Erasmus+

Brochure

"TECHNOLOGY INDUSTRY 4. FOR TEACHERS AND TRAINERS OF VOCATIONAL EDUCATION"

Project number:
2019-1-SK01-KA202-060772

Erasmus program + for education and training, Key Action 2 - Strategic Partnerships

PROJECT PARTNERS

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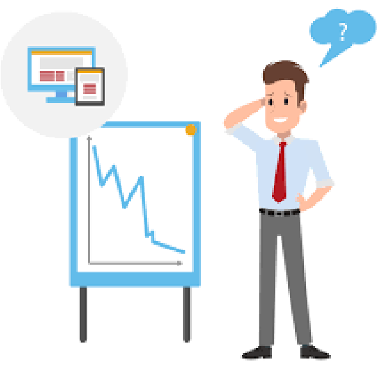
ERASMUS+ PROGRAM

Erasmus + is a new program of the European Union that supports activities in the field of education, training, youth and sports during the programming period 2014-2020. The program provides an opportunity for students, trainees, teaching staff, youth workers and volunteers to improve their knowledge and skills. The program supports organizations that they can engage in project cooperation and share innovations in youth education and training through partnerships.

TI4 PROJECT GOAL

The main goal of the project is the development of educational lessons and courses for vocational education teachers, as a crucial article in the profiling and acquisition of skills of vocational school graduates.

- Create didactic and information materials on Industry 4 technologies
- Create these materials in e-learning form
- Implement the results of the project into the curricula of vocational education subjects in schools
- Use the best training methods for Industry 4, smart production
- Provide study materials for vocational education teachers as creators of the professional profile of their students for better employment



TI4 PROJECT CONTENT

The content of the project is focused on:

- showing good practice examples from education for I4
- showing good practice examples from the implementation of I4 technologies to production
- elaboration of intellectual outputs with content focused on the development of I4 and an overview of key I4 technologies
- change in job requirements, benefits, risks

WHY THE PROJECT IS IMPORTANT

We are on the threshold of a technological revolution that will fundamentally change the way we live, work and we communicate with each other. To its extent, scale and complexity, this transformation will be as fundamental to humanity as any other technological change in the past. We do not know how it will develop, but one thing is clear: the response to it must be integrated and comprehensive, involving all stakeholders on a global basis, from the public to the private sector, academia and civil society.

Industry 4.0 Deployment in European businesses, it is not a question of the future, it is a process that is beginning today. Companies are interested in information and exchanging experiences, but most lack the confidence and commitment to gradually adjust their production to new technologies. Therefore, it is important to talk about what approach to take and what the first steps should be. Industry 4 or 4th Industrial Revolution are no buzzwords or marketing words. It is also clear that Industry 4 technologies will eliminate many jobs with current professional expertise and, on the other hand, create more opportunities with demands for the coming era of industry digitization. At present, each country has adopted or is adopting new national programs to increase the competitiveness and efficiency of production and personalization of products on the basis of I4, from which derives the requirement of flexibility not only of production but mainly of labor. The choice of a priority oriented to support teachers is a clear choice from this situation, because it is precisely the teachers of vocational education who must be the first priority to be knowledgeable but also skillfully prepared for education for the new generation of production - smart production.

ABOUT THE PROJECT

The priority of the project was to develop educational lessons and courses for vocational education teachers, as a crucial article in profiling and acquiring the skills of vocational school graduates with content aimed at: - showing good examples of practice from education for I4 and good examples of practice from implementing I4 technologies into production, - elaboration of intellectual output of I4 development: views and definitions of I4, concept-philosophy of building production 4 (smart production), digitization of cyber-physical systems as a basis of I4, structures of smart production, overview of technologies: I4, change of job requirements, risk benefits , -development of lessons: I4 technology as e-learning. Elaborate in detail the principles and methodologies of individual technologies, their applications, methods of implementation and use. These currently include: Internet of Things, Big Data, Robotics, Collaborative Robotics, Virtual and Augmented Reality, Simulation - Digital Twin, Cloud Systems, - Providing ICT Platforms as Open E-Learning, - Glossary and expressions I4 (Interoperability, customization, M2M, human-cobot, ...).

PROJECT RESULTS

The project brought about the elaboration of the topics of currently available I4 technologies, the aim of which is to put knowledge of theory into practice.

Project results I4 uses modern ICT solutions. All education systems are implemented on a special multifunctional platform for education and training, Coursevo.

The project introduced a series of lessons of new technologies that significantly affect production and provide insight into current and future global trends in advanced production.

Next The results of the project are to improve cooperation in the field of education for secondary vocational school teachers as well as students and employers, especially in the area of readiness and commitment of successful secondary vocational school graduates and their integration into the work process of companies.

Project results I4 are based on the synergistic effect of knowledge from practice and educational institutions. The goals of the project are of high quality, based on the current needs of industry and schools for target groups.

Project output no. 1: Examples of good practice

The goals of the output O1- Examples of good practice were to:
1. Analyze and use in the project the best training methods for Industry 4, smart manufacturing
2. Analyze and use in the project the best examples presenting solutions from practice. In the output O1 there are findings from the best examples from education for „Worker 4" but also the selection of the right methods and evaluation of education. It points out the benefits and effectiveness of using new methods and methods of measuring and using the acquired knowledge and skills. Good examples are considered to be those that use the new methods to achieve the goals of acquiring knowledge and skills on the part of the participant, the satisfaction of the lecturer but also the satisfaction of the employer.
Good implementation examples and implementation of the Industry 4 concept, resp. smart production or the use of new technologies in practice aim to support, master and supplement theoretical knowledge on specific practical solutions. These examples serve as a means of deepening and professional competence.
Selection of examples good practice is governed mainly by the following rules:
- Examples of good practices are directly related to the project objectives and target groups
- They provide an opportunity direct or indirect transfer of their approaches or methods to project activities
- They are usable in the pedagogical process in vocational education - material, content and approaches.

The basic scheme for processing O1 was:
- Find examples of courses, trainings, syllabi of subjects, etc., which already have in their content knowledge of smart manufacturing and technologies Industry 4. These examples to further serve to document the extent and how new knowledge is incorporated into the curriculum of technical education.
- Give examples of implementation and the use of individual technologies in practice. The aim of this approach was to show real examples of implementation and use, but mainly to show the validity of new technologies for future smart production.
To process this output, several examples were analyzed, which each partner presented for their field (education: TUKE, TUC Greece, SŠJH Bardejov, LUT Poland, for practice: Manex Košice, Cluster Košice) with subsequent evaluation and selection for final processing (MANEX Košice). The selection focused on examples that are validated, developed by reputable organizations and feasible in target groups. Almost every example from education but also from practice pointed to the impact on the change of the content of education but also on the change of approaches and new technologies and methods of education in the era of Industry 4 and smart production. Many state output O1 and some will be part of outputs O2 and O3. The analysis of good examples unequivocally confirmed that Industry 4 requires not only the implementation of new technologies but also top experts.
Intellectual output O1 fulfilled the essence of the description of the intellectual output given in the project. It demonstrates the material content of the integration of new knowledge from Industry 4 into education, the applicability of new teaching aids and training stands with a connection to the Internet of Things and also for online training. The complexity of the training processes for Industry 4 is documented by renowned organizations in the field of automation education such as FESTO.

Project output no. 2: Industry 4

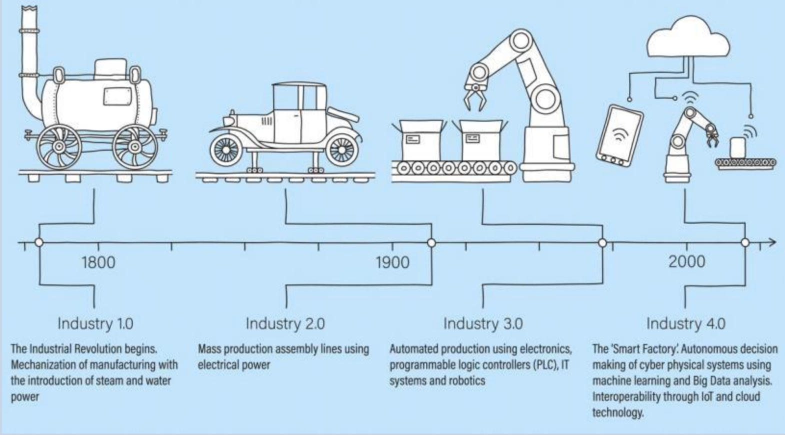
Output Industry 4 provides knowledge of general developments to the 4th Industrial Revolution, explains the concept and philosophy of I4, defines cyber-physical systems, describes the principles of smart manufacturing, the main features of the technologies used and their context. it also lists the benefits and risks of new production and the requirements for new content of knowledge and skills for the new scope of work.

Output 02 Industry 4 presents a comprehensive material on developments, trends and functions I 4.
Industry 4.0 is a very popular topic today due to its large impact on production. Over the centuries, the conditions and methods of production of products and services have changed. The direct reason for these changes was and still is technological progress. This progress is currently leading to the creation of a working environment in which the physical and virtual worlds come together. People, machines, objects and systems are connected via ICT and the Internet, communicate dynamically in real time, and organize and optimize processes. As part of intelligent production systems, all factory subsystems are interconnected from delivery through production to transport. Thanks to this, industrial production can flexibly satisfy the individual needs of the client, thanks to the optimal use of resources.

The Industrial Revolution transformed the ways in which people used to work. Throughout the 18th century, designers perfected inventions for the work that humans had done before. Manufacturing production gradually ceased to exist and production with the help of machines was promoted.

Progress in the field of science and technology, it has constantly supported the development of industrialization throughout the world and, over the years, has helped to bring more concrete and explicit meanings to the term.

The term "Industrial Revolution" it is also explained as a technical advance that has fundamentally changed the way it is made in the past. The Industrial Revolution is bringing new technologies that are changing the way people work and live.



Project output no. 3: Technology Industry 4

Intellectual output O3 is the most important output of the project. The aim of this output was to develop educational materials and lessons for vocational education teachers as a primary and crucial article in profiling and acquiring the skills of vocational school graduates.

Intention and the aim of processing the intellectual output of O3 was primarily to document and confirm the validity of the project objectives and to determine the content and scope of lessons. The requirements for the processing of lessons also resulted mainly from discussions with secondary school teachers at several events and from the demands of companies.

Educational materials - lessons

Module no. 1: Internet of Things

Once One of the key technologies for smart manufacturing is the Internet of Things (IoT), which is the creation of a global information network composed of a large number of interconnected "things". Manufacturing "things" can be, for example, materials, sensors, actuators, controllers, robots, people, machines, equipment, products, and material handling equipment.

1.1 Internet of Things, industrial Internet of Things

The lesson presents the findings on the development of the Internet of Things, the importance of its use in production and its priority in building digital production.

1.2 Automatic collection put from production

The lesson emphasizes that the presence of the Internet of Things (IoT) everywhere has a significant impact on the increasing speed of information and production messages, which through subsequent processing leads to the optimization of processes. He further points out the importance of production data, the specification of which data to collect, how often and for which model to use them and what they alone or in combination with others reveal and how to decide on them. What result of the analysis is only informative and what is already critical for the manufacturer resp. other features.

Module no. 2: Advanced robotics

Industrial robots have many benefits regardless on which type of industrial robot is implemented. If the robot is properly programmed to meet the unique needs of a particular application, it will almost certainly outperform manual work. A new type of robot has now entered the industrial environment, the main feature of which is the ability to work safely with humans. Collaborative robots represent a new technology that requires new approaches, new methodologies and designs. In the case of collaborative robots, many new aspects need to be reconsidered, such as: recognizing the opportunities that "cobots" bring, what they can do, how they can behave in cooperation with humans, and what area or operations they are suitable for.

2.1 Industrial robotics

The lesson presents the findings on the development of industrial robots, their properties and functions. He emphasizes that a robot, when properly programmed, can replicate human activities much more accurately and quickly.

2.2 Collaborative robots

The content of the lesson is focused on understanding the key functions of cobots for cooperation with humans with an emphasis on safety.

2.3 Bin picking robotic systems

Object selection randomly stored objects from a pallet or container by a robot guided by a 3D camera is referred to as Bin Picking. Bin-Picking application solves the localization and selection of objects from the palette without the need for human intervention. Bin-Picking is an intelligent object search and manipulation.

Project output no. 3: Technology Industry 4

Module no. 3: Big data analysis

Big Data Analysis is the often complex process of examining Big Data to uncover information — such as hidden patterns, correlations, market trends and customer preferences — that can help organizations make informed business decisions. Big Data includes all kinds of data, and helps deliver the right information, to the right person, in the right quantity, at the right time, to help make the right decisions. Whereas statistical analysis and traditional Business Intelligence Analysis answer questions on "What happened", Big Data Analysis answers questions on "Why it happened". This module includes introductory topics on Big Data Analysis and applications within the context of Industry 4.0.

3.1 Introduction to Big Data Analysis

This lesson is an introduction to Big Data and its importance in gaining insight for, and automating the decision-making process.

3.2 Visualization, Process, Tools and People. Information Privacy

This lesson introduces data visualization as an important part of the analysis process, and goes through the Life Cycle of Big Data Analysis and the major tools used in it. It concludes with important aspects concerning data and information privacy.

3.3 Big Data industry applications and use cases

This lesson consists of a collection of real-world applications and use cases in manufacturing and references sources for other industries.

Module no. 4: 3D printing, additive production

This module contains introductory topics on 3D scanning, data acquisition in reverse engineering and rapid prototyping, as well as professional 3D modeling of new parts and assemblies designed for 3D printing. Reverse engineering introduces the conversion of a physical part into a digital model.

4.1 3D scanning - a method of obtaining data in Reverse Engineering

The lesson introduces the possibilities of using 3D scanners to obtain data necessary for reverse engineering. Examples of 3D scanners designs are presented: Artec Space Spider for scanning small and very small objects and Artec EVA for scanning large objects. Both of the scanners discussed are handheld scanners, mobile scanners with mains and battery power. Also discussed was the performance of 3D scans with the above-mentioned scanners using the dedicated Artec Studio ver. 12. It is shown how to proceed in order to make a proper scan of a real object and obtain a high-quality 3D digital model. The following modes of tracing a real object, scanning geometry and texture, scanning using the real fusion function, editing scans and composing them into one model as well as data export to data exchange files were discussed.

4.2 Rapid prototyping. Reverse Engineering

The lesson introduces the issues related to Reverse Engineering technology and Rapid Protoyping methods. The importance of these technologies in the modern Industry 4.0, especially in the field of product development, was discussed. The classification of RP methods is presented. The most important RP methods were discussed and briefly characterized. Additionally, the Rapid Tooling technologies, which are inextricably linked with RP and RE, are used to make unconventional production tools.

4.3 Additive Technology - 3D Printing

The lesson introduces the methods of incremental production of porotypes and finished products with the use of 3D printing methods. The main focus was on the approximation of one of the additive manufacturing methods, which is 3D printing with the use of one of the most popular FDM methods. Examples of 3D printers printing with thermoplastic materials (Cartesian printer and Delta type printer) were discussed. Materials used for FDM printing and mechanical properties of printed physical models were presented. The impact of 3D printers printing parameters on the quality and printing time is discussed. The procedures for preparing * stl files and the selection of printing parameters on the example of Zortrax M200 (Cartesian printer) and Anycubic Predator (Delta type printer) printers were discussed.

Project output no. 3: Technology Industry 4

Module no.5: Digital twin

This module contains introductory topics on digital twins, tools for creating digital twins and a methodological framework for creating digital twins.
Basic concept A digital twin refers to the virtual representation of physical objects, processes, people, data, systems, or environments. The digital twin is therefore the only tool that allows continuous and continuous optimization.

5.1 Digital twin
The lesson presents the findings on the development of the digital twin, the importance of its use in production for production optimization and production efficiency. With the help of simulations in a virtual twin, it is possible not only to shorten the design phase, but also to speed up testing, which can be performed long before the production of physical prototypes begins.

5.2 Tools to create DT
The lesson content is aimed at understanding the key functions of the Digital Twin Process Simulate software.

5.3 Methodological framework creation of digital twins
This lesson presents a methodical procedure for creating a digital twin. The reader will gain the logic of the steps with the program instructions for creating the digital twin. The outlined methodology can be used as a guide in the implementation of the digital twin in production plants.

Module no.6: Virtual reality

This module contains introductory topics about virtual reality and virtual reality applications in production.
Virtual Reality (VR) is currently a phenomenon that is increasingly being transferred from the scientific field to real life, and its application can be observed in several sectors. This technology provides a whole new perspective on various areas that we would find very difficult to reach as ordinary mortals. It allows you to see and even feel things that are often very difficult to achieve in real life.
To obtain the basic concepts introduced no prior knowledge is required with the teaching material provided. Some of the presented use cases require an understanding of software tools for data manipulation and processing.

6.1 Virtual reality
This lesson is an introduction to virtual reality and its importance in gaining an overview and automating the decision-making process. It provides an overview of what virtual reality is, how it works and what types of virtual reality we know. The lesson explains what augmented reality and mixed reality are and what the difference is between them.

6.2 Applications virtual reality in production
The lesson gives an overview of the possibilities of using virtual reality in various areas of industry and non-industrial sectors. It deals with the use of virtual reality in production applications, which include design, prototyping, machining, assembly, inspection, planning, training.

Module no.7: Artificial intelligence

Smart Factory 4.0 Automated Factory - a flexible system that uses artificial intelligence (AI) to automatically optimize performance and link previous production line elements to autonomous production process control.

7.1 Artificial intelligence in production
The lesson presents the findings on the development of artificial intelligence, the importance of its use in production for building autonomous production and the impact on the change of current production.

7.2 Intelligent products, machines, robots
The content of the lesson is focused on understanding the fundamental features and differences of intelligent products and systems from traditional ones.

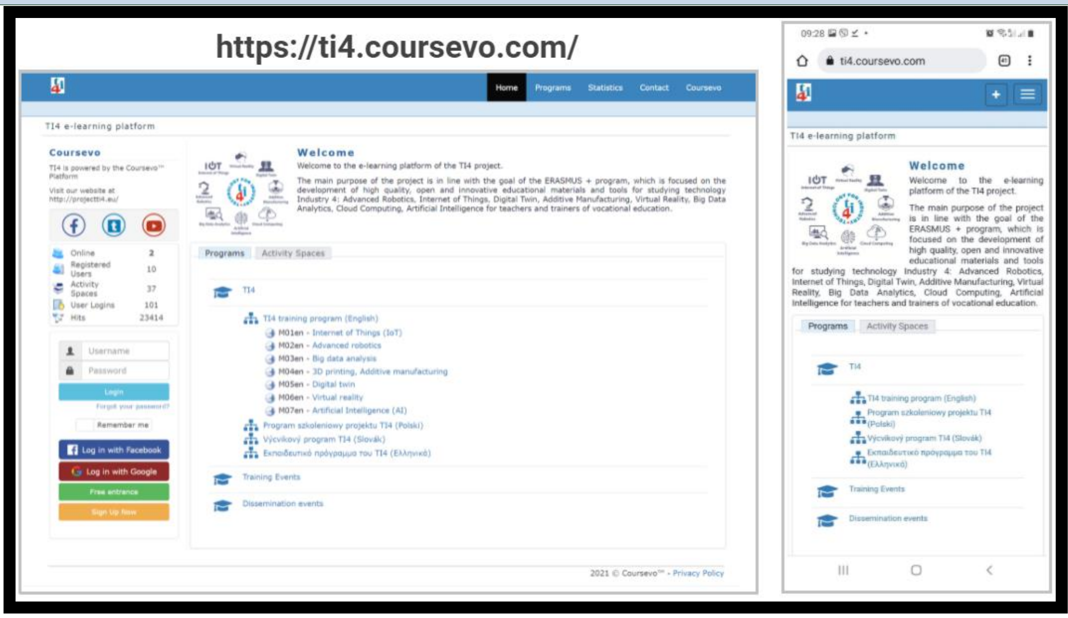
7.3 Technology artificial intelligence methods used in production
Artificial intelligence (AI) in production allows production systems to be aware of, compare, anticipate, optimize, and thus be more resilient than traditional production systems. An intelligent and self-optimizing production system can be implemented through artificial intelligence (including machine learning and with the growing amount and complexity of data especially deep learning, neural networks).

Project output no. 4: ICT methodology

All the education systems are implemented on a special multifunctional ICT platform for education and training, COURSEVO, developed by the Technical University of Crete.

The task was to determine the way of fulfilling and using the educational system of the eLearning platform. A methodology for working with the system has been developed so that all partners can work with it.

To this end, training took place at the responsible partner (TUC), where the participants got to know each other and learned to work with the system.



This intellectual output involves several tasks:

1. Creation of the e-learning platform.
2. Implementation of educational materials into the e-learning platform.
3. E-learning platform testing by project partners, external evaluators and in dissemination activities.
4. Update and implementation of comments and suggestions from testing.

The platform provides the instructor with a way to create and deliver content, monitor student participation, and evaluate their outcomes. The platform can provide students with the opportunity to take advantage of interactive features such as structured discussions, video conferencing and discussion forums.

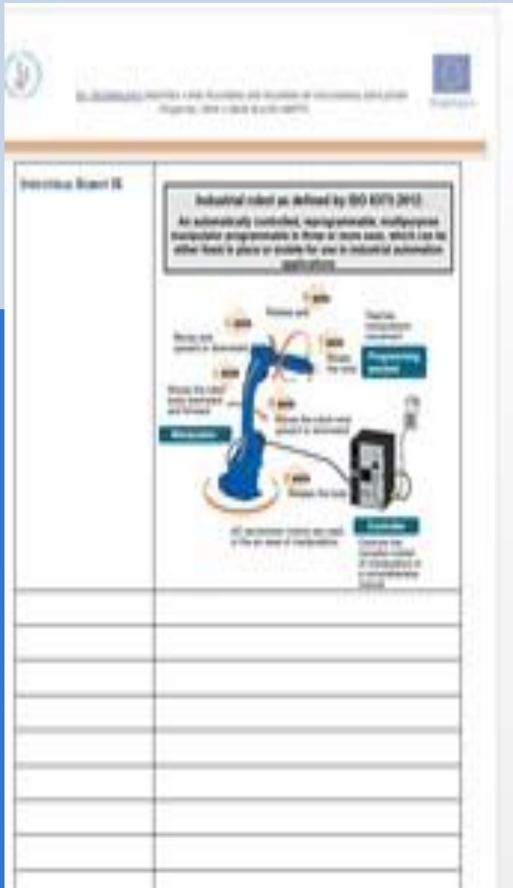
Project output no. 5: Glossary

Filling output O5 - Glossary are terms and expressions that have been used in connection with the development of industry 4 and new technologies. The terms and abbreviations commonly used in technical terminology relating to production are also explained below. It is their interpretation in order to understand their meaning.

Processing output O5 shows the validity of the elaboration of such technical terminology and teachers of vocational subjects themselves would welcome the development of a separate version in the form of a "glossary" and extended to the current abbreviations and designations used in automation and individual technologies.

The consortium wants to meet this requirement and plans to develop an extended version of the glossary after the end of the project.


GLOSSARY OF TERMS- MAIN TERMS



PROJECT IMPACT

The impact on participants, the organizations involved and the target groups is highly positive. The active solution and acquisition of knowledge from Industry 4 and its technologies, its impact on the change of production and professional professions are highly praised and appreciated. For many vocational teachers, the very ideas of the project, based on which they became more interested in Industry 4, are very valuable.

Interest The results of the project also have experience in all partnership countries. In Slovakia, this interest is confirmed by various working and business meetings between Manex and Klaster with partners from the manufacturing and non-manufacturing spheres.

The project coordinator especially appreciates the adoption TUKE's ideas to each partner, the essence of which is to present as much as possible the essence of the project, especially in various meetings with pupils and students, focused on how the new Industry 4 revolution is changing their education and professions.

General impact on target groups:

- providing opportunities for individuals, to be able to reach their full potential and strengthen their competitive advantage in the labor market,
- ensuring the successful implementation of target groups on the labor market in a given country,
- implementation lifelong learning and career planning,
- support target groups in search of a better position on the labor market,
- increase attractiveness and quality of study and vocational training programs.

i4Industry

M1- FIRST PARTNER MEETING, KOŠICE, SLOVAKIA

The first meeting of the partnership was 24.10.-25.10.2019 in Košice - all partners participated - a total of 13 participants. The first meeting provided basic information about the project, project schedule, project objectives, project financing, description of outputs.

Presentation of project partners - TUC Greece, Manex Košice, LUT Poland, TU Košice, Klaster Košice and SŠJH Bardejov, where each partner introduced itself. Detailed information on individual project outputs was presented, and a Gantt chart was presented. In cooperation with all partners, an action plan was prepared, which includes the tasks and activities of all partners for the next period of the project, where the goals and deadlines for the fulfillment of tasks and activities on intellectual outputs are set. Finally, the tasks were divided between the partners according to the work packages and the date of the next meeting was agreed.

M2 - SECOND PARTNER MEETING, TUC GREECE

The second meeting of the partnership was 03.06.2021- this meeting was organized online, due to the situation of COVID 19 - it was attended by all partners - a total of 11 participants. At the beginning, the conditions of the virtual meetings were presented at this meeting, and the fulfillment of the action plan and tasks from the previous meeting was checked.

Further The outputs were discussed, namely the analysis of the requirements of the target groups, a set of educational materials for the training of secondary school teachers and the educational-training ICT platform - Coursevo. Other tasks were divided among the partners and the date of the next meeting, which will be at the LUT in Poland, was agreed.

M3 - THIRD PARTNERSHIP MEETING, LUT, POLAND

The third meeting of the partnership took place 07.10.-08.10.2021 in Lublin, Poland. It was attended by all partners, a total of 12 participants. At the beginning of this meeting, the status of the previous project solution was discussed.

They checked dissemination activities and tasks were shared between the partners for the further solution of the project. At the end of the meeting, the date of the last partner meeting was agreed, which was set for December 2021.

DISSEMINATION ACTIVITIES

The dissemination activities of the project include regular updating of the project website, which provides up-to-date information about events, activities and meetings on the project. In addition to basic information about the project, the website also includes the final version of the processed reports from the individual project outputs.

The dissemination of the project also lies in promotion at secondary schools, on regional TV in Bardejov, high school magazines as well as at professional meetings and negotiations with companies, at conferences where articles, leaflets, newsletters are prepared, which were created during the implementation of work on the project.

These academic activities allow for discussions and the implementation of some new directions and procedures suitable for this project.

The project is spreading and popularizes results in two areas:

1.Dissemination for the professional public - schools, businesses, open days, leaflets, magazine publishing, conferences, internet.

2.Dissemination for the general public - dissemination in public magazines, promotional articles, leaflets, the Internet.

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