnaires vary both in content and distribution format. The first diversification occurred due to variations in the content/goals of each activity, as well as the different EQF levels that it referred to. The deviation in the distribution format was a result of the different deployment formats of the activities. Activities that took place online were facilitated from the online format of the survey, provided through the EU Survey platform. Conversely, in activities with physical participation, the distribution/fill-in of printed (hardcopy) questionnaires was preferred, in order to reach a higher rate of participation. The EU Survey platform provides the feature of printing the developed survey for hardcopy distribution.

To ensure the confidentiality of the procedure, during the assessment, no personal information was collected, and the results are presented in an aggregated form. This approach guarantees the privacy and anonymity of the participants while providing meaningful insights from the assessment.

Structure

The questionnaire starts with a brief overview of the EDDIE project and the scope of the questionnaires.



Education for Digitalization of Energy

EDDIE is an Erasmus+ project funded by the European Commission within the Sector Skills Alliances (SSA) framework. The goal is to develop a self-sustainable long-driven strategy (**Blueprint**) towards the digitalisation of the European Energy sector, bringing together all the relevant stakeholders.

For more information, please visit our website.

This questionnaire is part of the assessment procedure, aiming to measure the impactof the activities. The goal of the assessment is to achieve a continuous update of the Blueprint, and thus ensure thesustainability of the strategy, both during and after the end of the project.

The procedure involves filling an **online survey** that will take approximately **5-8 minutes.**

All responses will be kept strictly confidential. Analysis and reporting will be based on the aggregate responses only. If you decide to be informed about the follow up of this survey and about our project in general, your personal data will be processed in compliance with the General Data Protection Regulation (GDPR).

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Figure 1: Survey's project overview

The structure of the survey was divided into two sections.

The first section "Your profile" aimed at gathering basic information about the participants' profiles, for demographic purposes.

The second section "About the activity" included questions regarding the format of the activity, and questions for the raised awareness of the topics of the activity.

The 5-point Likert scale was employed for questions aiming to assess the level of success for the targets of the activities. The 5-point Likert scale is a commonly used method for measuring attitudes, opinions, and perceptions in research and surveys. It consists of a set of statements or questions that participants are asked to rate on a scale of five options, typically ranging from "Strongly agree" to "Strongly disagree."

The scale allows participants to express their level of agreement or disagreement with the statements provided. A breakdown of the five points on the Likert scale is presented next:

1. Strongly Agree: This option indicates a high level of agreement with the statement. It suggests that the respondent strongly believes in or supports the given statement.

2. Agree: Choosing this option suggests a general agreement with the statement, though perhaps not as strong as the "Strongly agree" option. The respondent acknowledges the validity or truthfulness of the statement.

3. Neutral: This option reflects a neutral stance or lack of a definitive opinion regarding the statement. The respondent neither agrees nor disagrees.

4. Disagree: Selecting this option indicates a general disagreement with the statement, suggesting that the respondent does not find it valid or accurate.

5. Strongly Disagree: This option represents a high level of disagreement with the statement. The respondent strongly opposes or disagrees with the content of the statement.

The Likert scale allows for a quantitative assessment of attitudes or opinions, making it easier to compare and analyze the data statistically. It provides researchers with a clear understanding of participants' viewpoints, preferences, or perceptions regarding the subject under investigation.

In addition to the advantages mentioned earlier, the Likert scale's structured nature and clear response options make it user-friendly and less time-consuming for respondents. The scale's ability to elicit nuanced responses enables researchers to gain deeper insights into participants' opinions and attitudes, enhancing the analysis of the collected data.

Overall, the 5-point Likert scale is a valuable tool in research and survey methodology, offering a practical and effective means of assessing attitudes and opinions while providing rich data for analysis.

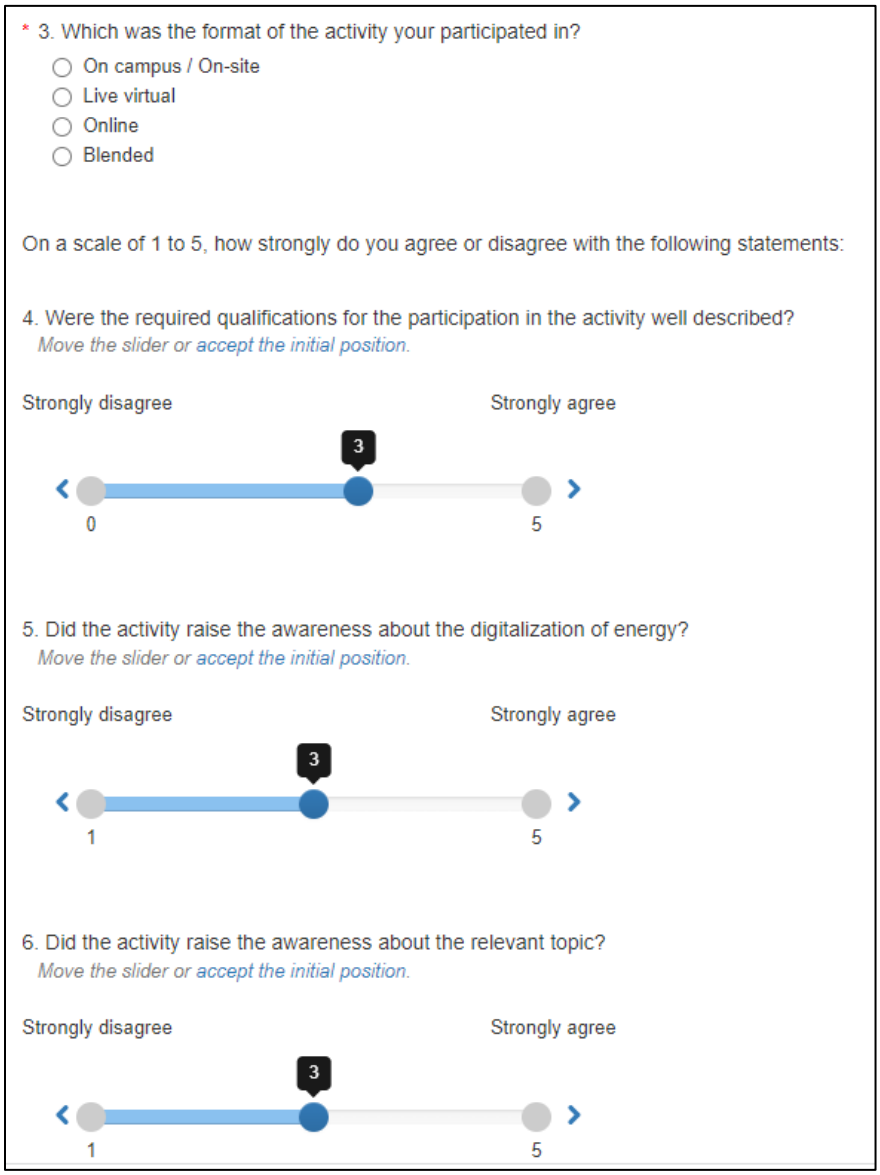
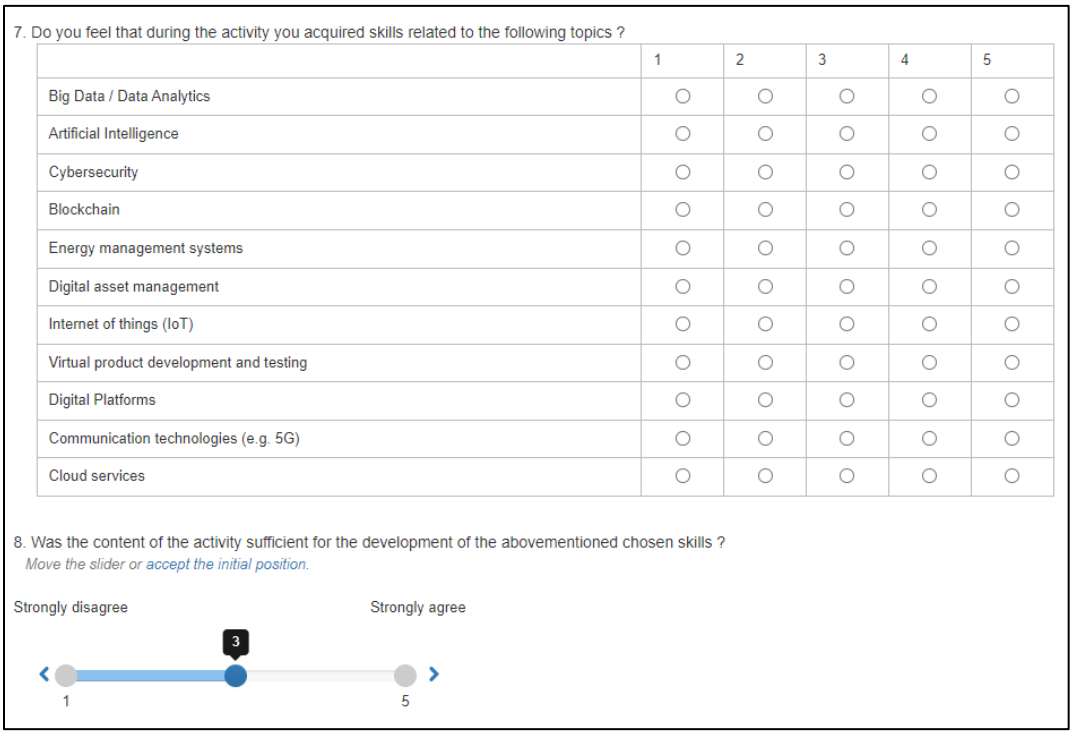


Figure 2: Survey template (1)

The survey aims to stress to what extent the activity managed to address the selected skill gaps. The list of skill gaps presented in the survey, arises from the skill gaps identified in WP2, utilized by the pilot leaders in the design/restructure/update of the pilot activities.

The last stage of the questionnaire focuses on the overall impact and motivation of the activity, as well as the participants' preferences for future activities and comments. The suggested topics for future activities were chosen from the results of D2.2 "Current and future skill needs in the Energy Sector" [1] where the key areas towards digitalisation converged towards: Data management and analysis, Big data, Cybersecurity, Programming and development competences.



7. Do you feel that during the activity you acquired skills related to the following topics ?

	1	2	3	4	5
Big Data / Data Analytics	○	○	○	○	○
Artificial Intelligence	○	○	○	○	○
Cybersecurity	○	○	○	○	○
Blockchain	○	○	○	○	○
Energy management systems	○	○	○	○	○
Digital asset management	○	○	○	○	○
Internet of things (IoT)	○	○	○	○	○
Virtual product development and testing	○	○	○	○	○
Digital Platforms	○	○	○	○	○
Communication technologies (e.g. 5G)	○	○	○	○	○
Cloud services	○	○	○	○	○

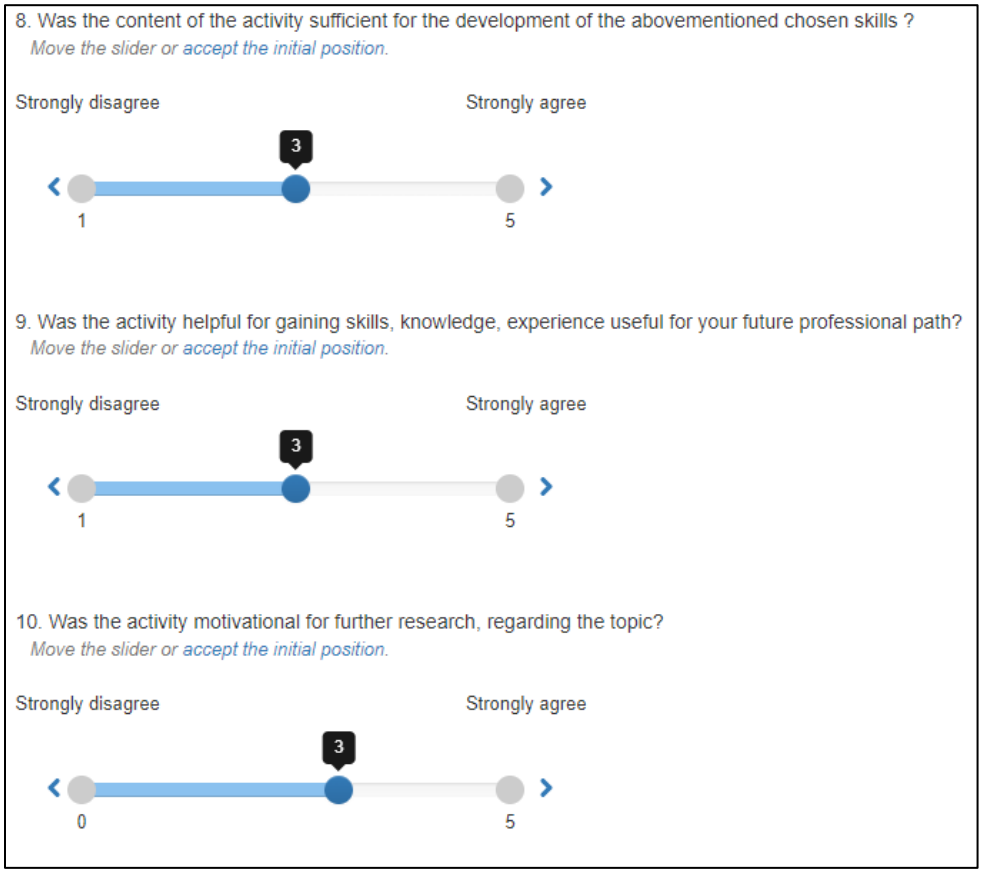
8. Was the content of the activity sufficient for the development of the abovementioned chosen skills ?
Move the slider or accept the initial position.

Strongly disagree Strongly agree

3

1 5

Figure 3: Survey template (2)



8. Was the content of the activity sufficient for the development of the abovementioned chosen skills ?
Move the slider or accept the initial position.

Strongly disagree Strongly agree

3

1 5

9. Was the activity helpful for gaining skills, knowledge, experience useful for your future professional path?
Move the slider or accept the initial position.

Strongly disagree Strongly agree

3

1 5

10. Was the activity motivational for further research, regarding the topic?
Move the slider or accept the initial position.

Strongly disagree Strongly agree

3

0 5

Figure 4: Survey template (3)

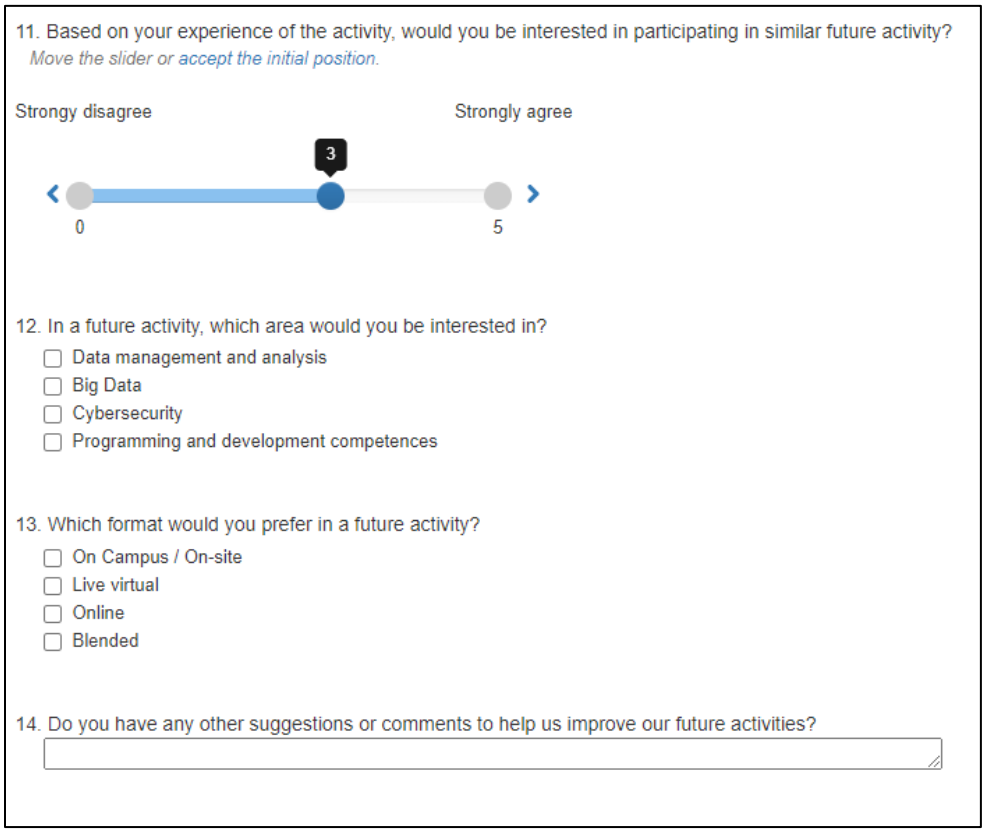


Figure 5: Survey template (4)

Analysis methodology

The format of the surveys varies in some pilot sites, cause of the diversity of the content of the questionnaires, guided by the content and the EQF level of the activity. The analysis of the results provides a comprehensive overview of the outcomes of the activities to obtain the key findings for the update of the Strategy.

For the analysis of the results, it is necessary to establish metrics. The first section of the analysis considers demographics. For most of the activities, the targeted audience is of a specific educational level and similar age. Therefore, significant deviations are not expected to be found within each activity. The purpose of including these questions is to analyze them cumulatively and ensure the comprehensive coverage of the activities.

The second stage of analysis aims to measure the level of engagement of the participants with the content of the activities, and the understanding of the qualifications required to participate in the activity. Evaluating to what extent the participants are familiar both in general with the digitalisation of the energy sector and the topic relevant to the activity, is crucial. This insight provides valuable information for the pilot leaders and the Blueprint, indicating whether the topic of the digitalisation of energy, in general, is effectively described and understood by the potential participants.

The field of digitalisation in the energy sector is undergoing rapid and constant evolution. As a result, professionals in this field must maintain a continuous engagement in updating their skills and knowledge. In this direction, the activities related to it should be motivational for further research and valuable for the future career path of the attendants. Therefore, it is crucial to validate that the activities are fulfilling these goals for the participants.

The third stage of the analysis is closely tied to the skill gaps mitigation and in that way, of high priority as a feedback component for the BSDE. Considering the identified skill gaps list, it is stressed whether the activity provided sufficient content to tackle the skill gaps that were chosen in the design and implementation phase, as well as to which extent the content was adequate for the required skill gaps mitigation. Also considering that the EDDIE project follows an industry-driven approach, it would be valuable to gauge the participants' level of satisfaction regarding the alignment of the activities to the current needs of the labor market and the industry.

The final stage of the analysis examines the potential future engagement of the attendees in similar activities and identifying the areas in which they are most likely to participate. This survey serves as the initial feedback to the Blueprint and so it is of high priority to check if the key areas of the skill gaps identified during WP2 from the comparable surveys to education/training providers and the industry are aligned with the needs and desires of the students/professionals/citizens and the activities' participants in general. Additionally, participants' recommendations will be investigated to provide feedback to pilot site leaders, and where applicable, contribute to the update of the Strategy. The feedback to pilot site leaders, will serve as a guideline for improvements during the next implementation phase of the activities (even after the project ends) and to similar future activities.

Ultimately, the key findings of the surveys are summarized, in order to serve both as guidelines for the improvement of the activities and as feedback for the update of the Strategy.

3. Analysis of the pilot sites' activities

3.1. Field test Aachen

The pilot site in Aachen covers with its 9 piloting activities a broad range of EQF levels and target audiences. The activities are carried out in different settings such as in the education sector with workshops, lectures, or dissemination events in an interdisciplinary setting. Other activities are aiming to raise synergies and appeal to a larger audience with workshops and experimental demonstrations in cooperation with the local communities. Therefore, the surveys are adjusted to the individual activity considering age, education level, target audience and activity format differently for the skill gap mitigation. In the following the survey results of the pilot activities are analyzed separately to accommodate the different surveys.

3.1.1. Archimedischer Sandkasten with city of Aachen

The pilot activity is a 3-week vacation program for children including a dissemination day in the city center of Aachen, which is open to the general public. In the course of this dissemination event, the wind park and energy grid model was exhibited, and two surveys were conducted. One survey addressed the children with 10 participants and one survey the adults with 5 participants, although there have been more visitors at the event.

Demographics:

In Figure 6 the board age range of the participants is visualized. The majority of the children were 11 years old and the majority of the adults were in the Age range between 25 – 34 years.

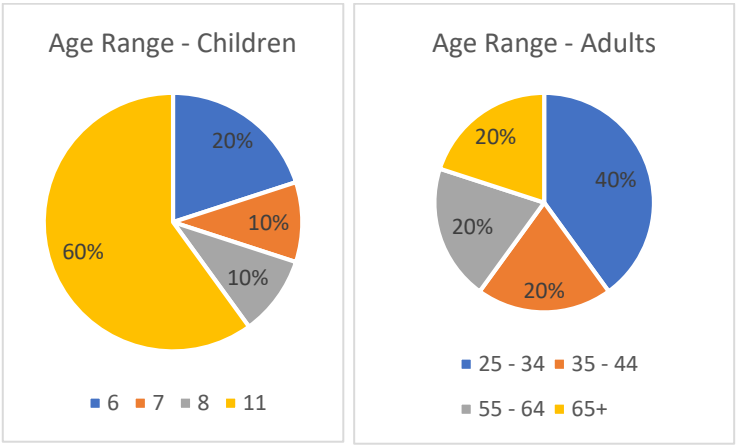


Figure 6 Age range of participants in Archimedischer Sandkasten with City of Aachen survey

Figure 7 shows the employment area of the adult participants, showing a concentration in education. This is correlated to the large dissemination of this event in education facilities.

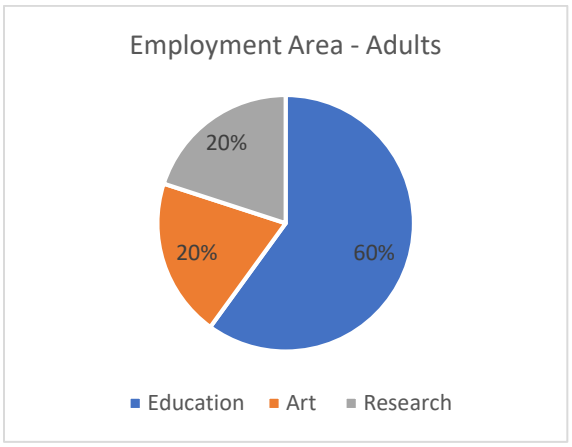


Figure 7 Employment area of participants in Archimedischer Sandkasten with City of Aachen survey

Skill Gap Mitigation:

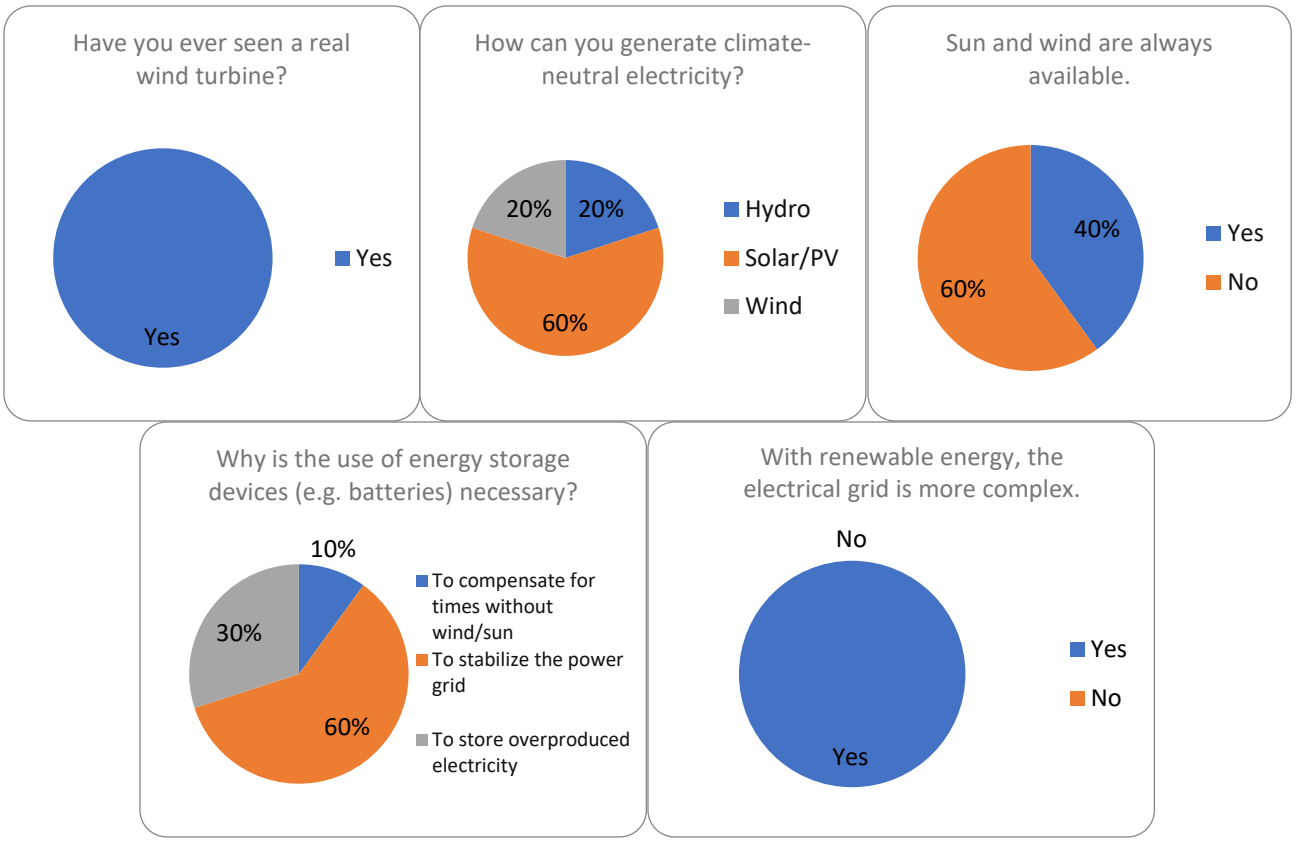


Figure 8 Results of Archimedischer Sandkasten's survey (children)

Results of Archimedischer Sandkasten's survey conducted that children aged 6-11 have a basic understanding of how climate-neutral electricity is generated, if sun and wind are always available, why the use of energy storage devices is necessary, and if the electrical grid is more complex with renewable energy. In this pilot activity, a demo was used to enhance the basic understanding of the integration and impact of renewables into a grid. The demo shows the impact of electricity produced by wind energy on the grid and how storage devices can stabilize the electrical grid if renewable energy is present.

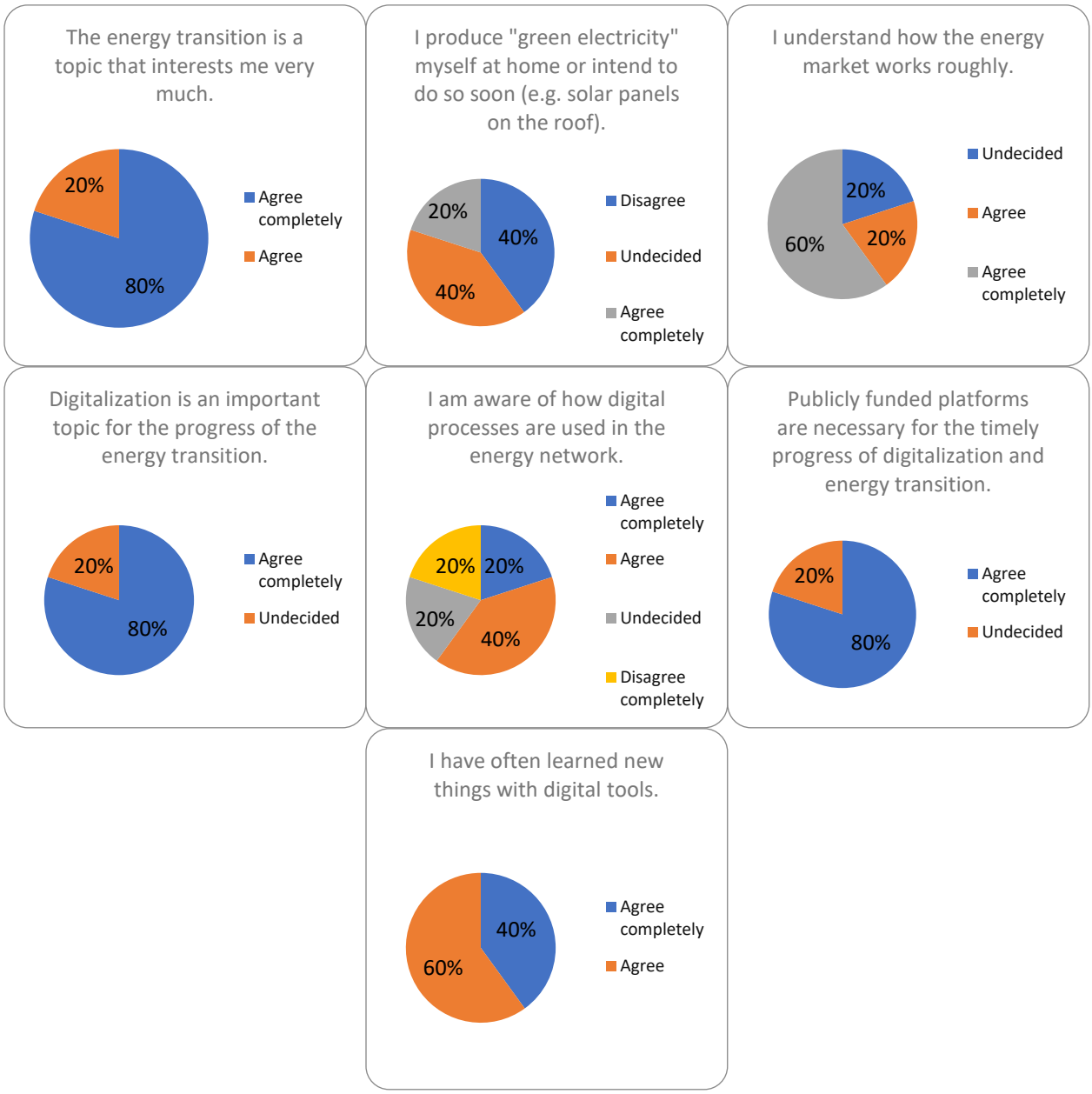


Figure 9 Results of Archimedischer Sandkasten's survey (adults)

The importance and necessity of energy transition and digitalization in this sector are evident among 80% of the participants. The results indicate that there is a fundamental understanding of the energy transition, digitalization, and their required implementation. However, there is a clear limitation for the participants when it comes to effectively implementing digitization in the electrical grid.

Recommendations:

During the dissemination event and the visit of the children at ACS, the conductors got feedback from the visitors and participants on the disseminated wind park and energy grid model. The feedback was very positive, but also highlighted some improvement potentials. This demo was already in use for quite some time, and the conducted survey encouraged the development of a new demo for the deployment in another pilot activity: **Girls' Day at ACS**. In the new demo, we also integrated topics that were identified as skill gaps in WP 2 such as Energy management systems. The demo has reduced complexity and is adapted to children's age but still shows increased complexity of the future energy systems, necessity for flexibility, automation, and advanced control of such systems.

3.1.2. Girl's Day at ACS

Girls' Day is a nationwide project for career and study orientation for girls. On this annual day of action, female students learn about professions or fields of study in which the proportion of women is less than 40 percent. The main component of this pilot activity is a workshop for lower secondary female students at the Institute for Automation of Complex Energy Systems. In the workshop, the female students explore the balance between generation and consumption in the energy grid using a plug-and-play power grid demo. After the explanation and usage of the demo, a survey was conducted. The number of participants was 7 and all of them participated in the survey.

Demographics

Figure 10 shows the age and grade of the participants in Girls' day at ACS pilot. The age of participants vary from 12-13 years, and majority of them attend the 8th grade.

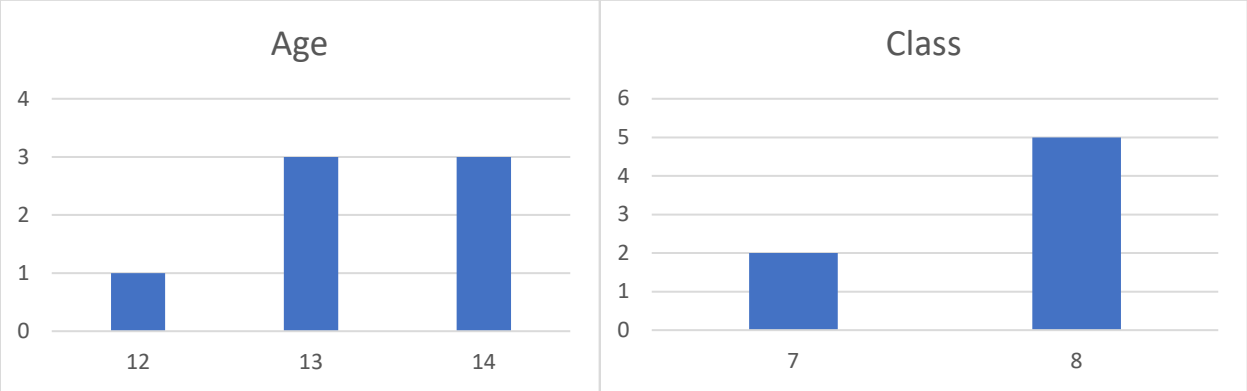


Figure 10 Age range and grade of participants in Girls' day at ACS pilot

Coverage of the topics / Motivation for further research:

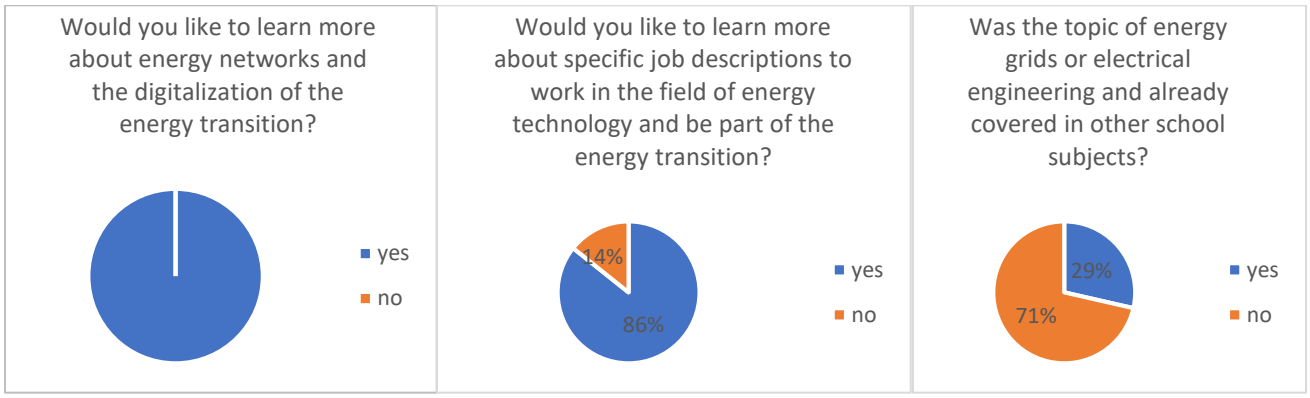


Figure 11 Results of Girls' Day's survey

The results of the survey show that the participants display a keen interest in and would like to learn more about the subject of energy networks and the digitalization of the energy transition. The activities conducted in this regard are perceived as beneficial and enlightening, effectively sparking an interest in the topic. It is worth noting that, in most instances, these subjects were not covered during formal education.

Skill Gap Mitigation:

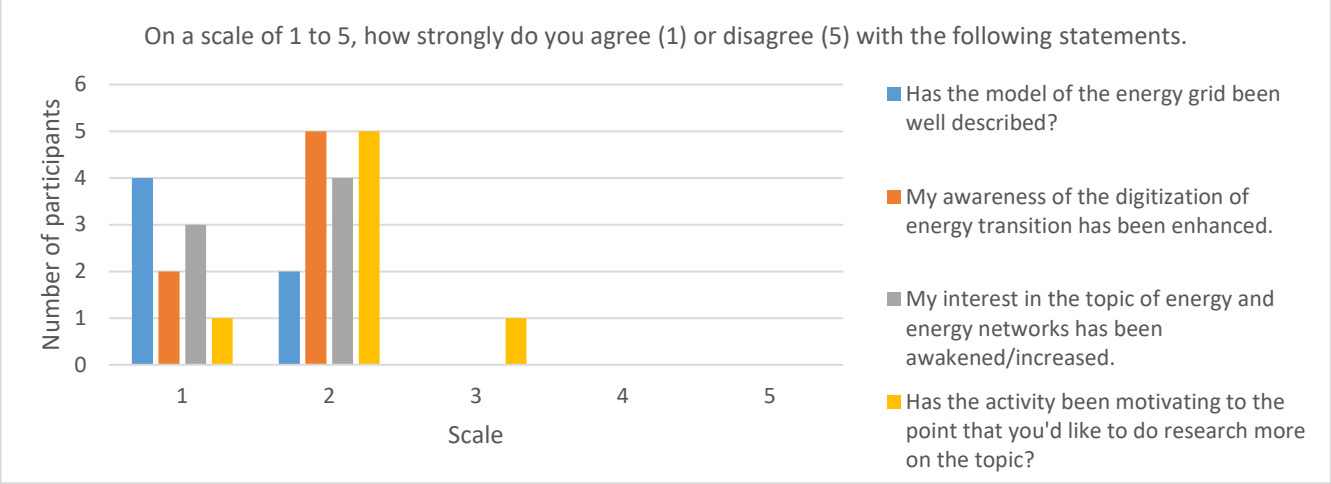


Figure 12 Results of the Likert scale type of questions for Girls' Day's survey

The results of the Likert scale type of questions show an enhancement and increase of interest in the topics of energy systems and the digitalization of such systems. It is also conducted that the demo is motivational for further research on the previously mentioned topics.

Recommendations:

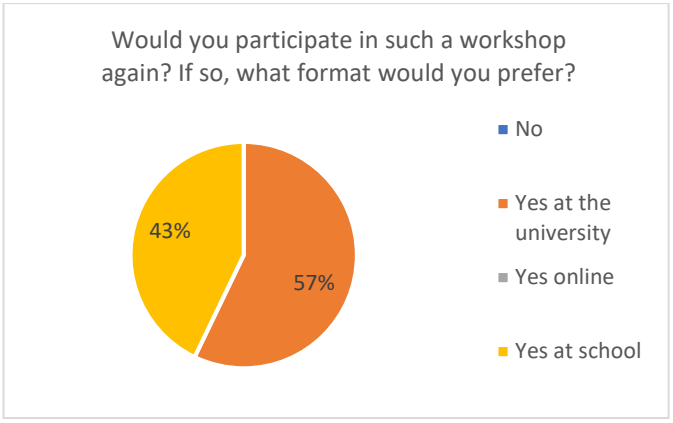


Figure 13 Feedback on the workshop

The feedback shows that participants would like to join such workshops again. The preference of the format for a future workshop is spread between in person at the facility of the school or university. Overall, it is recommended to purse such kind of activities due the interest of the students in the topic of digital energy and enhance their knowledge from an early age.

3.1.3. Gymnasium Workshop

After the workshop, a survey was conducted with the participants. The 17 individuals involved were primarily students participating in a voluntary STEM group.

Demographics:

In Figure 14 the age range of the participants and their current grade is shown. The majority is in 7th grade and 12 years old.

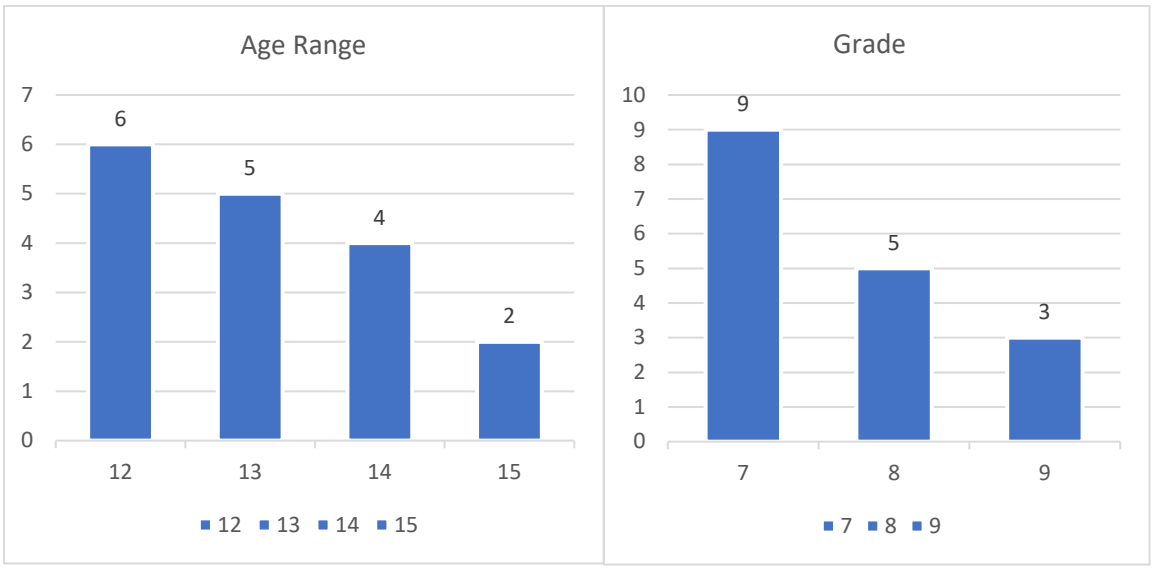


Figure 14 Age Range and Grade of participants in Gymnasium Workshop

Coverage of Topics/Motivation for further Research:

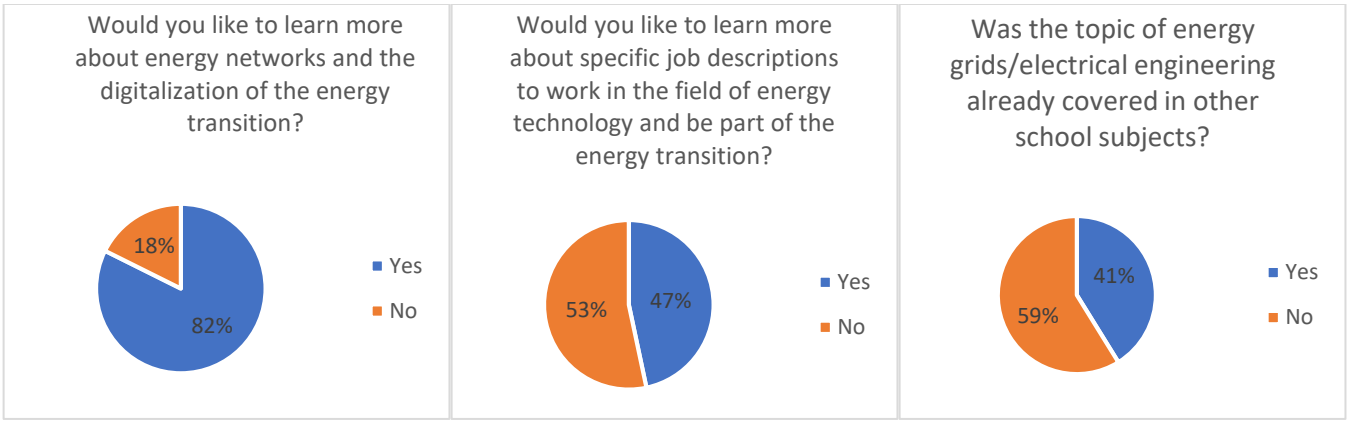


Figure 15 Results on motivation for further research of the Gymnasium Workshop survey

The results of the survey show that participants are interested in learning more about energy networks and the digitalization of the energy transition. However, it shows a lack of interest in learning more about jobs in the field of energy technology and in participating in such workshops again. The reason may be the lack of school subjects that cover electrical engineering topics, which indicates that there is a necessity to deal with electrical engineering topics from a young age. Another reason may be that participants do not understand what energy technology and energy transition cover topic wise.

Skill Gap Mitigation:

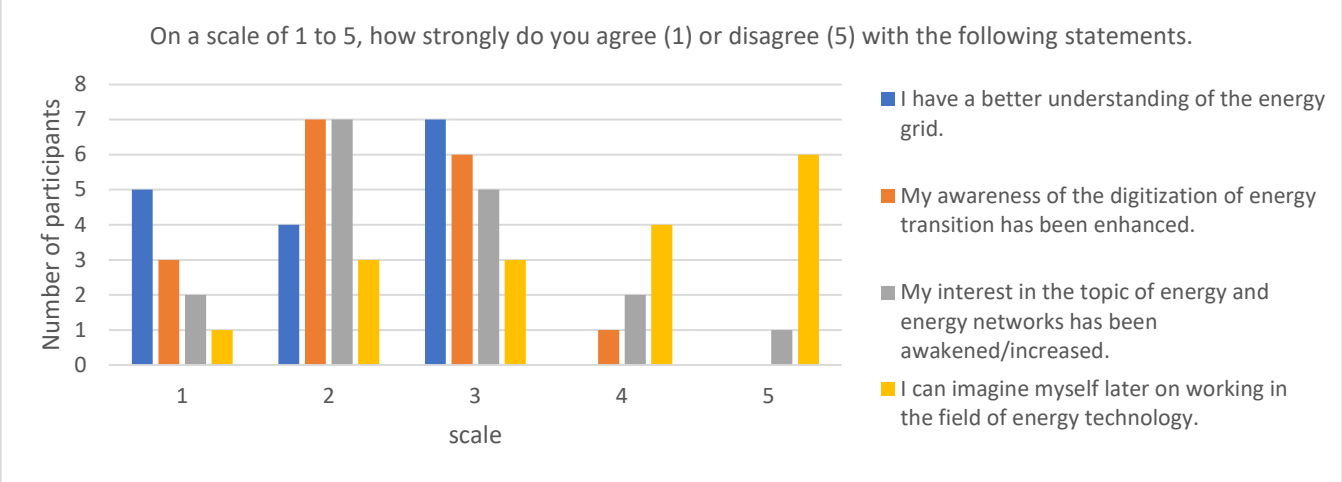


Figure 16 Results of the Likert scale type of questions of the Gymnasium Workshop survey

The evaluation of workshop content shows that majority of participants gained a better understanding of the energy grid. It also indicates that awareness of the digitalization of energy transition and interest in the topic of energy networks is increased. However, there is a lack of interest in working in the field of energy technology.

Recommendations:

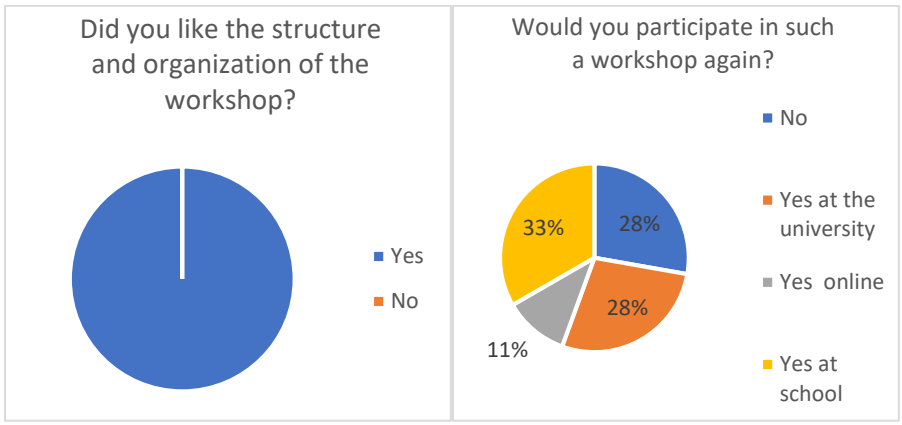


Figure 17 Feedback on the Gymasium Workshop

The feedback shows that the structure and organisation of the workshop was well received, and the majority of the participants would like to participate in a workshop again. The preference of the format for a future workshop is spread between in person at the facility of the school or university or online. However, due to the use of the LEGOS demonstration it is recommended to deploy these kinds of activities in person to allow hand-on experiences. Overall, it is recommended to purse such kind of activities due the interest of the students in the topic of digital energy.

3.1.4. SmartMilano

The survey of the SmartMilano pilot activity was conducted after the online meeting with ACS as experts. In total there are participating 24 students in the project with 12 students from the German school and 12 students from the Italian school. However, there are 22 participants in the survey.

Demographics:

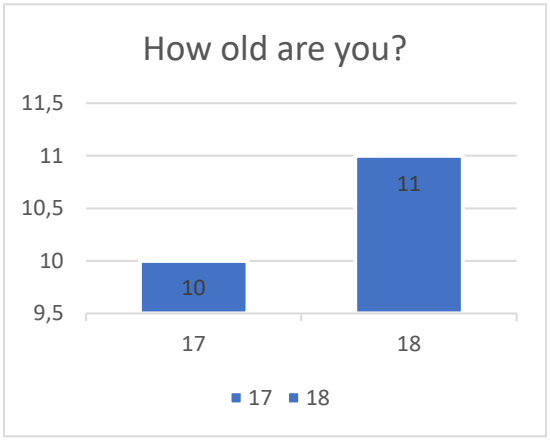


Figure 18 Results of Smart Milano survey on demographics

The Smart Milano event, part of the EDDIE project, was attended by high school students, primarily aged 18. They were all in the 12th grade in Germany and in the corresponding 5th grade of liceo in Italy. The age and grade level of the participants suggest a readiness to grasp complex concepts related to digitalization and energy. The event's success in imparting knowledge on these topics can be inferred from further survey questions on the students' understanding and learning outcomes.

Coverage of Topics/Motivation for further Research:

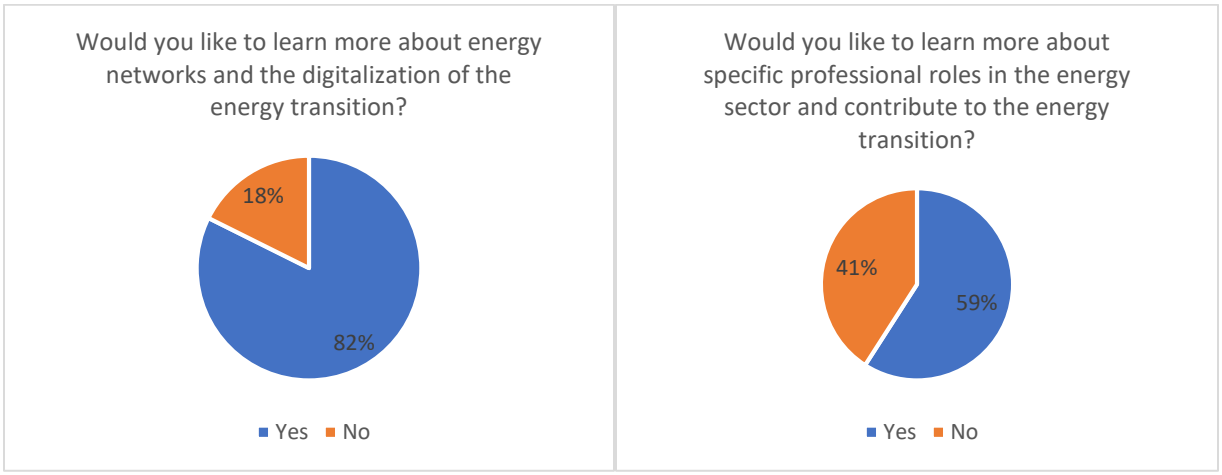


Figure 19 Results of Smart Milano survey on further interest

The survey results indicate a strong interest among the majority of students in learning more about energy networks, digitalization, and energy transition. This is a positive sign, suggesting that the Smart Milano event successfully piqued their curiosity in these areas. Furthermore, a significant number of students expressed interest in learning about specific professional roles in the energy sector and contributing to the energy transition. This shows that the event not only enhanced their understanding but also motivated them to explore potential career paths in the energy sector.

Table 1 Prior knowledge on energy grids of students in SmartMilano activity

Has the topic of energy grids and electrical technology already been covered in other school courses? If yes, what topics exactly and in which course?
Italian course (x3)
No (x7)
Geography course (however, only touched upon, in the 8/9 grade, unfortunately I can hardly remember what exactly was discussed, but in any case how energy can be (x1)
Physics course (x2)
Renewable energy and climate change (x1)

Part of the survey was to understand how much the students learn in school about the topic of energy grids and electrical technology. Therefor the question “Has the topic of energy grids and electrical technology already been covered in other school courses? If yes, what topics exactly and in which course?” shown in Table 1 was asked. The survey responses indicate that the topics of energy grids and electrical technology have not been covered to a satisfactory degree in the students’ school courses. Some students have encountered these topics in the context of renewable energy and climate change, while others have discussed the ecological transition and potential solutions during physics lessons. Three students have indicated that they learned about the topic in their Italian course, which is due to the project “SmartMilano” being part of this course. However, it’s noteworthy that the majority of students mentioned that these topics have not been particularly covered during their lessons or not yet covered but they would like to delve deeper. This suggests a gap in their current curriculum and a potential area for further exploration and integration. Interestingly, one student recalled discussing energy creation from solar panels and wind turbines in geography classes, albeit briefly and a few years ago. This shows that these topics are not confined to traditional science classes and can be incorporated into various subjects to provide a holistic understanding of energy networks and the digital energy transition.

Overall, these responses highlight the importance of comprehensive and continuous education on these critical topics across different subjects and grades.

Skill Gap Mitigation:

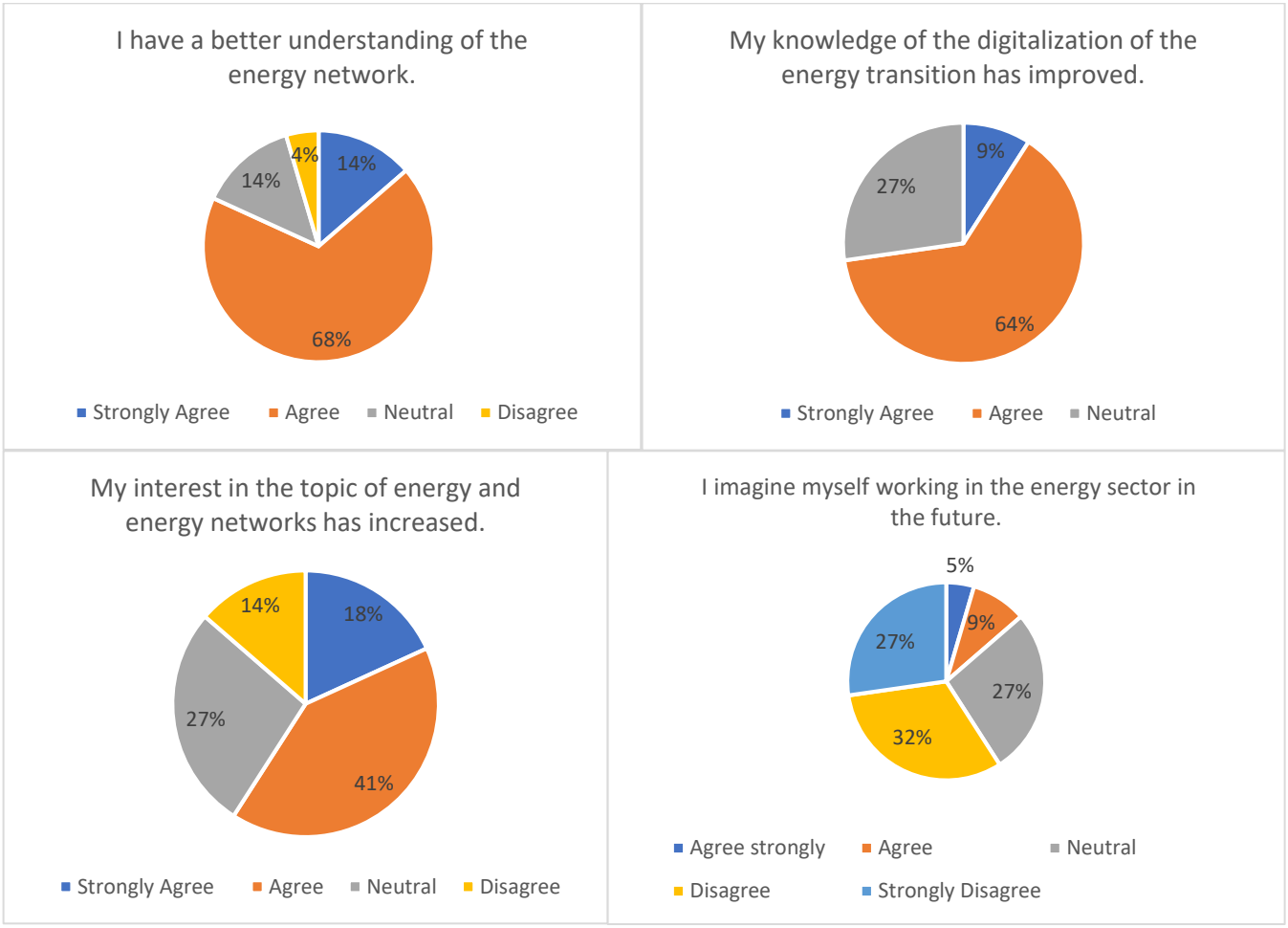


Figure 20 Results of Smart Milano learning outcome survey

Smart Milano appears to have had a positive impact on the participating high school students' understanding of the energy network and the digitalization of the energy transition. A majority of the students agreed that their knowledge in these areas has improved. The event also seems to have sparked interest in the topic of energy and energy networks among some students. However, the survey results indicate a mixed response regarding the students' future career aspirations in the energy sector. This suggests that while the event was successful in imparting knowledge and generating interest, more efforts might be needed to inspire students to consider careers in this field.

These findings underscore the importance of such educational initiatives in shaping the perceptions and career choices of young individuals in the context of the digital energy transition.

Recommendations:

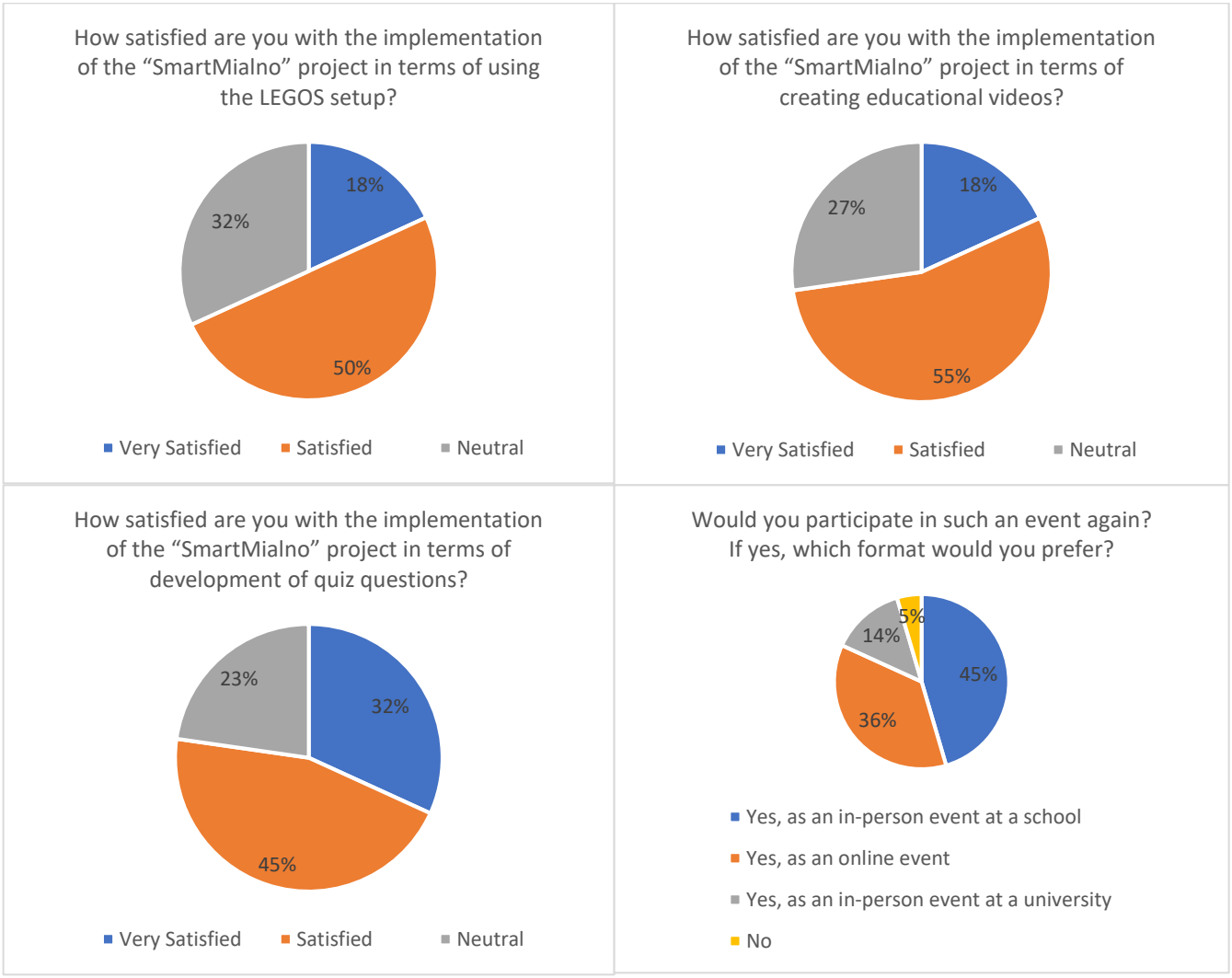


Figure 21 Results of Smart Milano satisfaction survey

The majority of students expressed satisfaction with the implementation of the "Smart Milano" project, particularly in terms of using the LEGOS setup and the development of quiz questions. However, the responses were more mixed regarding the creation of educational videos, indicating room for improvement in this area.

Most students would participate in such an event again, with a preference for in-person events at a school, followed by online events. This suggests that the project was successful in engaging students and fostering their interest in energy networks and digitalization.

These findings provide valuable feedback for future iterations of the project, highlighting the importance of interactive elements like the LEGOS setup and quizzes, and the need to enhance the quality of educational videos. The preference for in-person events also underscores the value of hands-on learning experiences in this context.

One student provided feedback suggesting that future workshops could benefit from incorporating more examples or films. This would help students better visualize the concepts being taught. This feedback is valuable as it highlights the importance of using varied and engaging teaching methods in educational workshops. It underscores the effectiveness of visual aids in enhancing understanding and retention of information. Another student remarked

that the project was well organized but time consuming. Since the project is a voluntarily iniziative of the teachers and involves collaboration with students from another country, this is reasonable. Hence, the incorporation of projects like this into the regular curriculum would help.

3.1.5. Science Night at RWTH

Science night is an open event with different stands showcasing different topics. This survey was conducted at the stand of ACS presenting the LEGOS demonstrator. Despite the high number of visitors, only 35 individuals participated in the survey.

Demographics:

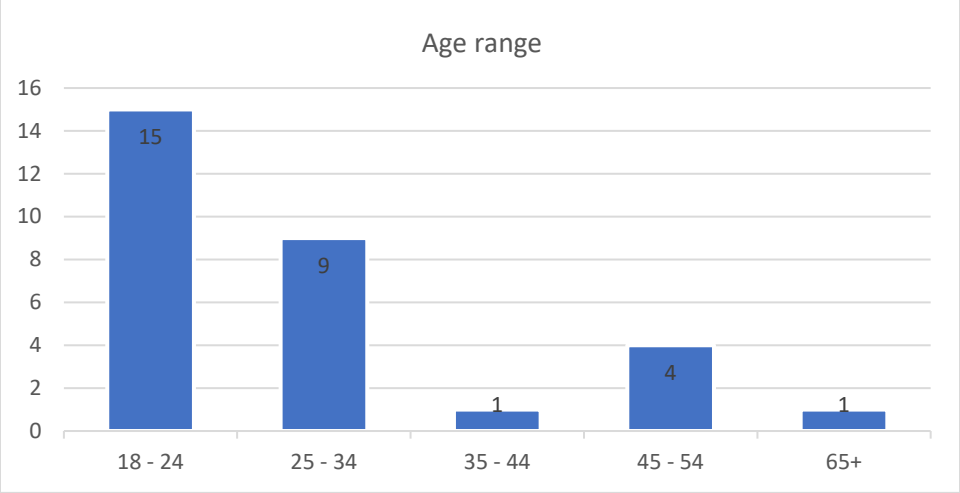


Figure 22 Age range of participants at Science Night

The age range of the survey participants is visualized in Figure 22. The age range spans from 18 to 65 years plus, with the majority falling within the 18-24 age group. This is related to the context of the university with participants from university.

Coverage of Topics/Motivation for further Research:

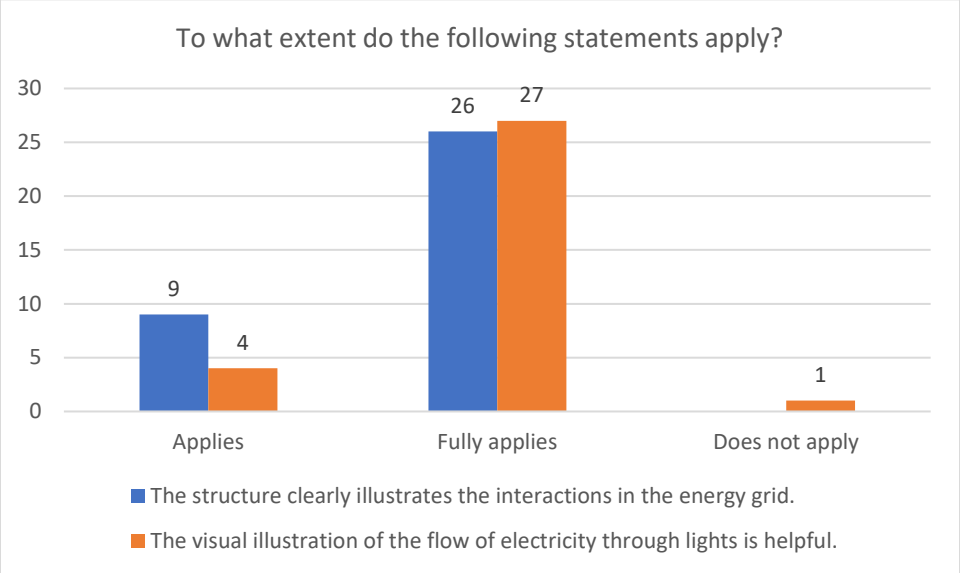


Figure 23 Coverage of topics at Science Night at RWTH

The results in Figure 23 demonstrate that the LEGOS demo effectively visualizes interactions in the energy grid and illustrates the flow of electricity to the participants. This is indicating that the topic of smart grids is conveyed to the participants with the features of the demo.

Skill Gap Mitigation:

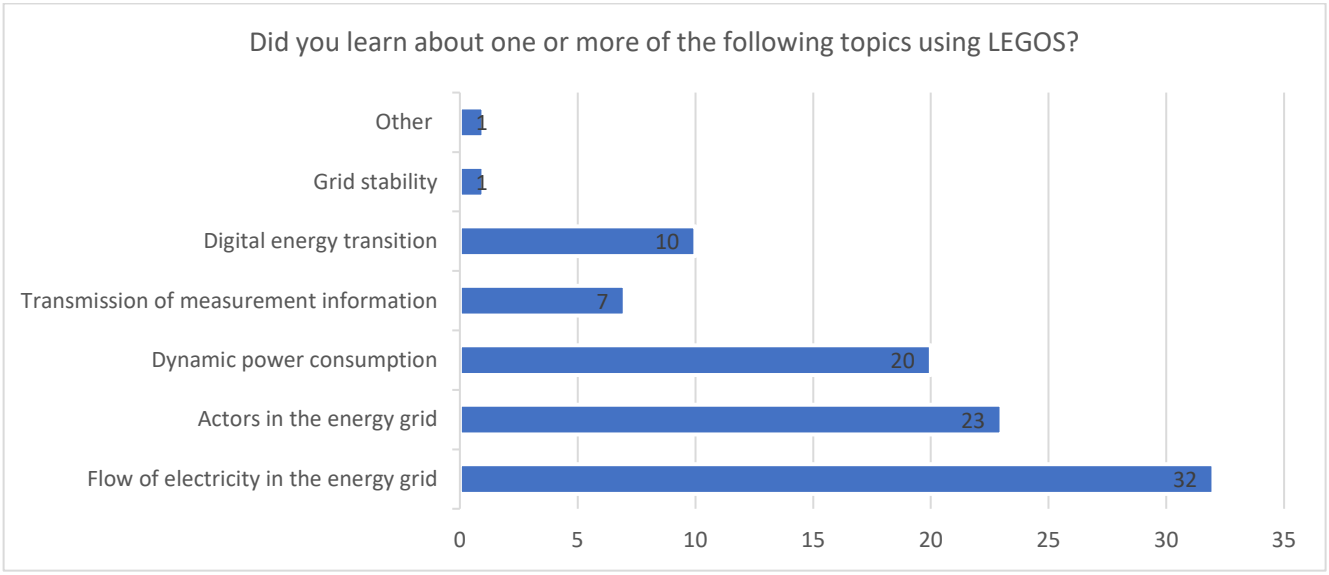


Figure 24 Skill gaps mitigation at Science Night

Figure 24 shows that participants knowledge has increased in topics such as electricity flow, energy grid actors and dynamic power consumption.

Recommendations:

Table 2 Feedback on the LEGOS demo according to participants of Science Night at RWTH

Is there anything you especially like about LEGOS?	Is there anything you do not like about LEGOS?
• Stable structure • Interactivity • Excavator • Hospital • Diversity of actors in the grid, particularly in the hospital context • Vividness • Computer center • Dynamic representation of the power station • Visual representation • Visualization • Sparkling lights and visual appeal	• Blue light not flashing • Wobbly contacts • White roof at the stadium • Limited possibilities due to small size • Absence of a dashboard

In Table 2 the positive and negative feedback of the participants on the LEGOS demo is listed. Participants expressed diverse positive sentiments about LEGO, praising its stable structures, interactive nature, and specific entities of the model. But there are also some observations of the participants of the demo indicating possible improvements of the demo. It is recommended to consider this feedback in the further development of the demo.

3.1.6. Workshop on Data Platforms for the Energy Infrastructure

The Workshop on Data Platforms for the Energy Infrastructure was organized for participants from the local municipality in Herne, industry and university. In total 12 people participated in the workshop and survey.

Demographics:

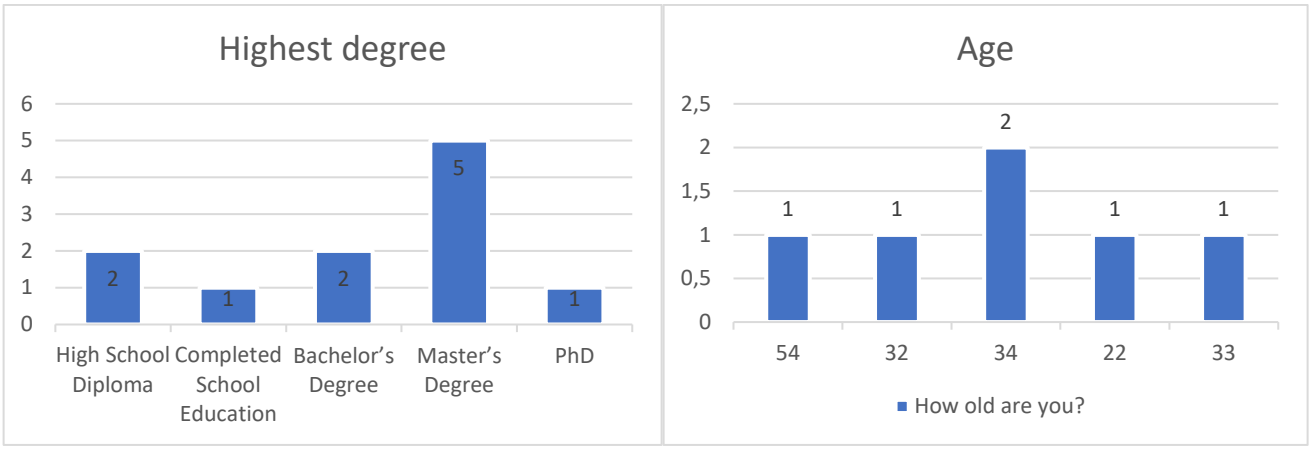


Figure 25 Age and highest degree of participant of the Workshop on Data Platforms

Not all participants have indicated their age in the survey. However, the answers indicate a board age range between 22 and 54 years. The educational background of the participants is diverse with the majority having a master's degree.

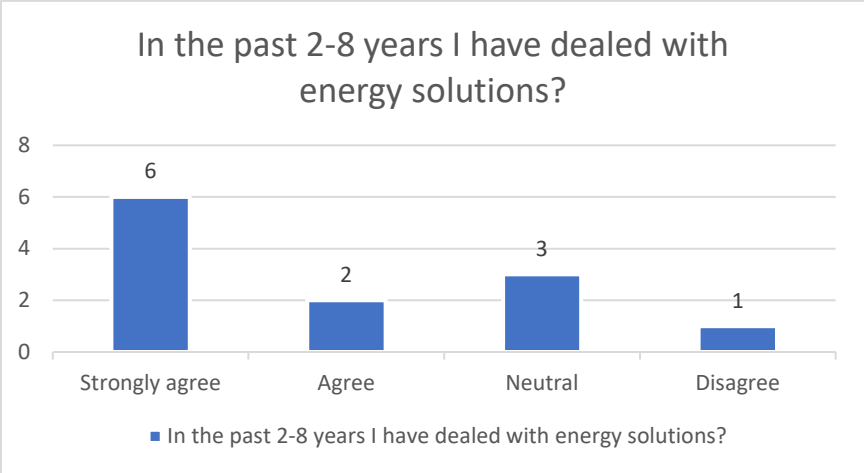


Figure 26 Engagement of the participants with energy solutions

The participants were also asked about their activity in regard to energy solutions in their professional career. The answers are showing that the majority are dealing with energy solutions in their professional career and have experience in it. This is indicating that the workshop is a upskilling opportunity for the participants.

Coverage of Topics/Motivation for further Research:

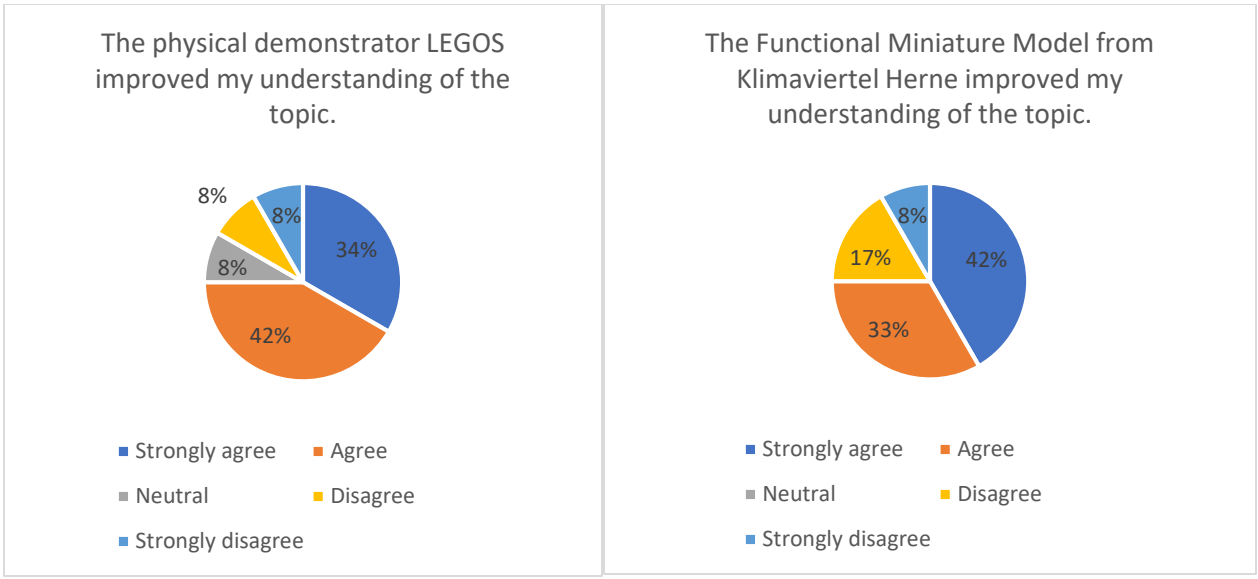


Figure 27 Feedback of the participants on the demonstrators in the Workshop on Data Platforms

The use of the physical demonstrator in the workshop helped the majority of participants to improve their understanding of the topic. This is indicating that the use of the demonstrators was successful.

Skill Gap Mitigation:

The workshop participants were queried with the same questions both prior to and subsequent to the workshop. Table 7 displays the average improvement in understanding of topics listed in the table. In average, participants increased their knowledge significantly after the workshop in the following topics: smart grids, business concepts for smart city solutions in the energy transition, and open-source technologies like MQTT and FIWARE.

Table 3 Average improvement after the Workshop on Data Platforms for the Energy Infrastructure

Question	total difference	**average improvement**
How do they rate your level of knowledge in terms of...		
... the generation of electrical energy by the solar cells from photovoltaic systems	3	**25%**
... stationary battery storage	4	**33,33%**
... electric cars as consumers	1	**8,33%**
... technical correlations of a solar-battery-consumer system	5	**41,67%**
... smart grids	8	**66,67%**
... business concepts for smart city solutions in the energy transition	7	**58,33%**
... open-source technologies like MQTT and FIWARE	9	**75%**

Recommendations:

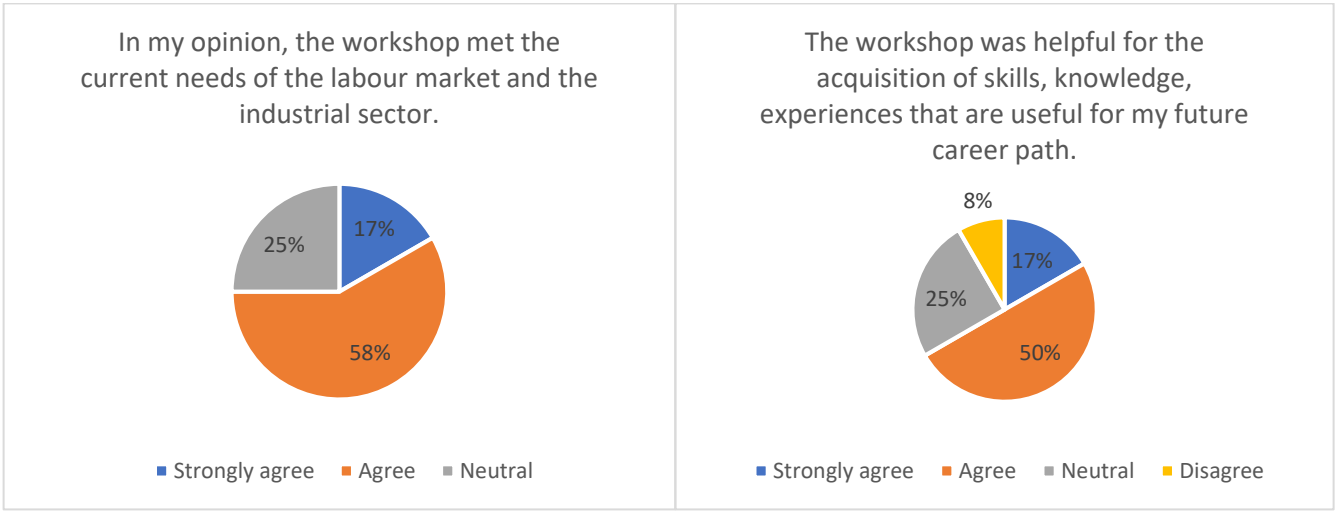


Figure 28 Feedback of the participants on the Workshop on Data Platforms

The majority of the participants agree that the workshop was targeting the right needs of the energy sector and increased their knowledge (see Figure 28). Also, according to the conductors the workshop was received positively. The interest of the municipality employees in the LEGOS demonstrator was very high, and there was a request to showcase the demonstrator at future city events for the public. Therefore, it is recommended to continue the collaboration with the city of Herne.

3.1.7. Leonardo lecture on energy transition

The Leonardo lecture series “Energy Transition – Potential Tension between Economy, Politics and Science” at RWTH is an interdisciplinary teaching series of lectures open to all students. Lecturers from different scientific backgrounds and industry collectively offer this course to a broad audience by highlighting different parts of the energy transition. Depending on the study regulations and performance, 2 ECTS credits can be acquired through participation and a protocol with a critical analysis. In addition, a Certificate of Participation (0 ECTS, not graded) is possible. The main part of this pilot activity is the lecture “Digital Energy Revolution” by Prof. Monti from the Institute for Automation of Complex Power Systems highlighting the topic digitalisation of the energy system and the lecture

"Urban Electrical Energy Systems" by Prof. Ponci from the Teaching and Research Area Monitoring and Distributed Control for Power Systems.

Demographics:

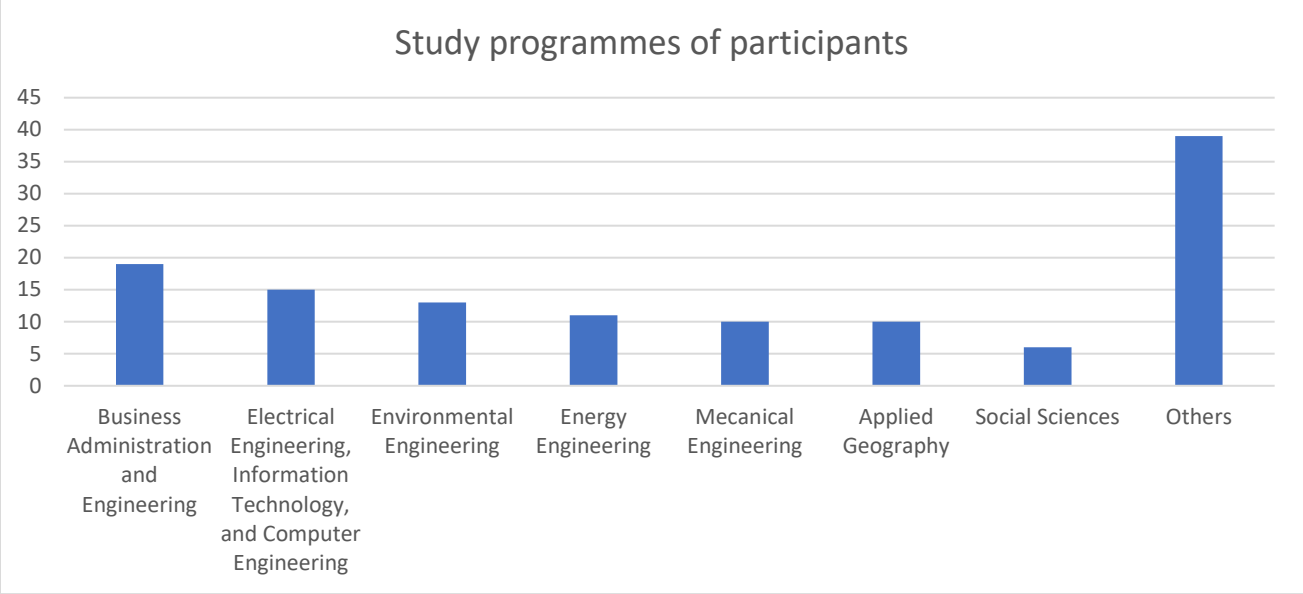


Figure 29 Study programmes of participants in Leonardo lecture on energy transition

Figure 28 shows the number of participants in the whole Leonardo lecture series on "Energy Transition – Potential Tension between Economy, Politics and Science" at RWTH. The survey results indicate a varied participation in the event across different study programmes. Business Administration and Engineering (mechanical and electrical engineering) attracted the largest group with 19 participants. Electrical Engineering, Information Technology, and Computer Engineering followed closely with 15 participants. Environmental Engineering and Energy Engineering garnered 13 and 11 participants, respectively. Mechanical Engineering and Applied Geography both had 10 participants each. Social Sciences had a comparatively lower participation with 6 participants. The category of Others includes study programmes whose participation was below 5 participants per program, such programs are chemistry, informatics, physics, etc. Overall, the participation distribution underscores a rich mix of academic interests, displaying the event's appeal across a broad spectrum of study programmes.

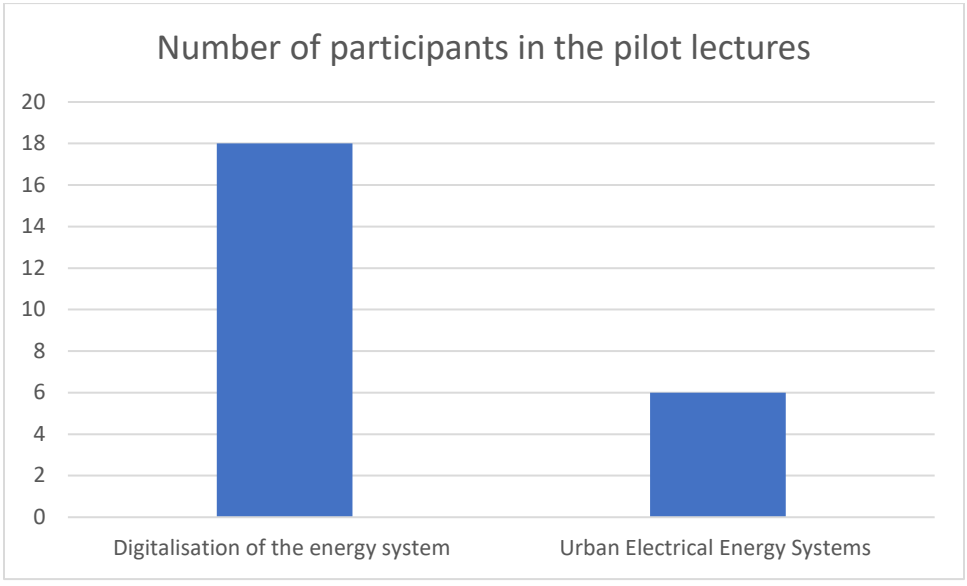


Figure 30 Number of participants in the pilot lectures

Number of participants in the lecture “Digitalisation of the energy system” was 18, while in the lecture “Urban Electrical Energy Systems” was 6.

Skill Gap Mitigation:

The gained knowledge during the first lecture “Digital Energy Revolution” was evaluated immediately after the lecture through a quiz. The quiz had four questions and they are shown in the figure below. The right answers are marked in a red box. Number of participants was 18.

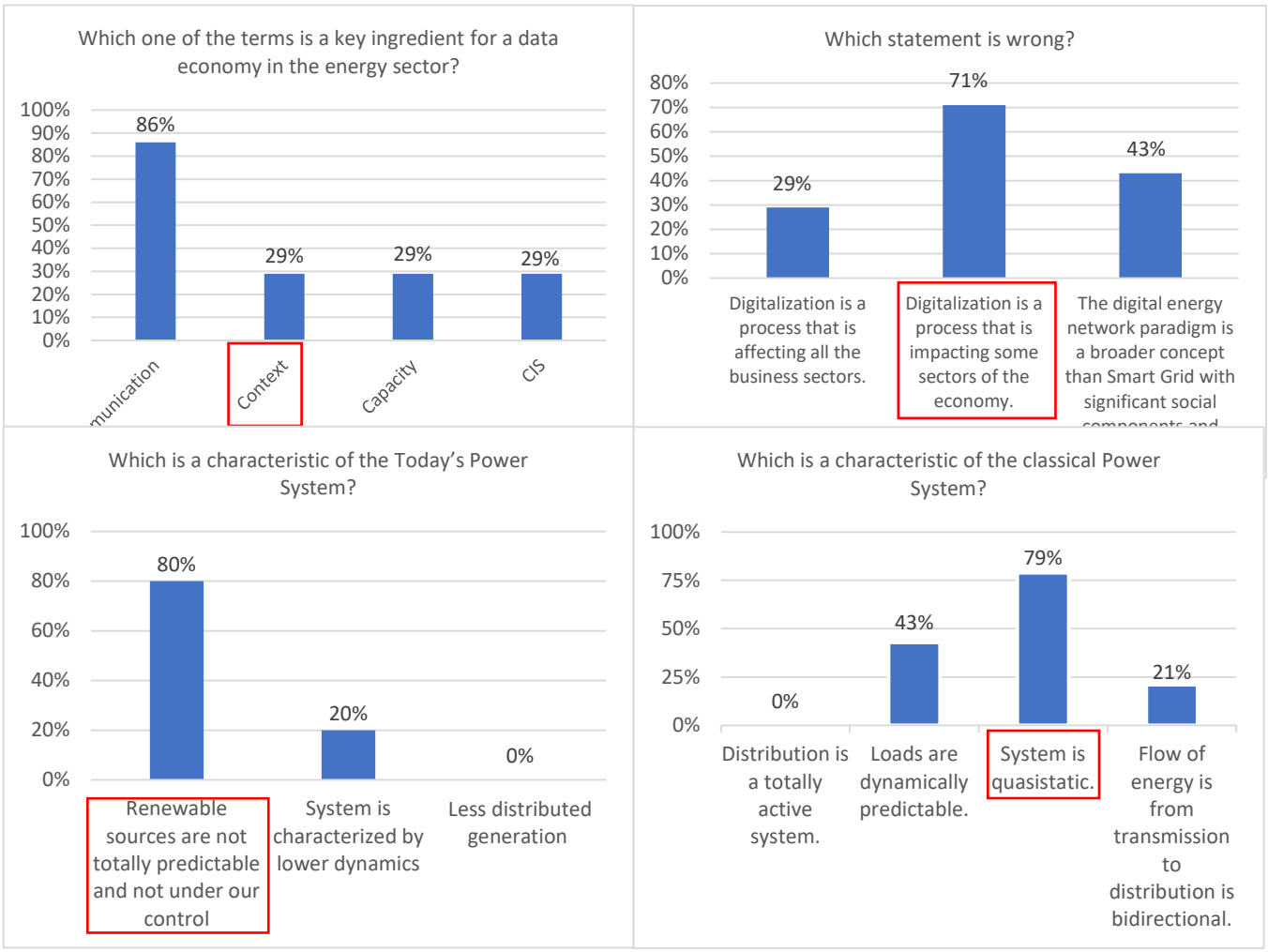


Figure 31 Skill gap mitigation in the lecture “Digital Energy Revolution”

The results of the quiz show that students were able to comprehend the knowledge of the lecture by scoring more than 70% of correct answers in 3 out of 4 questions. The goal of the quiz was also to foster more interactive lecture session by using Pingo platform.

Figure 32 Participants opinion on how to make urban energy systems better in the lecture "Urban Electrical Energy Systems"

In lecture "Urban Electrical Energy Systems", participants were asked to give their opinion on what would make urban energy system better. The results are shown in the picture below.

Recommendations:

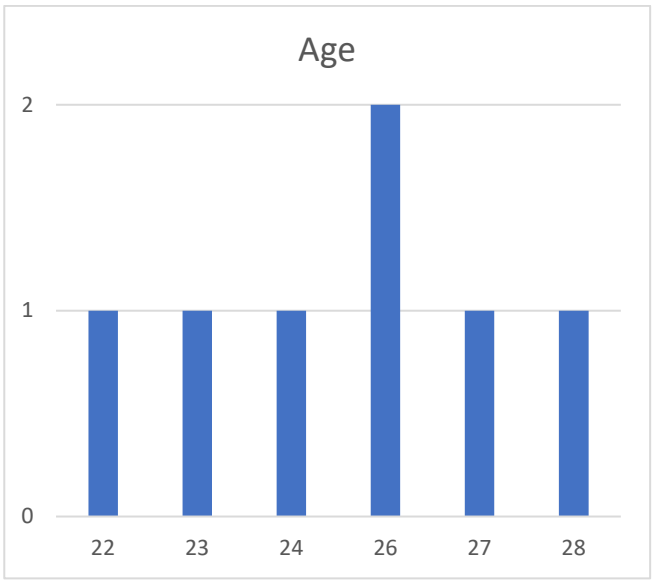
The overall lecture series received a very positive feedback highlighting that topics were exciting, interesting and very well structured. In some lectures, it was advised to focus even more on the energy transition and to provide a concrete measures. Furthermore, it was advised to perform a better time management so that everything can be presented. Considering the diverse and substantial turnout across various study programmes, it is evident that continuing participation in the event would further foster collaboration, knowledge exchange, and interdisciplinary engagement among participants.

3.1.8. Future energy systems lecture on digital energy

The pilot activity "Future energy systems lecture on energy digitalisation" is a Master level course and a highly interdisciplinary lecture series presented by different chairs. The lecture gives a comprehensive overview of the essential elements of the future energy system as well as important topics of sector coupling. In this lecture series, the Institute for Automation of Complex Power Systems has one lecture on the topic "Digitalization of the Energy System" by Prof. Monti. After the lecture, a survey is conducted and the results are elaborated below. The number of participants was 7.

Demographics:

Figure 32 show the age range and education level of the participants in Future energy systems lecture on digital energy pilot. The age of participants vary from 22-28 years and vast majority has a Bachelor's degree.



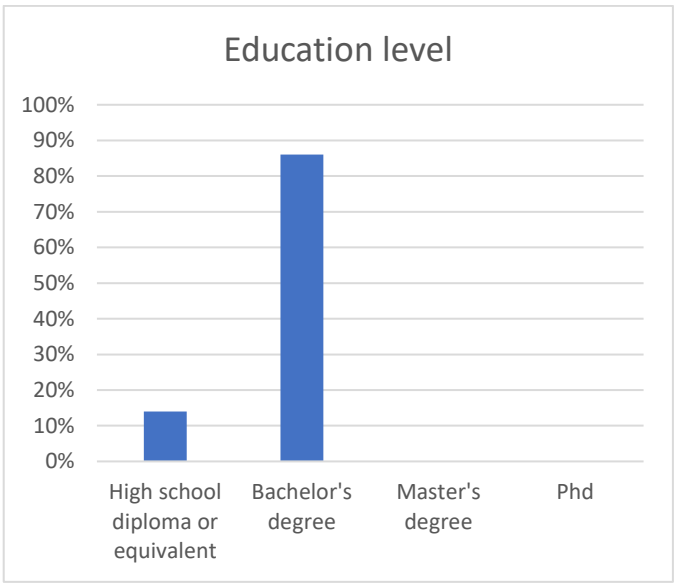
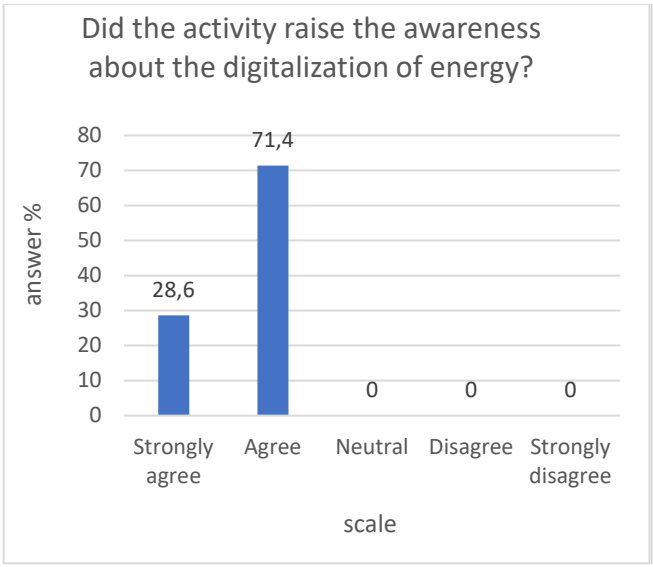
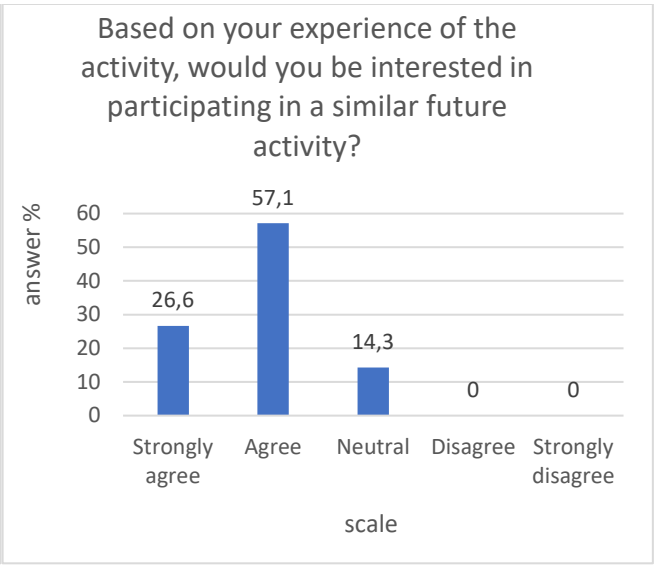


Figure 33 Age range and education level of participants in Future energy systems lecture on digital energy pilot

Coverage of Topics/Motivation for further Research:





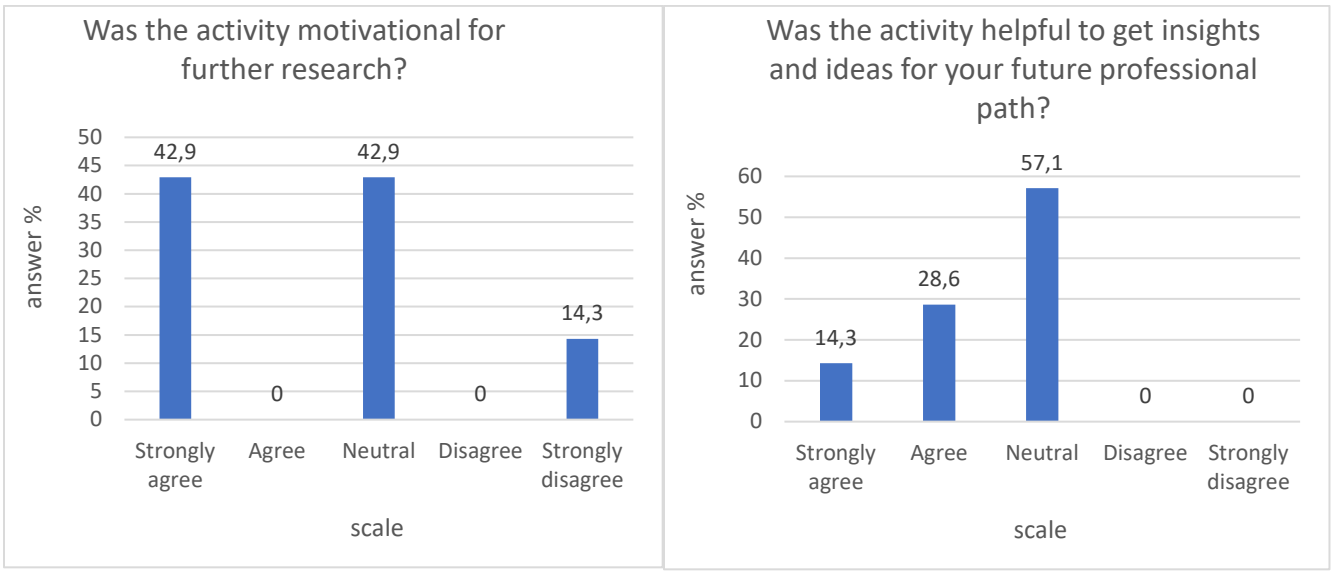


Figure 34 Results of Future energy systems lecture on digital energy's survey

Figure 33 shows the results Future energy systems lecture on digital energy's survey on raised awareness and future research motivation. The results show that participants raised their awareness about the digitalization of energy and showed interest in participating in a similar future events. This pilot activity was partially successful in motivating students in future research and giving the insights and ideas for future professional path.

Skill Gap Mitigation:

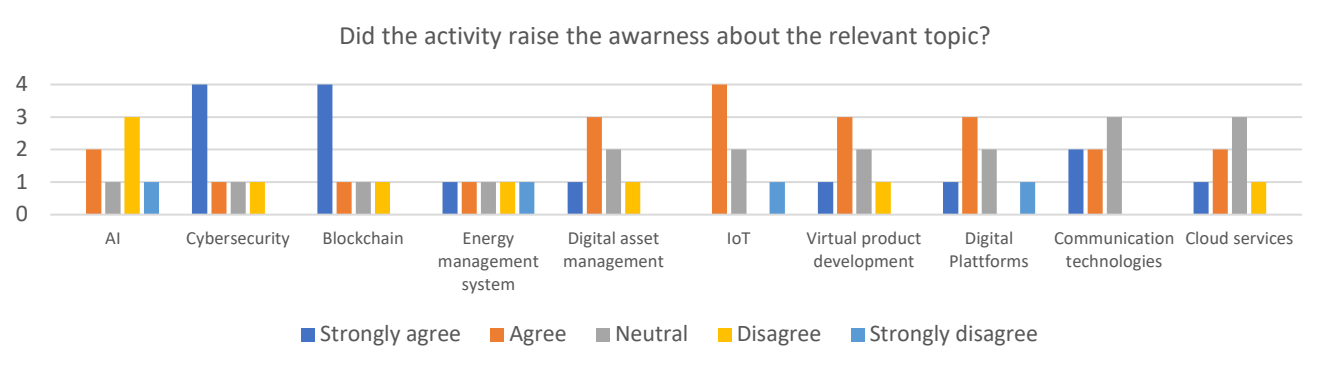


Figure 35 Skill gap mitigation in the Future energy systems lecture on energy digitalisation

In figure 17, we can observe that activity was particularly successful in raising the awareness about cybersecurity and blockchain. Furthermore, we can observe that participants agree that the pilot activity raised the awareness about the digital asset management, IoT, virtual product development, and digital platforms. The activity raised the least awareness about AI.

Recommendations:

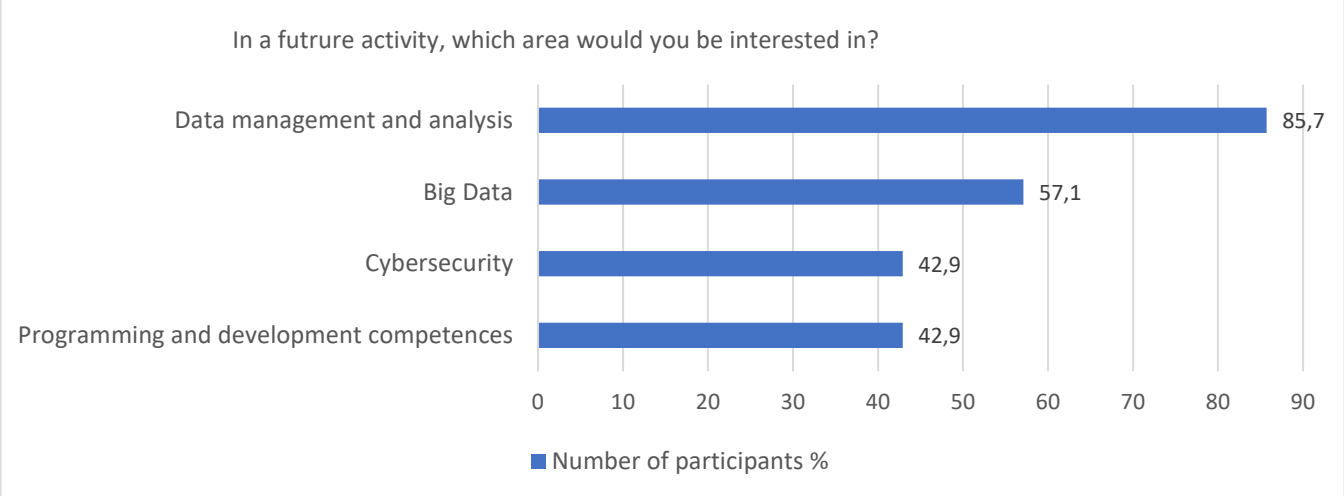


Figure 36 Interest of participants in similar future activities after the Future energy systems lecture on energy digitalisation

Since survey showed a partial success in motivating student for future research and giving the insights and ideas for future professional path, this could be improved for the next year and in similar events. Giving students an overview of future professional paths in the digitalization of energy may be beneficial in motivating them for future research. Furthermore, the survey showed that participants are highly interested in data management and analysis, and partly interested in big data, cybersecurity, and programming and development competences. These topics can be a good indicators on what to focus in future events.

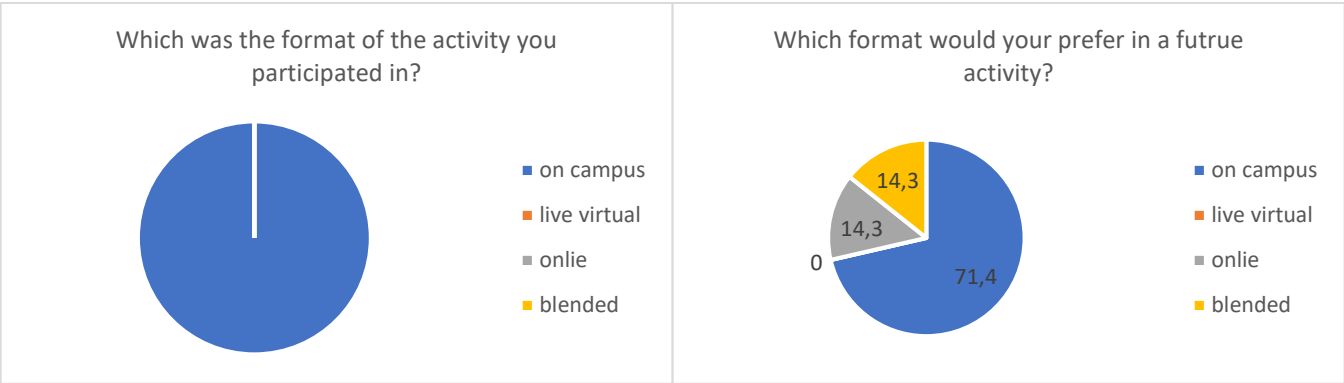


Figure 37 Preference of a format of future activities after the Future energy systems lecture on energy digitalisation

This pilot activity was on campus, and the survey show that the majority is interested in having such activities on campus/in person.

3.1.9. ACS lecture on automation of complex power systems

The Automation of Complex Power Systems Institute at the E.ON ERC of RWTH University offers the lecture ‘‘Automation of Complex Power Systems’’. It provides an introductory course on current research topics in modern power systems. The course can be taken from 16 different study plans within the faculties Mathematics, Computer Science and Natural Sciences, and Electrical Engineering, Information Technology, and Computer Engineering.

As part of the EDDIE project, additional learning methods were implemented in the Automation of Complex Power Systems course at RWTH Aachen University. The aim was to enhance traditional lecture content delivery with blended interactive and active learning techniques, addressing the needs for improved hands-on skills and stronger conceptual foundations.

Specifically, the following pilot methods were introduced:

- New lecture scripting- To provide students with an effective study aid and knowledge reinforcement tool, a new written lecture script was developed based on the video lectures delivered by Professor Monti. The full script was completed prior to the course exam and provided to all students electronically. This allowed them ample time to review the organized, explanations of all course material as exam preparation.
- Interactive Pingo questions - Multiple choice questions were inserted into lectures and exercises to actively engage students, gauge understanding of concepts in real-time, and strengthen knowledge retention.
- Live coding demonstrations - The instructor performed live coding of voltage control algorithms and filters in front of the students during lectures, responding directly to industry feedback on lacking hands-on experience.

Demographics:

At RWTH University, attendance is not mandatory and due to that, it was not tracked. However, 73 students wrote the exam. 3 of them were bachelor's students because it is allowed if you are close to finishing your Bachelor studies to take Master's courses and recognize them later on when you are a Master's student.

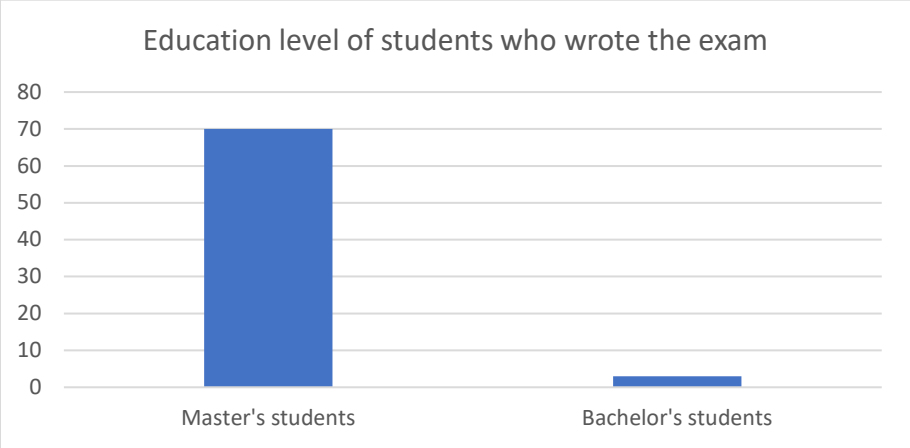


Figure 38

Coverage of Topics/Motivation for further Research:

The Automation of Complex Power Systems course provides students with a comprehensive understanding of the key concepts and technologies involved in automating modern power systems. The course covers several important topics related to distribution automation and control, including distribution automation and control functions, closed-loop control in power system automation, control of distributed energy sources, standards for distribution automation, and integration of renewable energy sources.

Communication systems for power systems are also covered in depth, with a focus on networking technologies and communication protocols. Additionally, the course introduces the Common Information Model (CIM). A semantic model, essentially a language to describe the entire grid architecture including cables, transformers, generators, etc. using standard definitions and terminology. CIM provides a data model associating class structures and names to specific quantities and system components. This classification logic applies to any network component, so that each element has a unique name and system association. This enables mapping real-time data from energy management systems (EMS) or distribution management systems (DMS) to a simulation model following the same information model structure.

The course format includes both lectures and exercises. To promote active learning and student engagement during lectures, the course incorporates the use of Pingo interactive questions. The professor presents multiple-choice questions to students at key points during the lectures, and students can vote on their response using their mobile

devices or laptops. The Pingo questions enable the professor to gauge students' understanding of lecture material in real-time and clarify or expand on concepts where needed.

The final exam for the course consists of both a question portion and a calculation portion. The Pingo interactive questions used during lectures help prepare students directly for the question portion of the exam by familiarizing them with the types of conceptual questions they will encounter. After the exam, we can analyze students' performance on the Pingo questions relative to their performance on the exam questions. This allows us to evaluate the effectiveness of the interactive questions for improving student learning outcomes.

Skill Gap Mitigation:

In the final exercise of the Automation of Complex Power Systems course, Pingo interactive questions were presented to students on topics related to the Common Information Model (CIM) and demand-side management (DSM). The goal of the final Pingo questionnaire was to evaluate knowledge transfer from the lecture to the exercise, as well as provide a comparison between students' Pingo performance and their results on the final exam in these topics.

To analyze the effectiveness of the interactive Pingo questions in reinforcing key concepts, we will present the answer statistics from the final Pingo session. For each multiple-choice Pingo question given during the exercise, we show the relative frequency of responses for each answer. The correct answer for each question is highlighted in green.

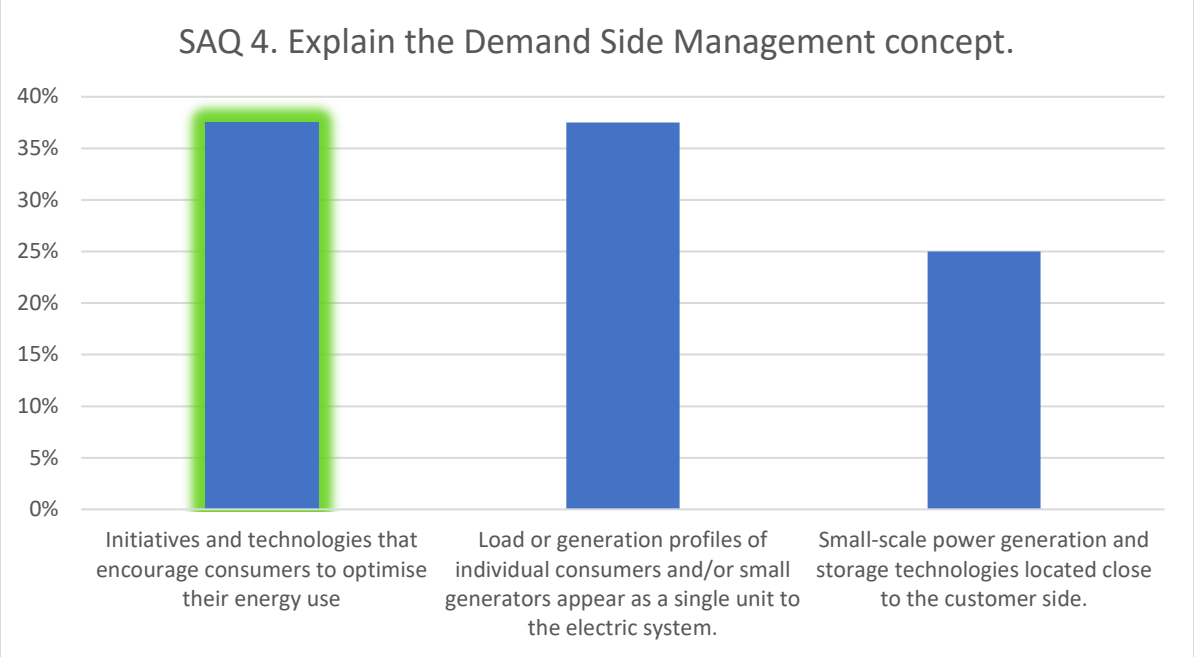


Figure 39 Skill gap mitigation on DSM concept

When asked to explain the general idea behind DSM, only 37% of students selected the correct response - "Initiatives and technologies that encourage consumers to optimize their energy use." Many students incorrectly associated DSM with distributed energy resources. This suggests that many students conflated the concepts of DSM and distributed energy resources.

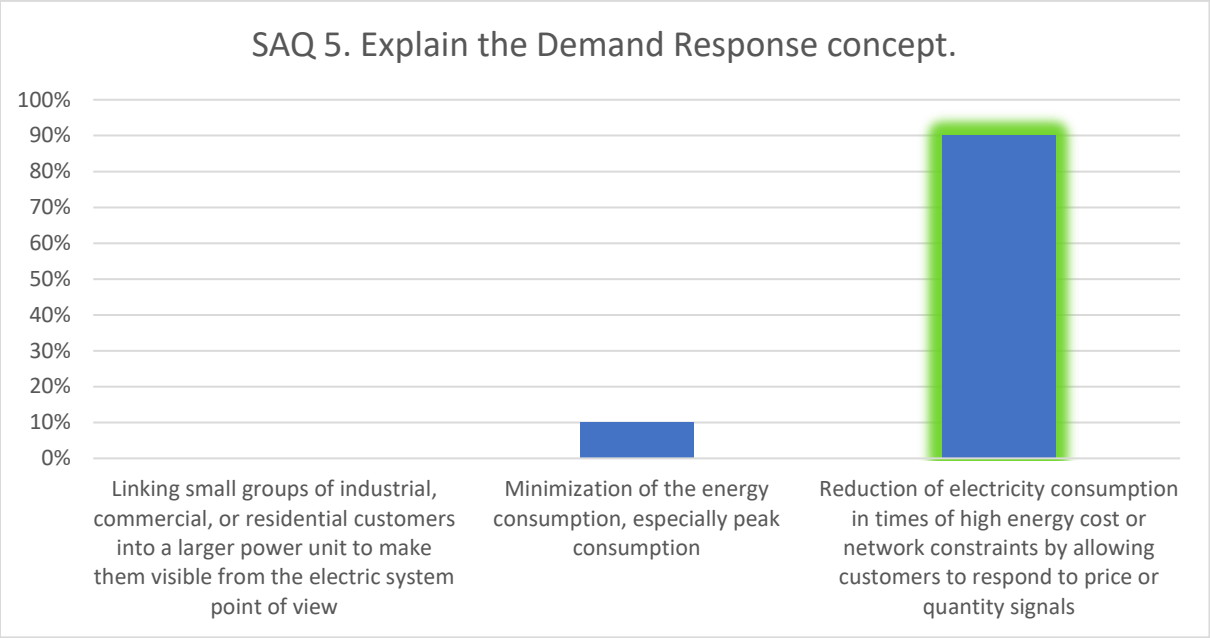


Figure 40 Skill gap mitigation on Demand Response concept

In comparison, most students answered correctly when asked to explain demand response (DR), recognizing it as "Reduction of electricity consumption in times of high energy cost or network constraints by allowing customers to respond to price or quantity signals."

The contrast between student performance on defining DSM versus DR indicates stronger mastery of demand response concepts compared to the broader category of DSM. Students appear to have retained the specific idea of event-driven demand curtailment in response to market or grid conditions, but lacked comprehensive understanding of the full range of DSM approaches for shaping consumer energy use.

To evaluate students understanding of various DSM strategies, several numbered figures depicting different energy load shape profiles over time were presented during the exercise. Students were then asked to interactively vote on which figure corresponded to a particular DSM strategy, using the Pingo polling system. For each DSM strategy, the relative frequency of presented load shape chosen by students is shown, with the correct responses highlighted in green.

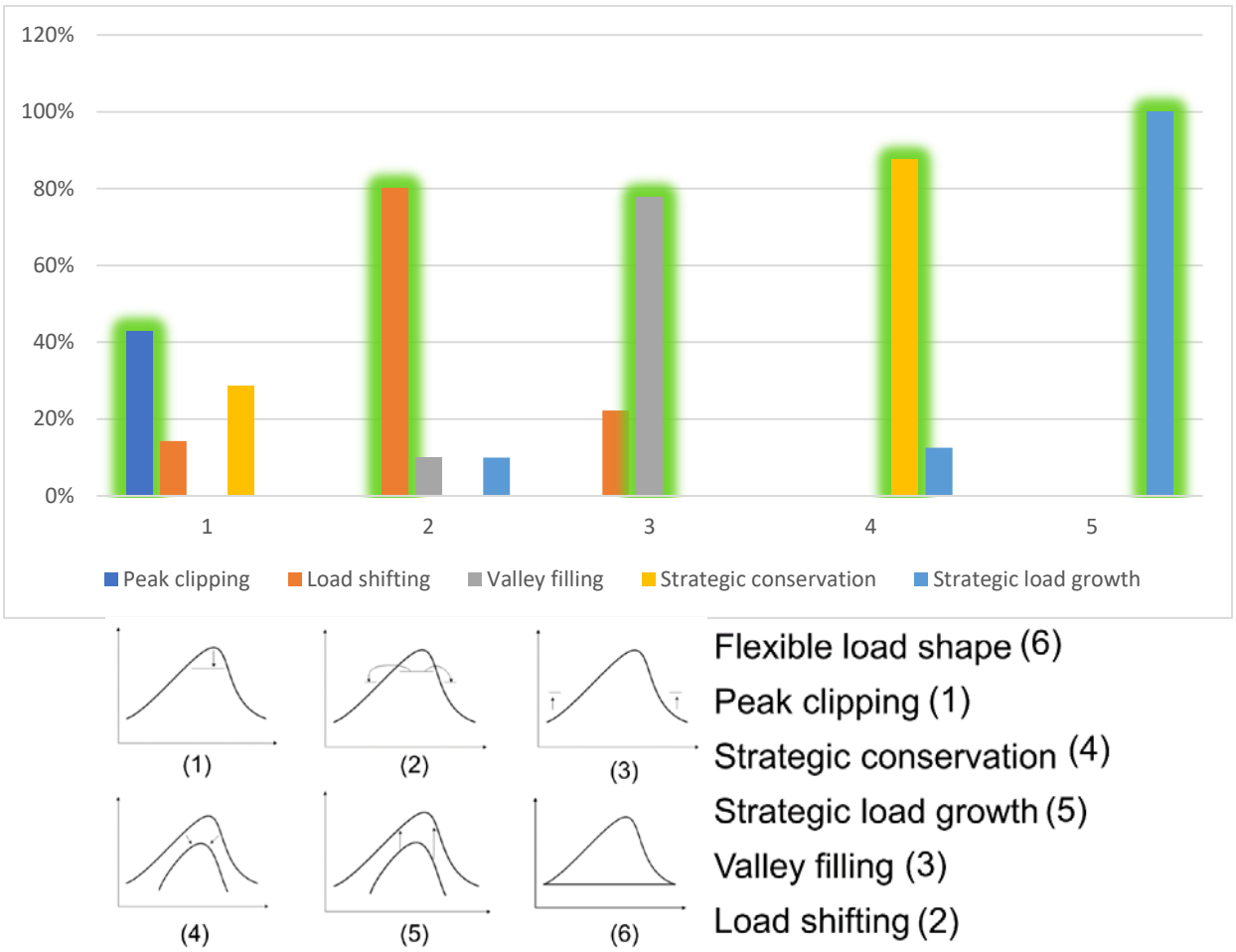
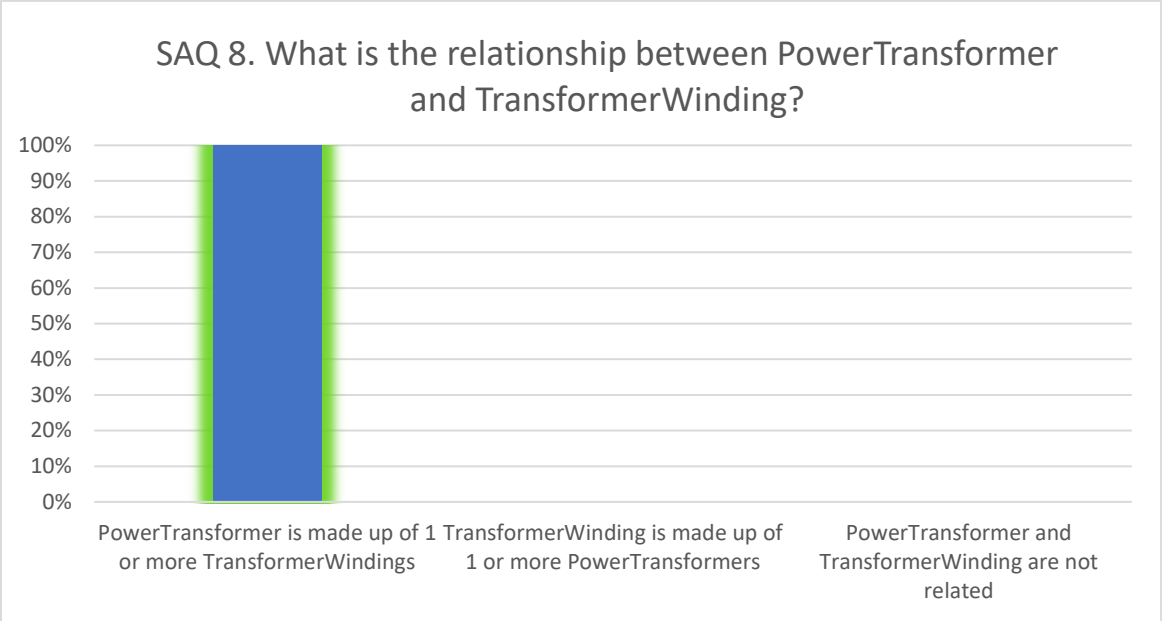
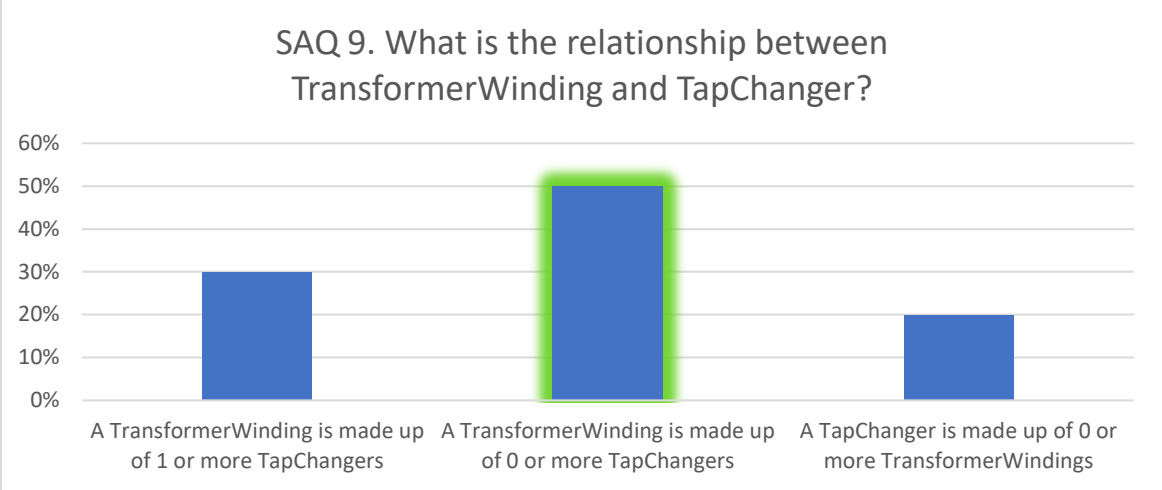


Figure 41 Skill gap mitigation on DSM strategies

The Pingo activity that required students to match load management techniques to graphical representations of load profiles provided useful insights into their mastery of these concepts. Specifically, the method that students were most easily able to identify was strategic load growth, with 100% answering correctly. This aligns with expectations, as the strategic load growth profile demonstrating new off-peak loads has a highly intuitive and distinct shape. Students were also largely successful at recognizing load shifting, valley filling, and strategic conservation based on their load graphs. However, the technique that caused the most difficulty was peak clipping. Students often confused this with strategic conservation and load shifting. The confusion appears to stem from the similar flattened shape of the load profiles for peak shaving, strategic conservation, and load shifting methods. Though the techniques differ, students struggled to discriminate based on the nuanced visual differences between these flattened load curves. The findings emphasize the benefit of using interactive visual identification activities to reveal gaps in associating foundational concepts like load management approaches with their tangible applications and outcomes.





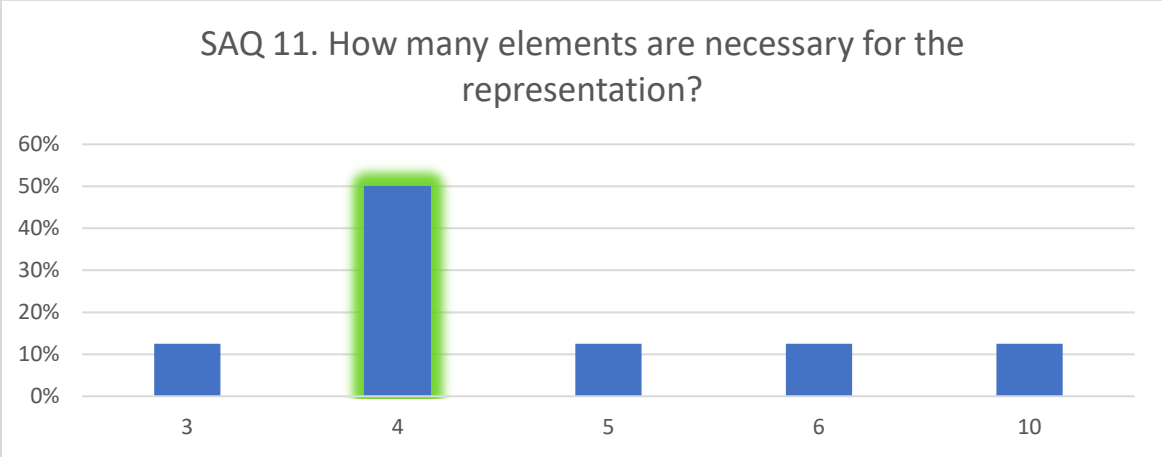


Figure 42 Skill gap mitigation on CIM

When asked about the relationship between the PowerTransformer and TransformerWinding classes, all students correctly identified that a PowerTransformer aggregates one or more TransformerWindings. However, only 50%

correctly answered that a TransformerWinding aggregates zero or more TapChangers when queried about the association between TransformerWinding and TapChanger.

Other students reversed the directionality of the relationship, answering that a TapChanger aggregates TransformerWindings. This suggests they comprehended the high-level one-to-many association but not the precise navigational direction between these CIM classes.

Now, we can compare student performance to their corresponding exam questions. Specifically, Question 3 on the exam focused on demand-side management (DSM) concepts, aligning directly with the material covered in the Pingo sessions leading up to the exam.

Exam Question 3 is part of the knowledge-based portion of the exam that the Pingo sessions were intended to prepare students for. It consisted of two parts:

- Part a) asked students to give a brief description of the general DSM concept, similar to SAQ4.
- Part b) tasked students with naming four specific methods of load management and sketching their associated load profiles over time. This relates directly to the Pingo exercises where students identified peak clipping, valley filling, load shifting, strategic conservation in SAQ 6.

For Part a), students could receive a maximum of 2 points. For Part b, naming the four correct methods accurately was worth 4 points in total. Here we show the distribution of points received by all students in the exam for these two DSM tasks:

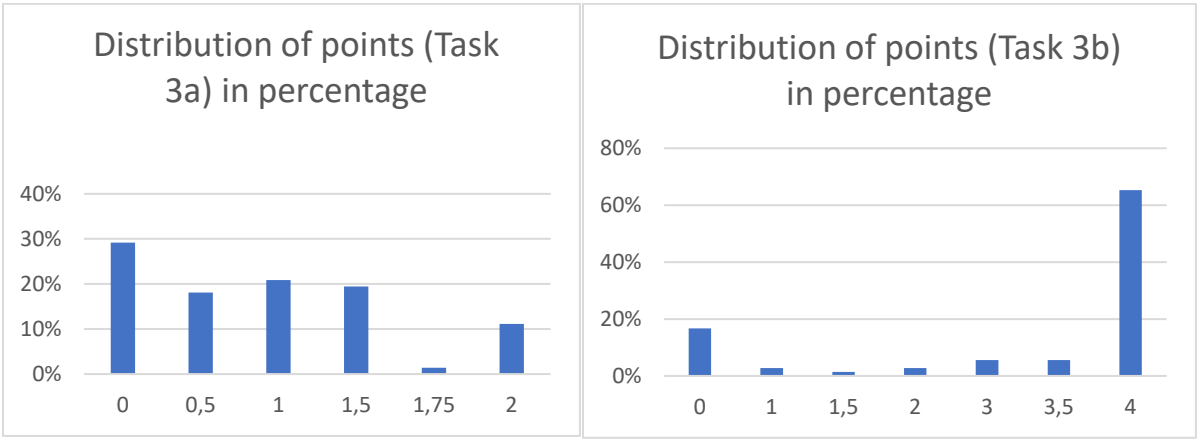


Figure 43 Skill gap mitigation on DSM in the exam

Comparing the exam results to the Pingo session statistics reveals several interesting observations. First, similar to the Pingo questions, students demonstrated more difficulty with Part a) of Question 3, which involved explaining the general DSM concept, versus Part b) which required identifying and sketching specific DSM methods.

In the original SAQ4, only 37% of students provided the correct response when asked to describe DSM. In the exam, this performance improved, with 53% of students scoring at least 50% of the points on the conceptual explanation part.

For Part b), students had already exhibited strong recognition of the DSM methods in SAQ6, with 80-100% correctly picking valley filling, load shifting, etc. This knowledge was replicated on the exam, where 65% of students scored full points on listing the methods, and 79% scored over 50% of points.

In both Part a) and b), we see an improvement in student performance from the interactive Pingo activities to the traditional exam scenarios. This suggests that incorporating intermittent knowledge checks and interactive engagement during lectures and exercises led to positive learning outcomes that translated to enhanced exam scores. The fact that students scored higher on recalling specific DSM techniques (Part b) compared to explaining general DSM concepts (Part a) in both cases indicates that they had mastered the concrete examples but needed more reinforcement on high-level conceptual knowledge. Overall, the analysis here demonstrates the utility of using targeted Pingo questions throughout the course to identify gaps in knowledge and improve retention of key concepts.

The exam included two questions assessing students' knowledge of utilizing the Common Information Model (CIM) in power systems. Students performed comparatively worse on these CIM questions than on the demand-side management (DSM) questions.

Exam Question 2 consisted of two parts:

- Part a) asked students why CIM is used for power systems.
- Part b) tasked students explaining a benefit from the harmonization of IEC61850 and CIM and to provide a example.

An interesting observation can be made here - the CIM exam questions were highly conceptual and quite different from the specific CIM relationship questions used in the Pingo exercises. In contrast, the DSM exam questions closely mirrored the topics and formats covered by the interactive Pingo activities. This divergence highlights the importance of closely aligning interactive learning checks with desired exam outcomes. The Pingo questions focused narrowly on deducing relationships between CIM classes, while the exam tested broader knowledge of CIM applications and standards mapping. The weaker CIM performance also echoes the conceptual gaps seen in the Pingo data on hierarchical relationships between model entities. Students demonstrated shakier mastery of abstract knowledge on ontological representations versus concrete applications like DSM techniques.

Together, these factors explain the poorer outcomes on the conceptual CIM exam questions compared to the very well-aligned DSM questions. The results underscore the need to incorporate a diversity of interactive exercises targeted at both theoretical foundations and applied skills when preparing students for multifaceted exam topics.

By comparing student exam performance between the SS22 and SS23 iterations of the course, before and after implementing the new interactive learning methods, we can evaluate the impact of these methods on learning outcomes.

Notably, even with an increased passing threshold of 50% versus 44% previously, the average exam grade improved from 2.64 in SS22 to 2.55 in SS23. Applying the old 44% cut-off to the SS23 exam would have further improved the average to 2.31. Specifically looking at the question portion of the exam, which the new Pingo activities directly targeted, the average score increased from 55% correct in SS22 to 62% correct in SS23.

Recommendations:

The results provided in the Skill mitigation section show quantitative evidence that the blended interactive and active learning methods piloted in SS23 improved student exam performance and knowledge retention compared to the previous traditional lecture format. The significant increases in average scores and question part accuracy highlight the benefits of interleaving targeted knowledge checks and discussions during instruction. Keeping students actively engaged appears to have strengthened conceptual mastery and equipped them with better retention and recall on relevant exam topics. Hence, we recommend a more interactive learning methods in other course and keep this trend in the ACS course as well.

3.1.10. Key findings

The results and the analysis of the responses has yielded several key findings regarding the assessment of pilot activities:

- Participants of pilot activities in Aachen were from EQF level 1 until 8, and the vast majority showed interest in the digitalization of energy systems.
- In lower EQF levels (1-2), it is noted that there is a lack of school subjects that cover electrical engineering topics. This can be seen as the opportunity to incorporate such topics in lower EQF levels in order to foster interest in electrical engineering and its digitalization from a very young age.
- Pilot activities were designed in a way so that participants were able to increase their knowledge in topics such as energy management systems, smart grids, and energy transition.
- Results of surveys showed that there is still a place for progress in motivating students in choosing professions related to digitalization of energy systems. This could indicate an encouragement in conducting more activities related to digitalization of energy systems.
- In ACS lecture on automation of complex power systems, it was conducted that students better preform in tasks with more a more detailed topics than in high level tasks. Furthermore, this pilot activity showed that

interactive learning methods increased the performance of the students in the exam compared to earlier years.

- In Future energy systems lecture on energy digitalization, it was conducted that the vast majority is highly interested in data management and analysis same as the students in Athens.

3.2. Field test Cologne

The field tests in Cologne, three activities, are planned but only partly carried out. There were unexpected delays due to a lack of registration for the program. The first two lectures of the pilot have taken place. However, the questionnaires were not sent out at this point in time, as the number of attendees is limited, and the lecture series was planned for two semesters. For the EWI Academy, the courses were developed and there are multiple events planned, but none have taken place during the period of the evaluation. It is planned that questionnaires will be distributed during the implementation phase and results analysis will be included in the updated version of the deliverable.

3.3. Field test Athens

In the field tests of Athens, four activities are planned to be deployed. As of the development of this deliverable, two of them have already been carried out. The lectures on local energy markets, energy communities and blockchain applications, as well as the lectures on AI applications on energy systems: Dynamic security and forecasting have been presented to the students enrolled in the NTUA MSc program “Energy production and management” in the context of the course “Digitalisation of energy systems” during May 2023.

The questionnaire was distributed to all the participants of the lectures (approximately 15 in all lectures) and 12 of them responded and completed it.

Survey results

Demographics

Figure 20 and Figure 21 show the age of the participants and the highest level of education completed. As the participants were students of the MSc program, the answers were clustered in ages 18-24 and 25-34, as the level of education concentrated between BSc and MSc degrees, as expected. Regarding the participation format of the activities, all the students attended the lectures on-site, as scheduled by the administration of the MSc program.

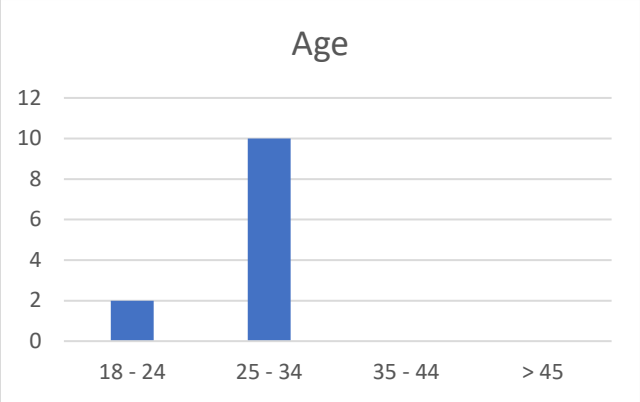


Figure 44: Age of the participants in lectures of pilot site Athens

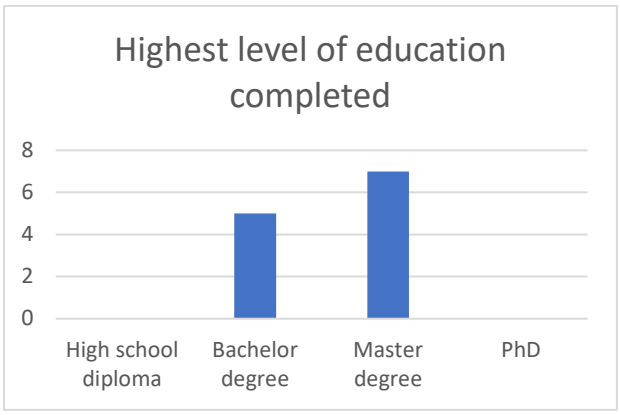


Figure 45: Educational level of the participants in lectures of pilot site Athens

Coverage of the topic / motivation for further research

At this stage, the extent to which the content of the activities covered the relevant topic was examined. Before examining this, it should be stated that the required skills for the participation in the activities were well described for most of the students. This was slightly expected, as it refers mostly to the requirements of participation in the MSc program and not to the lectures developed in the context of EDDIE and are part of a specific course.

Then, students were asked to evaluate the coverage of the lectures regarding the main topic, using the 5-point Likert scale. The main points of the results are:

1. For all of the topics the vast majority of the participants do not disagree with the extent of topics' coverage.
2. The least satisfaction is presented for the general point of digitalisation of energy
3. Topics like local energy markets and RES forecast, which are more closely related to the general content of the MSc program (Energy production and management) present a higher understanding rate, than Blockchain and machine learning
4. The development of the skills connected to the lectures' topics was evaluated as sufficient by the students, but still measures and adaptations need to be carried out.

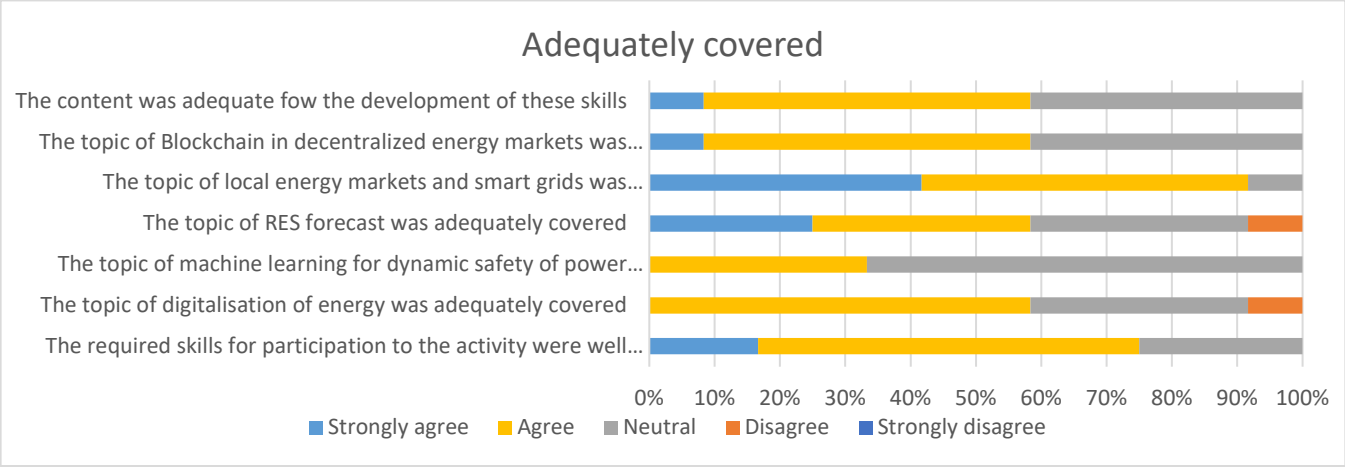


Figure 46: Results of topics coverage in lectures of pilot site Athens

A crucial point is the examination of the motivational character of the activities, to ensure the engagement of the participants with the constantly evolving sector of the digitalisation of energy. In this direction, the following figure presents the responses of the participants to the questions "Was the activity helpful for gaining skills, knowledge,

experience, useful for your future career path" and "The activity was motivational for further research regarding the topic. The key point is:

1. The vast majority had a positive or neutral response to the activity's facilitation for further research and support their future career path. This can be positively evaluated and serve as a guideline to improve the content in the direction of raising the motivation of future participants.

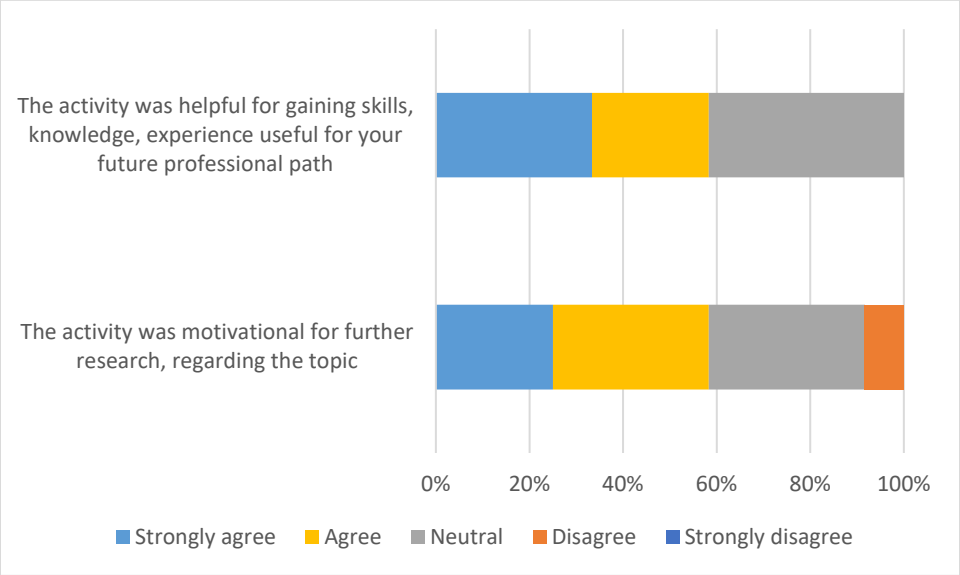


Figure 47: Motivation results for lectures of pilot site Athens

Skill gaps mitigation

The participants were asked to assess the effectiveness of the activities in mitigating the skill gaps. The results are presented in Figure 24. This insight is the major factor in the assessment of the activities, as it links the identification of skill gaps and the Blueprint strategy to the activities roll-out, aiming to provide valuable feedback to the Strategy. The skill gaps included in the questionnaires were chosen based on their relevance to the content of the lectures. The results seem to vary slightly across the mitigation of the various skill gaps. An explanation for this variation is that the lectures' intention was not to focus on all the mentioned skill gaps equally, rather than to target specific ones, taking into consideration the limited time available for the presentations. In this direction, the key points of the responses are:

1. The main topics of the lectures were Blockchain, Machine learning, Mathematical optimization and forecasting, as identified skills gaps. The mitigation attempt for these skill gaps seems to have sufficient acceptance from the participants
2. The skill gaps about Computing Tools and Platforms & Digital Platforms received the lowest agreement among the participants in terms of their effectiveness in tackling those specific gaps.

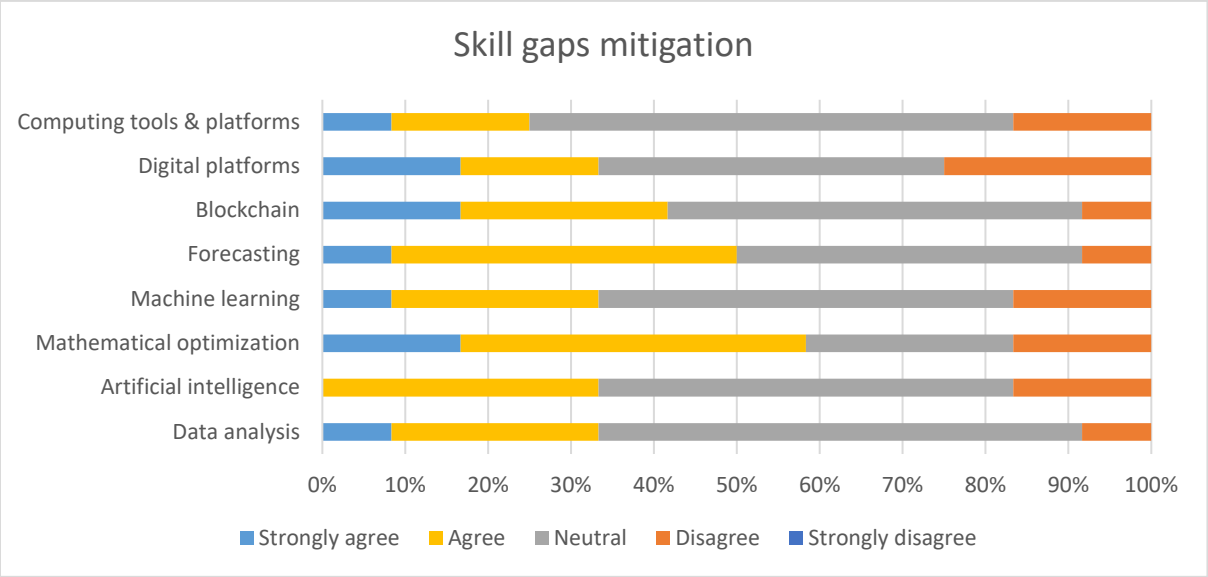


Figure 48: Skill gaps mitigation results for lectures in pilot site Athens

Moreover, the following figure illustrates the level of satisfaction of the students regarding the response of the activities content to the current needs of the labor market and the energy sector. The first insight is really positive, highlighting that the activities design was well-aligned with the current needs of the industry.

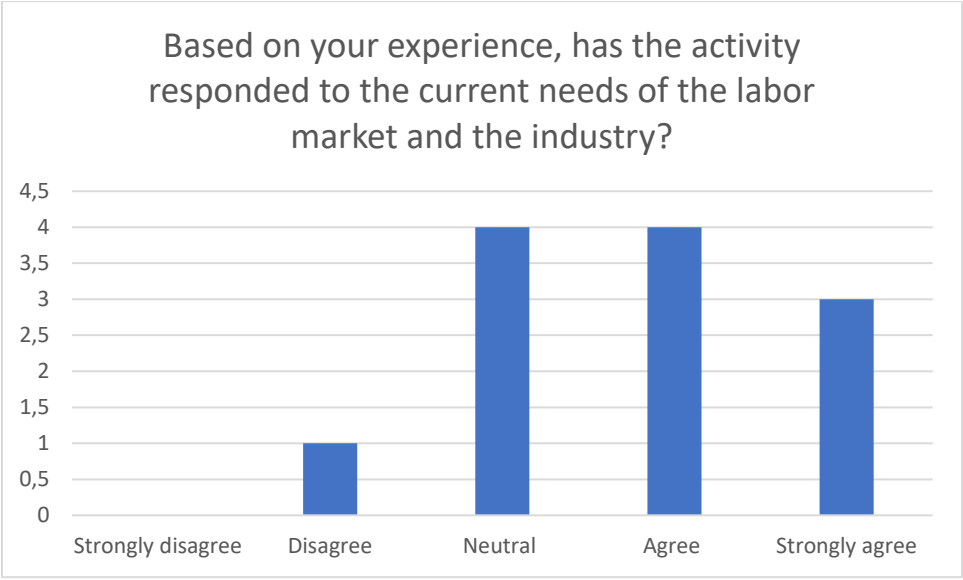


Figure 49: Results of relation with industry needs for lectures of pilot site Athens

Recommendations / future preferences

In the final stage of the analysis, the preferences of the participants regarding the topics for future activities and the format of these activities was investigated. As potential topic choices, the key areas of identified skill gaps were chosen. The results are presented in the following table. Notably, the majority of the students expressed their interest in participating in a future activity focused on data management and analysis. The second most preferred choice is cybersecurity. These two topics received less coverage during the MSc program, that the lectures are part of, yet they generate high interest among the participants.

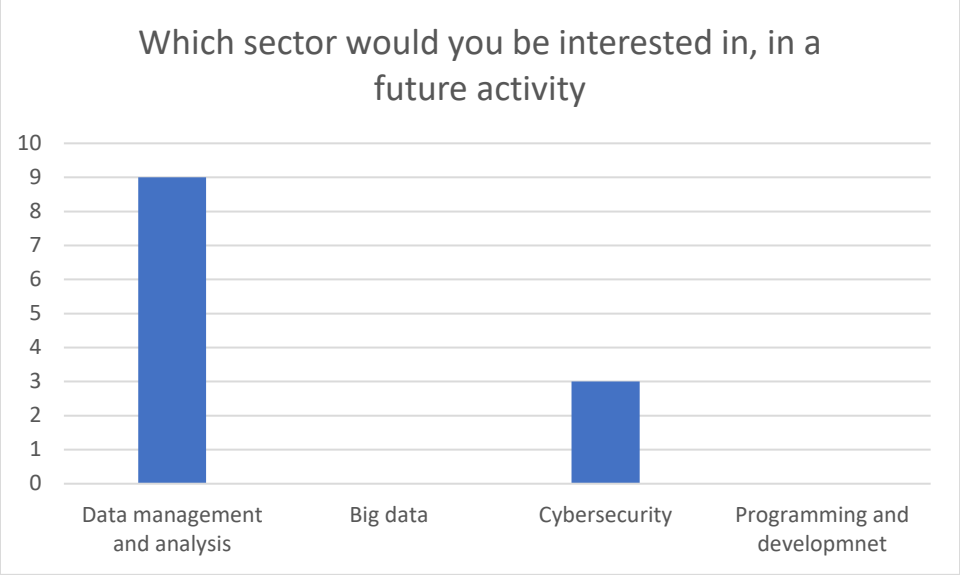


Figure 50: Future preferences of participants in lectures of pilot sites Athens

Regarding the preferred format of future activity, most of the students responded that on campus/on-site is the most likely way, showing that in the post-COVID era, students prefer to return to in-person learning experiences, that foster greater interaction.

The last part of the survey encouraged the participants to complete a free text with comments and recommendations for further improvements. Among the students who responded to this question, the key observation was that many of them expressed the opinion that the lectures should incorporate practical examples, real-time simulation of the selected examples and more focus on them, as well as the possibility to engage the students to the simulations and the configuration of the examples' simulated.

The two sets of lectures consisted of 4 lectures, each created and delivered by distinct presenters. Following the deployment of the activities and the questionnaires distribution, the presenters were asked to share their opinions on the design, development, and deployment stages of the lectures. Their feedback was notably cohesive, aligning closely not only with each other but also with the survey results.

Their initial feedback primarily focused on the design and development phases of the activities. The topic of Local Energy Market was considering as significantly challenging. The majority of the examined existing education material for the topic targeted mainly skilled professionals or researchers with previous experience on the matter. In this direction, to develop a lecture that provides a comprehensive overview of the topic but also goes deeper to more technical and specific topics of market formation and optimization was judged as a crucial obstacle to be overcome.

A similar concern emerged with the lectures on machine learning and artificial intelligence in power systems. The presenters encountered challenges in sustaining the participants' engagement when delving deeper into the connection between machine learning or artificial intelligence with modern power systems.

Both concerns prompted recommendations to include more practical examples into the presentations and also target not the results of the simulations, but primarily to the simulations architecture This approach aims to capture students' interest by encouraging active participation and potentially motivating them to explore creating their own simulations.

Creating a lecture on Blockchain posed a challenge due to the technology's recent emergence over the last decade and its wide-ranging applications. Consequently, the presenter had to assume no prior knowledge of this technology. The task involved creating content that not only introduces the subject but also explores how Blockchain can significantly improve the coordination of active distribution grids.

Concluding, all presenters highlighted the challenge of time constraints in delivering comprehensive coverage of their topics Building upon the previously mentioned concerns, the proposal arose to divide the content of the topics in multiple lectures. This solution would offer the opportunity to dedicate a lecture to the theoretical analysis of a

specific topic and another one to simulations and interactive examples, offering a more focused, in-depth and interactive approach.

Key findings

The results and the analysis of the responses have yielded several key findings regarding the assessment of the four lectures:

1. The coverage of the topics was found to be adequate. That was achieved by utilizing various of tools of the Blueprint strategy, aiming to design and implement up-to-date and motivational activities.
2. The digitalisation of energy was not identified as a crucial topic covered by the lectures, even though the mitigation of more specific skill gaps was evaluated as sufficient. This fruitful insight points out the need for a more general approach that will highlight the cross-sectoral nature of digitalisation in the energy field.
3. Computing tools and platforms along with digital platforms were identified as the least mitigated skill gaps. This result could be connected with the main recommendation of the students, that they expect more hands-on involvement in simulations, utilizing computing tools.
4. The most preferred area for future education/training activities was Data management and analysis. Even though the survey was distributed to MSc students that have already completed their BSc programs in similar sectors, Data management and analysis is highlighted as an area with high interest from students, and therefore the need for comprehensive coverage.
5. To increase participants' engagement and comprehension, it is crucial to integrate more practical examples and interactive simulations. To achieve this objective, the extension of the activities' duration is proposed.

3.4. Field test Milan

The field test in Milan is mainly based on offering a main training opportunity on improving knowledge and competences linked to the energy manager role. In this frame, the MOOC realized under the project has been proposed on two different platforms with quite different targets:

1. POK addresses mainly to Italian catchment area with a majority of university students
2. Coursera addresses mainly to professionals from all over the world

A third activity, strictly linked to the MOOC, has been the open webinar (everyone can join it) conducted by a professional from FIRE (Federazione Italiana per l'uso Razionale dell'Energia).

We collected replies from both the standard initial and final questionnaires in POK other than the EDDIE survey, that participants can take at the end of MOOC contents. Considering the small number of replies obtained from POK questionnaires, we decided to include, in this document, only data from the EDDIE survey.

Survey results

Demographics

At the date of this report version (18 December 23) 128 learners joined the MOOC on POK, while 918 joined the MOOC on Coursera. 64 replies from MOOC participants were collected in EDDIE survey.

33% of respondents are between 25 and 34 years old followed by a 25% between 18 and 24 years old (Fig. 1). The majority of them own a Master's degree (Fig. 2). We suppose that learners over 35 years old, at least (40%) are workers while the youngers are probably students.

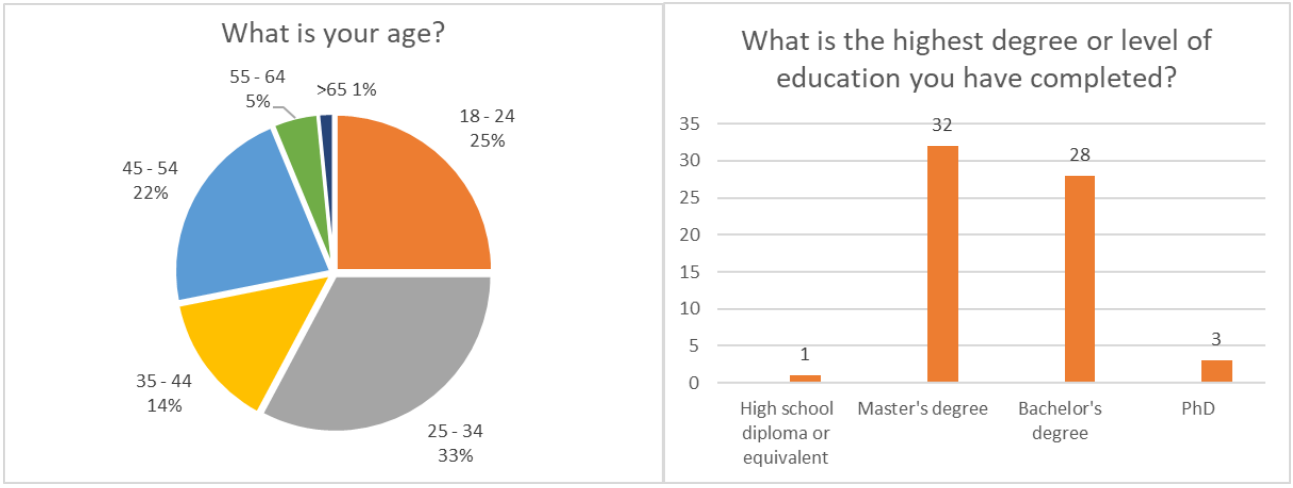


Figure 51 Age of distribution and Level of education

Coverage of the topic / motivation for further research

Almost the most part of respondents declared that the course has been effective in raising awareness about the digitalization of energy and on the specific field of energy management for real estates, with a 73% of them that strongly agree with this statement (Fig. 3). General agreement emerged also about the willingness to deepen the topic and conduct further research (Fig. 4).

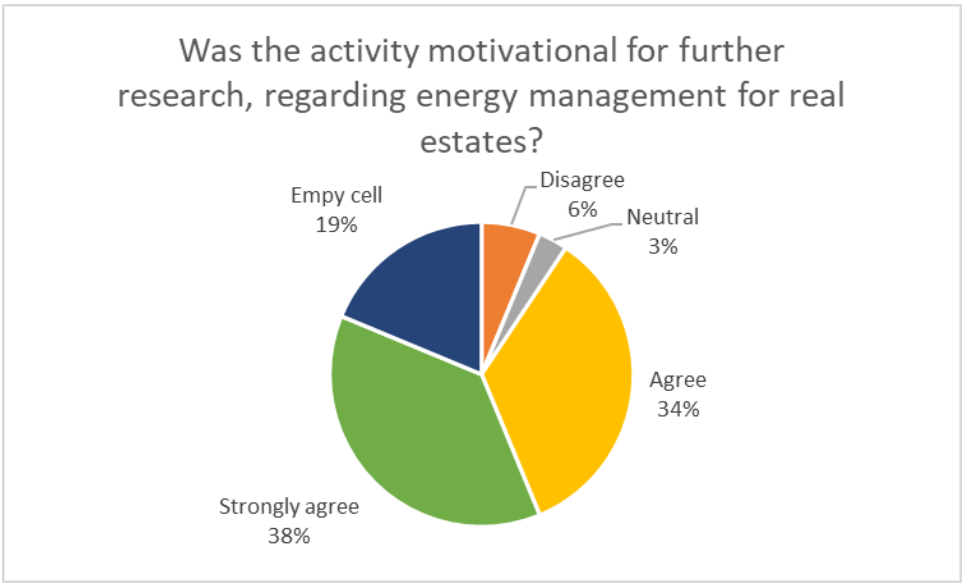


Figure 52 Level of awareness in energy

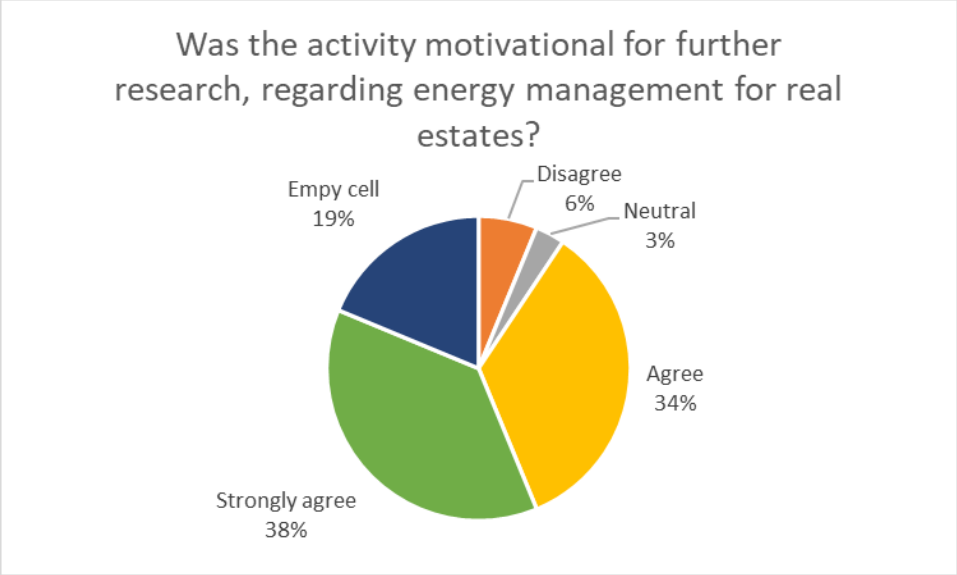


Figure 53 Further research

67% of respondents declared that what they have learned would be useful for their future professional path (media 3,7). Numbers are not so wider to be able to make strong assumptions, but it is true that the MOOC fits needs of a specific niche in energy field linked to a specific role. (Fig. 5).

Figure 54 Usefulness for professional path

The learning experience has been appreciated, with the majority of respondants (64%) rating 4 or 5 the activity (Fig. 6).

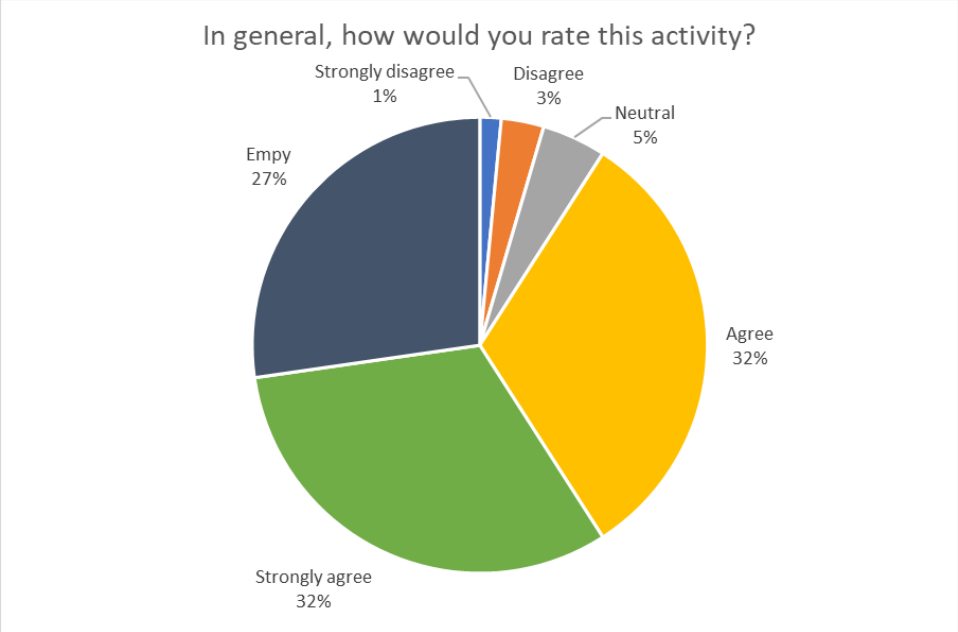


Figure 55 General rating

Skill gaps mitigation

The MOOC is addressed at improve knowledge and competencies related to the energy manager for real estates. When learners are asked to reply to the *question "Did you acquired knowledge and/or skills/competences during the activity, related to the following topics?"*, they confirmed that the energy management system is the topic in which they acquired the most part of knowledge and skills followed by digital asset management (fig. 7). The other topics indicated in the questionnaire are not treated in the course, that's why lot of respondents reply not applicable or didn't give reply..

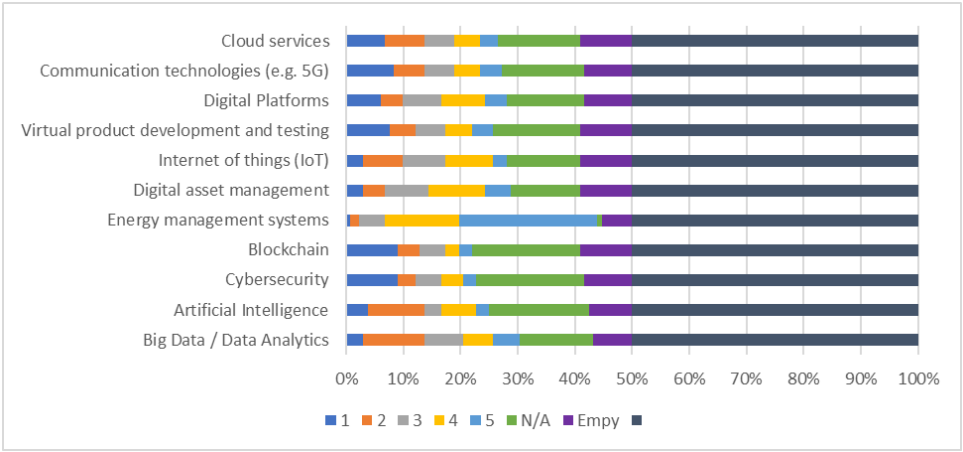


Figure 56 Topic and knowledge acquired

Recommendations / future preferences

80% of learners who replied to the questionnaire said they would be interested to join future activities like this one reinforcing results collected through the other questions. We can say that they also like the fruition modalities as a good part of them indicated the willingness to attend next initiatives online. Others would prefer blended format or on-site (Fig. 8).

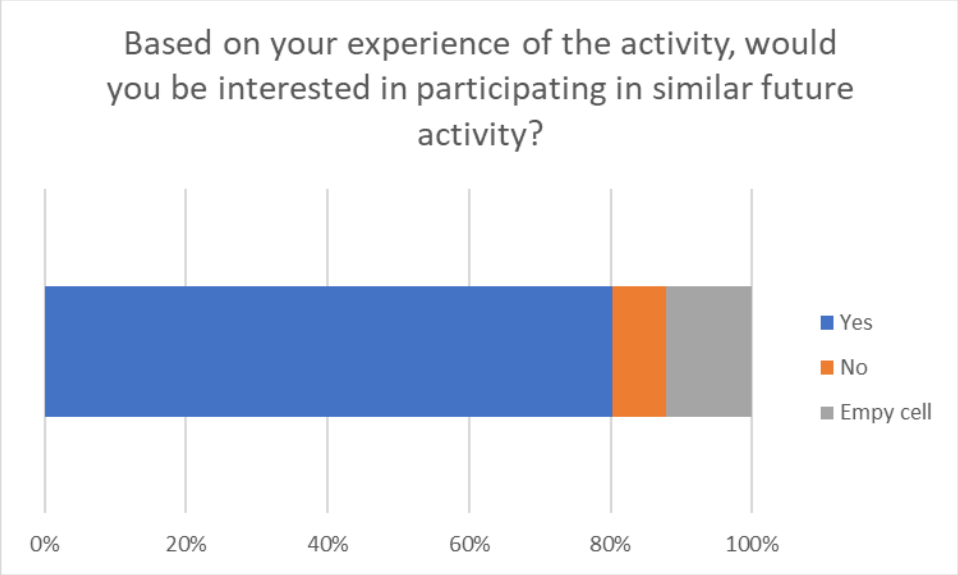


Figure 57 Future activities

The majority of them would be very interested in attending course/initiative on Data management and analysis (66%), Big data and Cybersecurity (22%) that emerged, in fact, as the most significant skills gaps. A future proposal may be to continue to use MOOC as effective tool to mitigate skills gaps, reinforcing interactivity with teachers and among peers, through some moments on-site or, at least, synchronous.

Some of them propose to enrich the materials with examples, practical use cases.

3.5. Field test Madrid

In field test Madrid, one activity is planned to be deployed. The aim of this training is to establish a complementary training module to the educational offer in Vocational Education Training (VET) (EQF level 4 and 5) at ESCUELAS PROFESIONALES PADRE PIQUER, which explicitly includes the possible restructuring of the electrical installation of a home, and the use of automation to improve energy efficiency and manage the energy consumption. The program consists of seven modules starting with the basics of the electrical installations in a house and the regulations, addressing the phantom or idle consumption, the tariffs applicable, the automation systems, the generation technologies in buildings, the adaptation of the electrical installations, and the consumption management. Special attention is given to the home automation systems, the adaptations of the electrical installations, and the telecommunication and computer applications for energy management. This course aims to build new skills for electrical installers and emphasizes the digitalisation of the systems and the skills of both installers and consumers to improve energy efficiency.

The knowledge acquired can be applied throughout the national territory as it is based on the state regulations for the electrification of housing, and the training, as well as the model, can be exported to any member country of the European Union.

The questionnaire was distributed to all the participants.

Survey results

Demographics

Figure 34 and Figure 35 show the age of the participants and the highest level of education completed. As the participants were all students of the “Telecommunication Installation and Facility” program in Piquer, the answers were clustered in ages 18 (33,3%), 19 (33,3%) and 20 ((33,3%)).

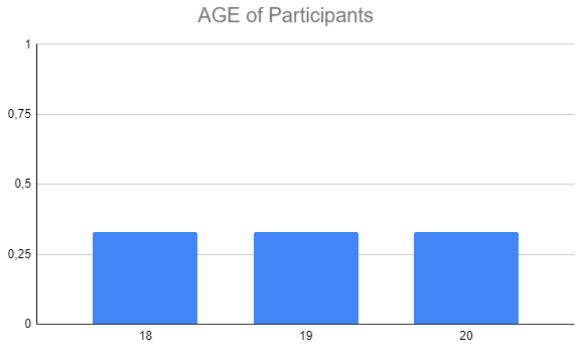


Figure 58: Age of participants

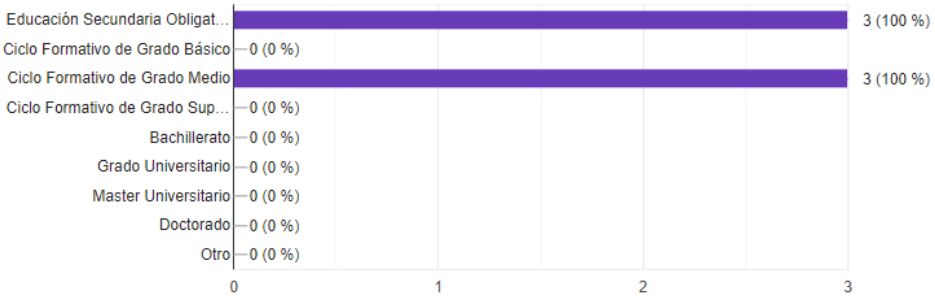


Figure 59: Level of education

Coverage of the topic / motivation for further research / Skill gaps mitigation

At this stage, the extent of which the content of the activities covered the relevant topic was examined. Before examining this, it should be stated that the required skills for the participation in the activities were well described for most of the students (66,6%).

Then, students were asked to evaluate the coverage of the contents of the course regarding the main topic, using the 5-point Likert scale as shown in the next figure:

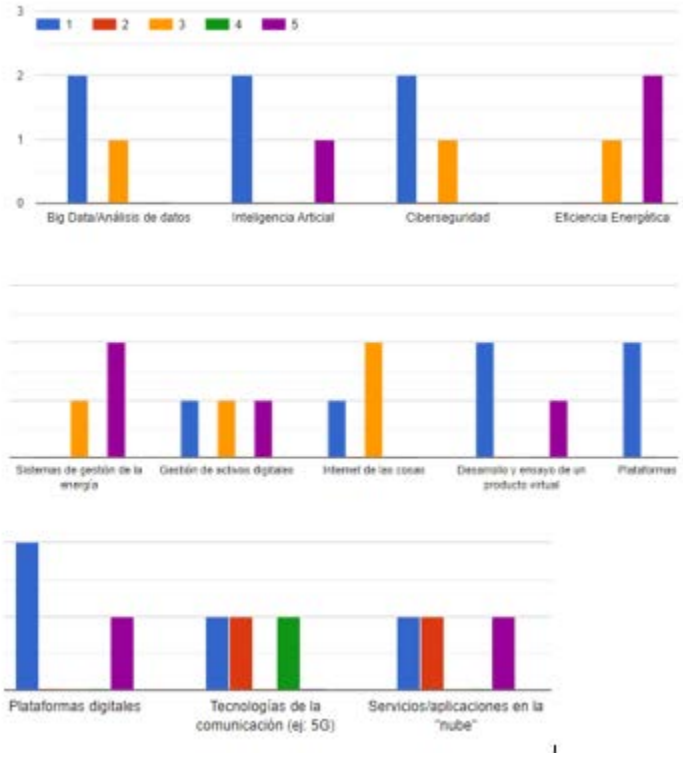


Figure 60: Skill gaps mitigation

The main points of the results are:

1. At all of the topics the vast majority of the participants do not disagree with the extent of the topics' coverage.
2. The least satisfaction is presented at the general point of 5G (T.T) or Apps/services in the "cloud".
3. Topics like big data/data analysis, cybersecurity or IoT (internet of the things) are not well enough covered as the results point at.

The development of the skills connected to the activity was evaluated as good/very good by the students as shown in the chart:

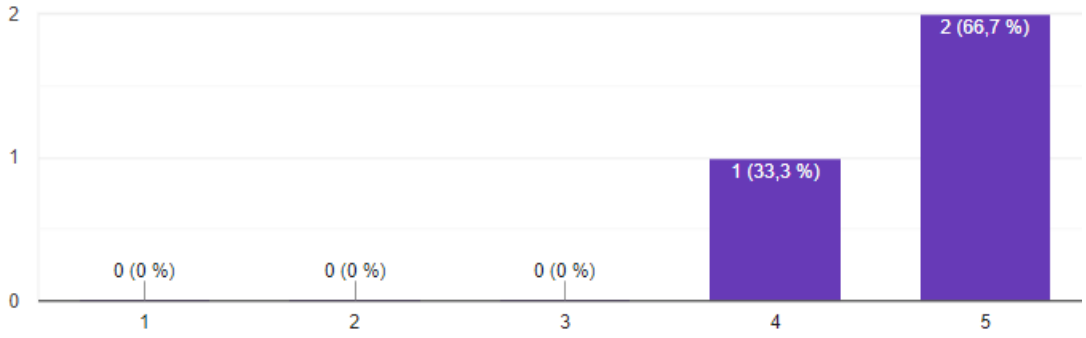


Figure 61: Skills development evaluation

A crucial point is the examination of the motivational character of the activities, to ensure the engagement of the participants with the constantly evolving sector of the digitalisation of energy. In this direction, the following figure presents the responses of the participants to the questions "was the activity helpful for gaining skills, knowledge, experience, useful for your future career path" and "the activity was motivational for further research regarding the topic. The key point is:

1. The vast majority (66,6%) have a positive response to the activity's facilitation for the further research and support their future career path. This can be positively evaluated and serve as a guideline to improve the content in the direction of raising the motivation of the future participants.
2. With the same rate (66,6%) not only they agree with the contents of the course but also, they expect to participate in further activities/courses in order to improve their professional path.

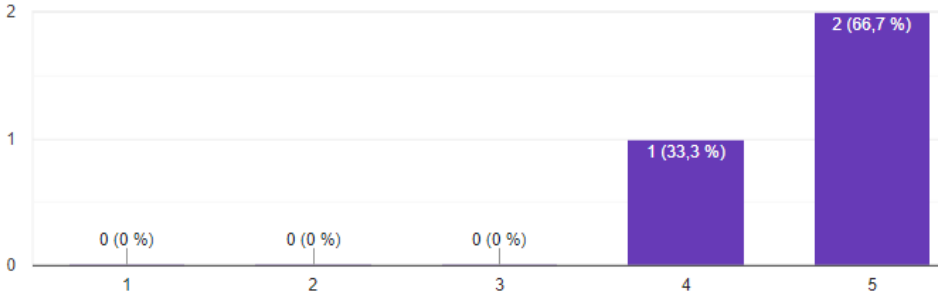


Figure 62: Interest for future participation

The figure presented below demonstrates the extent of student satisfaction regarding the relevance of the activities' content to the current demands of the labor market and the energy sector. The initial observation is highly encouraging, indicating that the activities' design is closely aligned with the industry's present requirements.

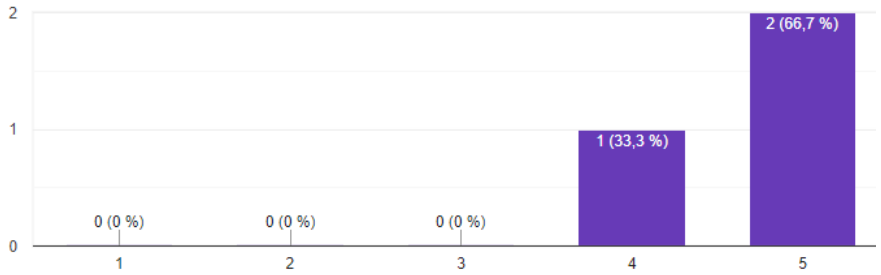


Figure 63: Results of relation with industry needs

Recommendations / future preferences

The subsequent figure displays the participants' preferences concerning the subjects for future activities and the desired format of these activities, marking the concluding phase of the analysis. The majority of the students expressed their interest in participating in a future activity focused on Cybersecurity. Equally chosen are data management & analysis and programming and development competences. Surprisingly, Big Data wakes no interest to these participants.

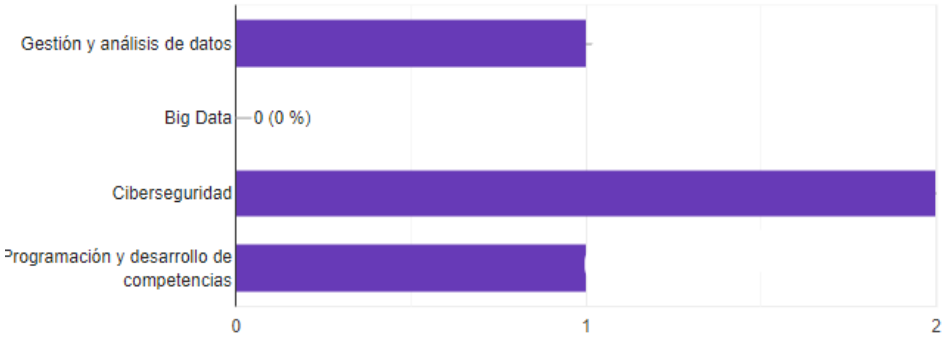


Figure 64: Future preferences of participants

When asked about their preferred format for future activities, the majority of students indicated a preference for on-campus/on-site learning. This finding suggests that in the post-COVID era, students are inclined to return to in-person learning environments that facilitate increased interaction, as depicted in the following figure.

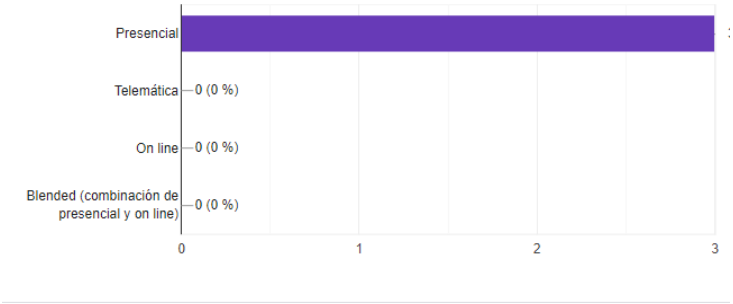


Figure 65: Format preferences of participants

The last part of the survey encouraged the participants to complete a free text with comments and recommendations for further improvements. Among the students who responded to this question, the key observation is that many of them expressed the opinion that the course should incorporate more practical examples as well as more theorical contents and data.

Key findings

The results and the analysis of the responses has yielded several key findings regarding the assessment of the four lectures:

1. The assessment revealed that the coverage of topics in the activities was deemed adequate. This achievement was made possible through the utilization of various tools within the Blueprint strategy, which aimed to design and implement up-to-date and motivational activities.
2. The digitalisation of the energy was covered by this course with the Smart home and demotics.
3. The most preferred area for future education/training activities is Cybersecurity, followed by Data management & analysis programming and development competences
4. There is a need for an increased focus on practical applications and examples, as well as a deeper understanding of theoretical knowledge.

4. Feedback from industry

To ensure that the highest quality of the pilot activities, the opinion of industry, in addition to the feedback received from the courses' participants is of high importance. EDDIE project aims to facilitate a direct communication channel between education/training providers & the industry and establishing a feedback loop from the industry regarding the content of the pilot activities is the initial step in that direction.

Due to the activities' implementation stage commencing close to the deadline of the current deliverable, the initial phase of this procedure considers the opinion of the industrial partners of the EDDIE project. A short presentation of the activities design and content was presented to the partners from industry, aiming to gather comments/recommendations per pilot site or even per pilot activity, in the format of questionnaire. Subsequent steps involve a more thorough investigation of the content of the activities, addressed by interviews with the industrial partners and a concise survey of key stakeholders from industry across the European Union

The first responses indicate that the conducted effort of the pilot partners in designing, developing, and implementing the pilot activities has been highly praised by the industrial partners. The activities are anticipated to tackle the existing gaps identified in the industry, both at the most elementary levels and for the employees themselves for their reskilling. This feedback has been consistently highlighted across the majority of the pilot activities.

A recommendation acquired from the feedback procedure is that the industry encourages the education providers to incorporate cutting-edge technologies (e.g. artificial intelligence) even in lower EQF courses to familiarize students with practical applications and provide them with general knowledge.

Delving into more specific recommendations, the topic of gender equality was raised, emphasizing the importance of having more female presenters, especially in activities like Girl's Day activity. Additionally, the inclusion of the Virtual Power Plants concept, green hydrogen and technologies applied to the electricity sector in the pilot courses was suggested, whenever relevant and applicable.

Overall, the initial feedback from the industry showed that the activities seem to be aligned with the needs of the sector, addressing the identified skill gaps.

5. Recommendations for the update of the Blueprint strategy

The main goal of the pilot activities implementation and evaluation is to provide feedback to the Blueprint, establishing a continuous and robust update process.

The implementation of the activities is followed by an assessment procedure, aiming to gauge their impact. The objective of this assessment is to consistently update the Blueprint and ensure the long-term sustainability of the strategy, both within and beyond the project's completion. The conclusion of this procedure will mark the finalization of the Blueprint Strategy.

This deliverable contains the initial evaluation of the activities that have already taken place. This should serve as a first step for validating and updating the Strategy.

Overall, it appears that the activities are heading in the right direction in terms of addressing the identified skill gaps, guiding the participants in the digitalisation of the energy process, and providing motivation for further research and convenient experience for their career development.

A crucial and fruitful insight obtained from the questionnaires to activities' participants is their preference for focus areas in potential future activities. The responses were aligned in the different pilot sites and pilot activities and indicate that most participants demonstrate a significant interest in Data management and analysis, with Cybersecurity being the second most popular choice. In that direction, it is evident from the participants' responses, that Data management and analysis, and Cybersecurity at the second level, were areas that present a practical mismatch between the current education/training material and the needs of students/professionals. Therefore, the Strategy must promote activities and initiatives aiming to tackle the mismatches in these areas.

In close relation to this observation, it is noteworthy to highlight the identification of Computing tools & platforms, as well as Digital platforms, as the least mitigated skill gaps during the pilot activities. This outcome is consistent across multiple activities and pilot sites. This insight is valuable for the pilot sites and the Blueprint, as it prompts them to further examine and refine their activities and recommendations in order to tackle these skill gaps more effectively and practically, through professional training, corporate universities or online courses.

Shifting focus on lower EQF levels, an important finding emerges regarding the motivation of students to follow a career path related to the digitalisation of energy. Regarding this topic, there is a notable opportunity to further enhance efforts in this area, leading to a recommendation for more activities/courses related to the digitalisation of energy systems. Particularly at the lowest EQF levels (1-2) activities, mainly implemented in field test Aachen, the lack of courses or content linked to the topic of electrical engineering, raises the need to introduce this topic to lower EQF levels. By engaging young students with the fundamental principles of electrical engineering and the digitalisation of energy process, we can foster their interest and pave the way for their future involvement in this field.

Table 4: Key findings from the pilot sites and recommendations to the Blueprint Strategy

Pilot site	Key finding	Recommendation to the Blueprint Strategy
Aachen	The vast majority showed interest in the digitalisation of energy systems	--
Aachen	In EQF levels 1-2, there is a lack of school subjects that cover electrical engineering topics.	Incorporate such topics in lower EQF levels in order to foster interest in electrical engineering and its digitalisation from a very young age
Aachen	Participants were able to increase their knowledge in topics such as energy management systems, smart grids, and energy transition.	--

Aachen	There is still a place for progress in motivating students in choosing professions related to the digitalisation of energy systems	Encouragement in conducting more activities related to the digitalisation of energy systems.
Aachen	Most of the participants are interested in data management and analysis as an area for a future activity	Encourage new initiatives in the area of data management and analysis and update the content of current relevant activities to incorporate this topic
Athens	Adequate coverage of the topics, by utilizing various of tools of the Blueprint strategy, aiming to design and implement up-to-date and motivational activities	--
Athens	The digitalisation of energy was not identified as a crucial topic covered by the lectures	Need for a more general approach that will highlight the cross-sectoral nature of digitalisation in the energy field
Athens	Computing tools and platforms & digital platforms are identified as the least mitigated skill gaps.	New activities and adjustments in the existing ones should consider addressing these skill gaps areas Hands-on involvement of participants in simulations, utilizing computing tools.
Athens	The vast majority is highly interested in data management and analysis as an area for a future activity	Encourage new initiatives in the area of data management and analysis and update the content of current relevant activities to incorporate this topic
Madrid	Adequate coverage of the topics, by utilizing various of tools of the Blueprint strategy, aiming to design and implement up-to-date and motivational activities	--
Madrid	There is a need for an increased focus on practical applications and examples, as well as a deeper understanding of theoretical knowledge	Relevant activities to include more practical examples and applications and also try to adjust the content of the courses in order to be more comprehensive and thorough
Madrid	The most preferred area for future education/training activities is Cybersecurity, followed by Data management and analysis.	Encourage new initiatives in the areas of cybersecurity & data management and analysis and update the content of current relevant activities to incorporate this topic
Milan	The activity has been effective in covering the specific field of energy management	--

Milan	The most preferred area for future education/training activities is Data management and analysis, followed by Cybersecurity	Encourage new initiatives in the areas of cybersecurity & data management and analysis and update the content of current relevant activities to incorporate this topic
Milan	Most of the participants stated that they would participate in a similar future activity in a same attendance format	Encourage more activities in the area of energy management Support initiatives that include MOOC activities

6. Conclusions

The roll-out of the Blueprint is currently in progress across the five pilot sites. After the implementation phase, an assessment procedure is deployed to ensure the update of the Strategy, establishing an active feedback loop that aims to serve as an iterative mechanism for ongoing improvement.

Overall, the implemented activities were considered sufficient by the participants in addressing the targeted skill gaps and aligned with industry needs.

The coverage of topics in the field tests was generally comprehensive. The activities adequately addressed relevant areas, and participants expressed satisfaction with the extent of topic coverage. However, there were variations in participants' understanding and satisfaction levels for different topics. Subjects closely related to the participants' educational background, such as local energy markets and renewable energy forecasting, were better understood compared to topics like blockchain and machine learning.

The activities were found to be motivational for participants in terms of gaining skills, knowledge, and experience for their future career paths. Participants expressed positive responses and indicated that the activities were helpful in furthering their research and learning in the respective topics. This positive feedback suggests that the activities were effective in motivating participants to pursue their interests and develop their expertise.

The effectiveness of the activities in mitigating skill gaps varied depending on the specific gaps targeted. Most of the addressed skill gaps seemed to be adequately covered. However, there was a lower agreement regarding the effectiveness of mitigating skill gaps related to computing tools and platforms, as well as digital platforms. This indicates the need for further measures and adaptations to address these specific gaps.

The activities were well-aligned with the current needs of the labor market and the energy sector. Participants expressed satisfaction with the activities' content in relation to industry requirements. This alignment suggests that the activities' design effectively addresses the industry's demand for specific skills and knowledge.

Participants expressed their preferences for future activities, indicating a need for comprehensive coverage in data management and analysis. Cybersecurity also generated high interest among participants. In terms of the preferred format for future activities, most participants favored on-campus/on-site experiences, indicating a preference for in-person learning that fosters greater interaction.

The field test reports provided valuable recommendations for improvement. Participants suggested incorporating practical examples and real-time simulations, as well as greater student engagement in the configuration of simulation examples. These recommendations highlight the importance of hands-on involvement and interactive learning experiences to enhance the effectiveness of the activities.

Moreover, the feedback survey to the industry indicated that the contents of the activities are aligned with the current needs of the industry. A general recommendation extracted is to include cutting-edge technologies content into the courses, where applicable.

In conclusion, the field test reports demonstrate that the implemented activities have been largely successful in addressing skill gaps and aligning with industry needs. The coverage of topics was generally adequate, although some variations were observed. Participants found the activities motivational and expressed a positive response to their future career prospects. While there is room for improvement in addressing specific skill gaps and incorporating practical examples, the overall findings highlight the effectiveness of the activities and provide valuable insights for further enhancements in future training programs.

7. References

[1] A. Chronis *et al.*, “Deliverable D2.2 ‘Current and future skill needs in the Energy Sector’ EDDIE project,” 2022.