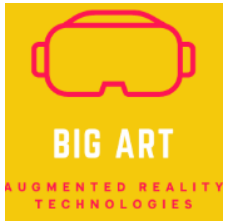

Bootcamps in Greece with

Augmented Reality Technologies

Deliverable 4.4

Evaluation of skills

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Contents

1. Introduction

The BIG ART project aims to introduce innovative learning approaches in Vocational Education and Training (VET) through the integration of immersive technologies such as Augmented Reality (AR), Virtual Reality (VR), and Digital Twin applications.

In recent years, the rapid development of immersive technologies has created new opportunities for vocational education, enabling students to interact with digital representations of real environments and processes. Digital twins and virtual environments provide powerful tools for experiential learning, allowing learners to explore complex systems, production facilities, and technical infrastructures in a safe and interactive way.

Within this context, the BIG ART project focuses on the integration of AR/VR technologies and digital twin methodologies into VET training programmes. The objective is to enhance students' digital competences while simultaneously supporting the development of practical and transversal skills required in modern workplaces.

Within Work Package 4 of the project, a pilot training programme was designed and implemented in order to introduce VET students to immersive technologies and digital space documentation techniques. The training programme combined theoretical instruction with hands-on practical activities and collaborative learning approaches.

The pilot implementation included two complementary learning components:

- **Pilot Training Course (Task 4.1)** – introducing students to the theoretical background and technical tools required for the creation of digital twins and virtual environments.
- **Project-Based Learning Activity (Task 4.2)** – enabling students to apply their knowledge through the development of virtual tours and

digital twin representations of real environments such as laboratories, production facilities, industrial installations and architectural spaces.

A total of **89 VET students** from the three partner countries participated in the pilot implementation, including **20 students in Greece, 20 students in Albania, and 49 students in Israel**. The training activities were implemented within the framework of vocational education programmes and were supported by educators and technical mentors in each participating institution.

The learning process concluded with **National Bootcamps organised in each partner country**, during which student teams presented their project outcomes and received feedback from evaluation committees composed of educators and experts in digital technologies. The highest-ranked projects from each country were then selected to participate in the **International BIG ART Bootcamp and Competition in Athens**.

The present deliverable (D4.4 – Evaluation of Skills) focuses on the evaluation of the educational outcomes of these activities. It analyses the learning experience of participating students, the development of digital and transversal competences, and the overall impact of the pilot implementation within the participating VET institutions.

The report also presents the methodology used to evaluate the activities, the main results of the student feedback questionnaires, and the key findings regarding the effectiveness of the BIG ART training approach.

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2. Pilot Training

The Pilot Training (Task 4.1) constituted the first stage of the educational activities implemented within Work Package 4 of the BIG ART project. The objective of the pilot training was to introduce students of Vocational Education and Training (VET) institutions to immersive technologies and digital twin methodologies, with a particular focus on the use of Matterport technology for the creation of virtual environments.

The pilot training was implemented in the three partner countries – **Greece, Albania, and Israel** – within the framework of vocational education programmes delivered by the participating institutions. The training activities were organised in collaboration with educators and technical mentors who guided students throughout the learning process.

Overall, **89 students** participated in the pilot training activities, including **20 students in Greece, 20 students in Albania, and 49 students in Israel**. The course was implemented over a period of approximately **twelve weeks**, combining theoretical instruction with practical exercises and collaborative activities.

The training programme aimed to familiarise students with the basic principles of immersive technologies and to enable them to understand how digital twin models can be used to represent real-world environments in a digital format.

2.1 Learning Objectives

The pilot training course was designed to support the development of both **technical and transversal competences** relevant to modern vocational education and industry needs.

The main learning objectives of the training included:

- understanding the concept of **digital twins** and their applications in industry and education
- familiarisation with **AR/VR technologies** and immersive digital environments
- acquisition of basic skills in **3D scanning and spatial documentation**
- learning how to capture and process real-world environments using **Matterport technology**
- development of digital storytelling and multimedia documentation skills
- enhancement of **teamwork and collaboration competences**

Through these objectives, the training sought to bridge the gap between theoretical instruction and practical application of digital technologies in vocational education.

2.2 Structure of the Training Programme

The pilot training followed a **blended learning structure**, combining classroom instruction, workshops, and practical activities.

The training programme included:

- **Theoretical sessions**, introducing the fundamental concepts of digital twins, immersive technologies, and virtual environments
- **Technical workshops**, where students were trained in the use of Matterport cameras and related software tools
- **Hands-on practice sessions**, during which students performed scanning activities in real environments
- **Collaborative learning activities**, encouraging students to work in small teams and exchange knowledge

- **Mentoring sessions**, where instructors provided guidance on technical and methodological aspects of the projects

This combination of instructional methods allowed students to gradually build their understanding of immersive technologies while applying their knowledge in practical scenarios.

2.3 Technologies and Tools Used

The pilot training focused on the use of **digital twin and virtual tour technologies**, with particular emphasis on the Matterport ecosystem.

Students were introduced to a range of digital tools and technologies, including:

- **Matterport 3D cameras and scanning equipment**
- cloud-based processing platforms for the creation of digital twin models
- virtual tour editing environments
- multimedia tagging tools for adding educational content within digital spaces
- digital documentation and presentation tools

Through the use of these technologies, students learned how to capture spatial data, process digital models, and create interactive virtual environments that can be used for educational or professional purposes.

2.4 Skills Development

Participation in the pilot training enabled students to develop a wide range of competences relevant to the evolving digital landscape of vocational education and industry.

The skills developed during the training can be categorised into three main areas:

2.4.1 Technical Skills

Students acquired practical experience in:

- 3D scanning of physical environments
- digital modelling and spatial visualisation
- processing and editing of virtual environments
- integration of multimedia information into digital twin models

2.4.2 Digital Skills

Students enhanced their digital competences through:

- the use of specialised digital tools and software
- understanding the workflow of immersive technology production
- managing digital files and data produced during scanning activities

2.4.3 Transversal Skills

The training also contributed to the development of important soft skills, including:

- teamwork and collaboration
- problem-solving during technical tasks
- communication and presentation of project outcomes
- organisation and documentation of project activities

These competences are considered particularly important for students preparing to enter modern labour markets characterised by increasing digitalisation.

As part of the pilot training course, a Project-Based Learning (PBL) approach was integrated into the learning process in order to provide students with practical experience in the use of immersive technologies. During the course, student teams worked collaboratively on the development of digital twin projects documenting real environments such as industrial facilities, laboratories, and infrastructure installations.

Through this process, students were able to apply the theoretical knowledge acquired during the training sessions in real-world contexts, while developing technical, digital, and transversal skills. The PBL activity therefore constituted the practical component of the BIG ART training methodology and played a central role in the overall learning experience.

The following section describes the Project-Based Learning activity and the process through which student teams developed their digital twin projects.

3. Project-Based Learning Activity

As part of the pilot training course, students participated in a **Project-Based Learning (PBL) activity**, which constituted the practical component of the BIG ART training methodology.

Project-Based Learning was selected as the main pedagogical approach of the training programme because it allows students to apply theoretical knowledge through the development of real projects that simulate professional environments. Within the context of the BIG ART project, this approach enabled students to explore the practical applications of digital twin technologies and immersive digital environments.

Through the PBL activities, students worked collaboratively to design and develop **virtual tours and digital twin representations of real environments**. These environments included industrial facilities, laboratories, production units, infrastructure installations, and architectural spaces.

The implementation of the PBL activity aimed to create an authentic learning experience in which students could interact with real spaces, collect digital data, and transform it into interactive virtual environments.

3.1 Pedagogical Approach

The PBL methodology adopted in the BIG ART project was based on the principle of **learning through practice and collaboration**. Instead of relying exclusively on theoretical instruction, students were encouraged to actively participate in the creation of digital projects that required problem-solving, teamwork, and creative thinking.

Within this framework, students were guided by instructors and technical mentors who provided support throughout the different stages of the project development process.

The learning process included:

- identification and selection of a real environment to be documented
- planning of the scanning and documentation process
- execution of the 3D scanning using specialised equipment
- processing and editing of the captured data
- integration of multimedia information and explanatory content
- preparation of presentations and documentation of the final project

This approach allowed students to develop both technical competences and transversal skills while working on projects with real-world relevance.

3.2 Project Development Process

The development of the student projects followed a structured process consisting of several stages.

3.2.1 Environment Selection

Students initially identified environments that could be documented using digital twin technology. These environments were selected based on their educational value and their relevance to vocational education.

Examples of environments included:

- industrial production facilities
- laboratories and training spaces
- infrastructure installations
- architectural or heritage buildings
- educational facilities

3.2.2 Data Capture and 3D Scanning

Students then performed **3D scanning activities** using Matterport technology. During this stage, they learned how to capture spatial information and create a digital representation of the physical environment.

The scanning process required careful planning in order to ensure accurate coverage of the environment and smooth navigation within the final virtual model.

3.2.3 Digital Model Processing

After the scanning process, the collected data were processed using digital platforms that automatically generated **interactive digital twin models**. Students were trained to review and edit the models, correct potential issues, and enhance the navigation experience.

3.2.4 Content Enrichment

In order to transform the digital models into educational tools, students added multimedia information such as:

- explanatory text descriptions
- images and videos
- information tags explaining specific elements of the environment
- measurements and spatial information

Through this process, the digital twin models became interactive educational resources rather than simple visual representations.

3.3 Learning Outcomes of the PBL Activity

The PBL activity enabled students to apply the skills developed during the pilot training in a practical and collaborative context.

More specifically, students had the opportunity to:

- apply **digital twin technologies** in real environments
- gain practical experience in **3D scanning and spatial documentation**
- develop **problem-solving abilities** during technical tasks
- collaborate with peers in multidisciplinary teams
- present and document the results of their work

The implementation of PBL activities also contributed to the development of important transversal competences such as communication, teamwork, and project management.

3.4 Educational Value of the PBL Approach

The integration of Project-Based Learning within the BIG ART training programme proved particularly effective for vocational education environments.

Unlike traditional classroom-based instruction, PBL allows students to experience a **more active and participatory learning process**, where knowledge is constructed through direct interaction with real situations and technologies.

The creation of digital twin projects enabled students to develop practical digital competences that are increasingly relevant in sectors such as engineering, architecture, industrial production, tourism, and cultural heritage documentation.

Furthermore, the collaborative nature of the projects encouraged peer learning and knowledge exchange among students from different educational backgrounds.

The outcomes of the PBL activity formed the basis for the **National Bootcamp events organised in each partner country**, during which student teams presented their work and received feedback from evaluation committees.

4. Student Projects

Students developed a series of digital twin projects documenting real environments using Matterport technology and immersive digital tools.

The projects focused on a variety of environments relevant to vocational education and training, including industrial facilities, production units, laboratories, infrastructure installations, and architectural spaces. Through these projects, students had the opportunity to apply the knowledge and technical skills acquired during the training programme in real-world contexts.

The projects were developed collaboratively in student teams under the supervision of educators and technical mentors. Each team was responsible for the planning, scanning, processing, and documentation of a selected environment, resulting in the creation of an interactive virtual tour or digital twin model.

The following sections present the projects developed in each partner country.

4.1 Greece

Five student teams developed projects focusing primarily on **industrial facilities and infrastructure environments**.

Four of the projects were developed by student teams participating in the pilot training course implemented during the current academic year. In addition, one project was further improved and expanded by a team of students who had initially developed the project during an earlier phase of the BIG ART project.

The projects developed in Greece include the following:

1. **Serafeim Pasta Production Unit**

Digital documentation of a pasta production facility, presenting the organisation of the production environment and the main stages of the manufacturing process.
The project: https://bigart-vet.eu/?page_id=1618

2. **Walnut Processing Production Unit**
   A virtual tour presenting the infrastructure and workflow of a walnut processing facility.
   The project: https://bigart-vet.eu/?page_id=1616

3. **Olive Oil Production Facilities in Askri Neochori**
   Digital twin representation of an olive oil production facility, highlighting the equipment and processes involved in olive oil production.
   The project: https://bigart-vet.eu/?page_id=1614

4. **Wind Park in Evia**
   Digital documentation of a renewable energy installation, illustrating the infrastructure and spatial organisation of a wind energy facility.
   The project: https://bigart-vet.eu/?page_id=1847

5. **Photovoltaic Park – Eastern Attica**
   Virtual representation of a photovoltaic energy installation, allowing users to explore the layout and technical components of the solar energy facility.
   The project: https://bigart-vet.eu/?page_id=1636

   Note: This project was originally developed during the first year of the BIG ART project within the course “Practical Application in the Specialisation”, involving a different group of students. Prior to the National Bootcamp, the project was further enhanced and technically upgraded through the online mentoring sessions implemented in Activity 3.3.

4.2 Albania

Students in Albania developed projects focusing mainly on **architectural documentation and industrial production environments**.

The projects were developed within the framework of the training activities implemented at Kolin Gjoka Vocational High School and were later presented during the national bootcamp organised at the institution.

The projects developed include:

1. **Twin Towers Scan**
   A digital twin model created through 3D scanning technology for the documentation of an architectural structure, allowing users to explore the building through an immersive virtual environment.
   The project: Hotel Twin Towers – BigArt VET

2. **Mrizi i Zanave – Winery Production**
   Virtual documentation of a winery production facility, presenting the infrastructure and workflow of the wine production process through an interactive digital environment.

   The project: Mrizi i Zanave – Wine Processing Area – BigArt VET

3. **Gjergj Fishta Library, Lezhë**

   This interactive 3D scan of the Gjergj Fishta Library in Lezhë offers a detailed virtual exploration of one of the city's key cultural and educational institutions. Using advanced 3D spatial scanning technology, the interior spaces of the library have been digitally preserved, capturing architectural structure, reading areas, book collections, and study environments in high resolution.
   The project: Gjergj Fishta Library, Lezhë – BigArt VET

4. **HANA Youth Center**

The 3D scan of Qendra Rinore Hana presents a detailed digital representation of the youth center, capturing the spatial structure, architectural elements, and surrounding environment of the building. Using modern 3D scanning and photogrammetry techniques, the model accurately reconstructs the exterior and key features of the space, preserving both its geometry and visual characteristics.

The project: HANA Youth Center – BigArt VET

5. **Infiniti Textile Company**

The 3D scan of Infiniti Textile Company provides a detailed digital representation of the company's industrial facility, capturing the architectural structure and spatial organization of the textile production environment. Using advanced 3D scanning and digital modeling techniques, the model accurately recreates the physical space, including structural elements, work areas, and key components of the production setting.

The project: Infiniti Textile Company – BigArt VET

6. **IT Cabinet, Kolin Gjoka**

This 3D scan presents the IT Cabinet of Kolin Gjoka School, offering a detailed virtual view of the digital learning environment and its technical infrastructure. Using advanced 3D spatial scanning technology, the classroom has been digitally documented to accurately represent its layout, computer workstations, networking equipment, and instructional setup.

The project: IT Cabinet, Kolin Gjoka – BigArt VET

7. **Skanderbeg's Tomb, Lezhë**

   This interactive 3D scan allows visitors to explore the historic Tomb of Gjergj Kastrioti Skanderbeg inside the Memorial complex in Lezhë. Using advanced 3D scanning technology, the space has been digitally preserved to capture the architectural details of the former Church of St. Nicholas, where Albania's national hero was buried in 1468.

   The project: Skanderbeg's Tomb, Lezhë – BigArt VET

4.3 Israel

Students from different faculties participated in the development of digital twin projects using Matterport technology. The projects covered a wide range of disciplines, including medical environments, biotechnology laboratories, industrial processes, and architectural documentation.

The projects developed in Israel include:

1. **Dialysis Room**
   Digital twin documentation of a medical environment used for dialysis treatment, demonstrating how immersive models can support training in healthcare settings.
   During their studies in the medical device department, students learn about the renal system and the dialysis machine. The topic of dialysis is considered complex and challenging for many of them, mainly because it is taught theoretically at this stage, while practical experience and familiarization with the machine only take place at the end of the third year.
   The use of Matterport to present the topic of dialysis during the academic year contributed greatly to the understanding of the material. It allowed the students to get to know the dialysis machine and the work environment in the dialysis room in a tangible and interactive way. The students in the entire course showed great

interest in the 3D tour and the app, and expressed curiosity and involvement throughout the activity.
In addition, the presentation of the project in the competition by the students who participated in it increased their motivation to experiment with the application and actively use it as part of the learning process. The winning students presented the project at the hospital where they work, and it is now being used for real patients before they arrive at the dialysis room.
The project: Dialysis Room – BigArt VET

2. **Ecology Israel**

Virtual documentation of an industrial engineering environment.
Ecology Israel is an industrial e-waste recycling plant where over 80% of the workers are people with special needs who receive equal employment opportunities. In addition, the plant is an example and model of harmony between sectors! Workers in the plant are brothers and sisters, Jews, Muslims, Christians and Druze.
factory's target groups are:

- The Ministry of Environmental Protection to promote regulation and enforcement of electronic waste recycling
- Industrial plants that will bring electronic waste for recycling or recycling and purchase recycled raw materials such as shredded aluminum
- Educational institutions for outreach activities and promoting environmental ambassadors
- Non-profit organizations to promote equality and the advancement of people with special needs
- E-commerce sites for selling computers and electronic products that have arrived at the factory and have been recycled.
- Collaboration with private customers as a channel for delivering electronic products for recycling, computer

repair, and the purchase of second-hand computer equipment.

- Local councils and municipalities that will transfer containers of electronic waste to the factory.

The project: https://my.matterport.com/show/?m=Ps88GLXY9gf

3. **Sondos Ceramics**
   Digital representation of a ceramics production environment, illustrating the workflow of the manufacturing process.
   Sundos' ceramics studio is located in the Druze village of Yarka.
   Sundos is a Druze student majoring in industry and management whose vision was to establish a women's empowerment center for Druze women and a hospitality and creative complex for additional populations who come to the Galilee to experiential and relaxing therapeutic space where you disconnect from the intense pace of the modern world and enter a space of comfort, nature, peace and creativity
   The project:https://my.matterport.com/show/?m=r5yqQxPe4Af

4. **Feasibility Study of Improvements at Gav Systems Company**
   Virtual documentation of an industrial company environment focusing on production processes and operational improvements.
   GAV **Systems Ltd.** is an Israeli IT services company founded in 1988 in northern Israel. The company's mission is to deliver advanced computing solutions and services. It provides a range of offerings, including IT consulting, technological development, outsourcing, digital solutions, software testing, and automation.
   The solutions offered by the company are precisely tailored to both the Israeli and international business environments, drawing on extensive experience and strong professional expertise.

The project aimed to reduce costs, improve operational processes, and optimize standard work times for a client in the energy sector, with the goal of ensuring high levels of client satisfaction.

Use of the Matterport platform served several purposes:

I. **Marketing-oriented planning for capturing the factory workspace:** enabling the client to experience a professional and well-presented working environment.
II. **Identification of operational inefficiencies:** to support process improvement.
III. **Accurate measurements and technical data collection:** facilitating informed decision-making.

The virtual tour reflects the company's awareness of existing organizational challenges and inefficiencies, thereby offering viewers an experiential understanding of the issues targeted for improvement.

The project:
https://my.matterport.com/show?m=84XkMwZCK7H&play=0

5. **The Goldstein's House**

Digital twin representation of a residential architectural space.
Modern 170m home with vibrant kitchen, cozy living area, dedicated workspace, and playful children's room. Featuring eclectic decor, the space balances functionality with personal style

The project was carried out in accordance with the requirements of the course 'Climate Planning and Green Construction', at Ort-Braude College.

The Goldstein family residence, which researched and documented in this Matterport project, was designed by architect Alexandra Goldstein and was built in 2021 in Mikhmanim, Israel, using climate planning principles and green materials: hemp blocks, lime plaster, and insulated windows.

The house is spread over three levels. On the lower level is the public space of the house: entrance, living room, spacious kitchen and office. On the second level are two children's rooms and a master suite. On the third level is a room for creativity along with a large balcony.
The overall atmosphere of the home reflects a balance between contemporary design, climatic planning, green building materials, and living comfort, with each room displaying its unique personality while maintaining a cohesive feel throughout the home.
The project:https://my.matterport.com/show/?m=uqYjEfJzbbw

6. **GC Experience – The Next Generation of Laboratory Training: Gas Chromatography Virtual Tour**
   Virtual laboratory environment designed to support biotechnology training.
   The project: GC Experience – BigArt VET

7. **Between Anoda to Katoda**
   Educational digital twin project related to electrochemical processes.A Virtual Tour of the World of Electrochemical Cells
   The project: https://my.matterport.com/show/?m=rshMky8nkP8T

8. **Redox Unlocked**
   Interactive virtual environment explaining oxidation–reduction processes-understanding potentiometric titration from the inside
   The project: https://my.matterport.com/show/?m=nmCLE8Z6AdV

9. **La Riad – 360 Virtual Tour of the La Riad Conservation Building**
   Digital documentation of a conservation building using immersive technologies.
   The project: La Riad – BigArt VET

5. National Bootcamps and Competitions

As part of the pilot implementation of the BIG ART training programme, **National Bootcamps and Competitions** were organised in each partner country. These events represented the final stage of the pilot activities implemented within Work Package 4 and provided students with the opportunity to present the digital twin projects developed during the training activities.

The national bootcamps served multiple purposes within the project. First, they allowed students to demonstrate the outcomes of their work and present the digital environments they had developed using Matterport technology and immersive digital tools. Second, the bootcamps provided an opportunity for educators and experts to evaluate the quality of the student projects and the skills demonstrated during the development process.

During the events, student teams presented their projects through live demonstrations of their virtual environments. The presentations included explanations of the scanning process, the development of the digital twin models, and the educational or industrial relevance of the documented environments.

The evaluation process was carried out by national evaluation committees composed of educators and experts in digital technologies and vocational education. The committees assessed the projects based on the evaluation framework developed within the BIG ART project.

The bootcamps also served as the selection mechanism for identifying the teams that would represent each country in the **International BIG ART Bootcamp and Competition organised in Athens, Greece**.

5.1 Objectives of the National Bootcamps

The organisation of the national bootcamps aimed to achieve several educational and evaluation objectives within the BIG ART project.

More specifically, the bootcamps aimed to:

- provide students with the opportunity to present the digital twin projects they had developed
- assess the technical and educational quality of the virtual environments created by the students
- evaluate the development of digital and transversal skills
- promote knowledge exchange between students, educators, and experts
- select the student teams that would represent each partner country in the international bootcamp

Through this process, students were able to experience a **realistic project presentation environment**, similar to professional contexts where digital solutions are presented and evaluated.

5.2 Organisation of the Bootcamps in the Partner Countries

Each partner country organised a national bootcamp involving student teams that had developed projects during the training activities.

Although the specific format of the events varied slightly between countries, the overall structure of the bootcamps followed a similar framework.

The bootcamps generally included:

- introduction to the objectives of the BIG ART competition

- presentation of the evaluation criteria
- demonstration of the student projects
- discussion and feedback sessions with the evaluation committees
- selection of the teams that would participate in the international competition

The events created an interactive environment where students were able to present their work and exchange ideas with educators and peers.

5.3 National Bootcamp in Greece

The national bootcamp in Greece included the presentation of student projects documenting **industrial production facilities and renewable energy infrastructures**.

Student teams demonstrated the digital twin models they had developed and explained the processes followed during the scanning and documentation of the selected environments.

The evaluation committee assessed the projects based on the predefined evaluation criteria and selected the teams that would represent Greece in the International BIG ART Bootcamp.

5.4 National Bootcamp in Albania

The national bootcamp in Albania was organised at **Kolin Gjoka Vocational High School** and included presentations of projects related to **architectural documentation and industrial production environments**.

Students presented the digital twin models they had developed and demonstrated how immersive technologies can be used to document real environments and support vocational training.

Following the evaluation process, the highest-ranked teams were selected to participate in the international bootcamp.

5.5 National Bootcamp in Israel

The national bootcamp in Israel included presentations of digital twin projects developed by students from different educational programmes, including biotechnology, medical technologies, industrial engineering, and architecture.

Due to the security conditions in the region at the time of the event, the bootcamp was organised **online** to ensure the safety of participants.

Despite the challenges related to the remote organisation of the event, student teams successfully presented their projects and participated in the evaluation process.

5.6 Educational Value of the Bootcamp Process

Beyond their role as evaluation events, the national bootcamps also provided important educational benefits for the participating students.

By presenting their projects in front of evaluation committees and peers, students had the opportunity to:

- develop their **presentation and communication skills**
- receive constructive feedback on their work
- reflect on the development process of their projects
- understand how digital technologies can be applied in professional contexts

The bootcamps therefore functioned not only as a competition but also as a learning experience that strengthened the educational impact of the pilot activities.

5.7 Documentation of the Bootcamp Activities

The implementation of the national bootcamps is documented through the **official minutes of the events**, which include information about the participating teams, the evaluation committees, the evaluation criteria, the results of the competitions and the certifications of the participants.

These documents are provided in **Annex 2 of the present deliverable**.

6. Questionnaire Results and Statistical Analysis of the Project-Based Learning activities

To evaluate the learning experience, students completed a **satisfaction questionnaire** after completing the activities.

A total of **89 responses** were collected.

In order to evaluate the effectiveness of the Project-Based Learning activities implemented within Task 4.2 of the BIG ART project, a feedback questionnaire was distributed to participating students after the completion of the activities.

The questionnaire aimed to collect students' perceptions regarding:

- the organisation of the project-based learning activity
- the learning outcomes achieved during the project
- the development of technical and transversal skills
- the quality of mentoring and support
- the overall satisfaction with the learning experience.

A total of **89 students** from the participating countries completed the questionnaire.

The majority of the questions used a **five-point Likert scale** ranging from *Strongly Disagree* to *Strongly Agree*, allowing the project team to analyse the level of agreement with each statement.

6.1 Overall Evaluation of the Learning Experience

The analysis of the questionnaire responses shows **very high levels of student satisfaction** with the project-based learning activities.

Most of the responses were concentrated in the categories **"Agree"** and **"Strongly Agree"**, indicating that students perceived the learning experience as positive and beneficial for their educational development.

The average scores for the evaluation statements ranged between **4.57 and 4.64 on a five-point scale**, demonstrating a consistently high level of satisfaction across all aspects of the learning experience.

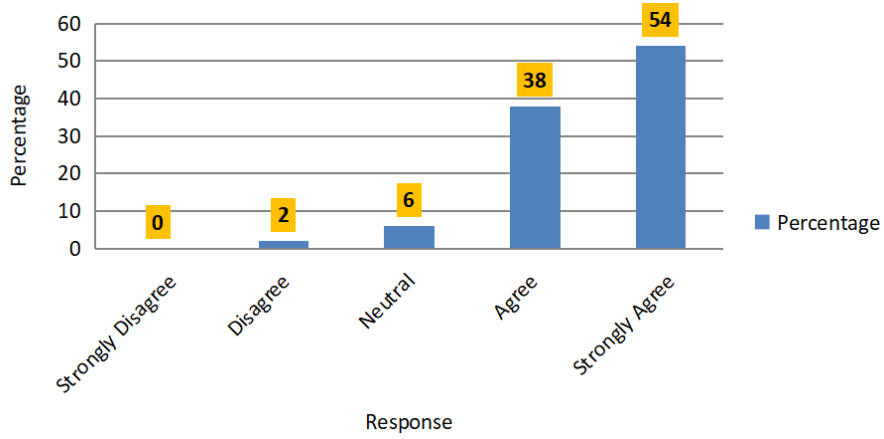

Figure 1 Overall Student Satisfaction with the Project-Based Learning Activities

The majority of students selected the responses "Agree" and "Strongly Agree", indicating a very high level of satisfaction with the project-based learning activities implemented in the BIG ART pilot phase.

6.2 Clarity of Objectives and Organisation

Students were asked to evaluate whether the objectives of the project were clearly explained and whether the workload and duration of the project were appropriate.

The results indicate that students considered the organisation of the activity to be well structured.

Statement	Average Score (1–5)
The objectives of the project were clearly explained	**4.58**
The project duration and workload were appropriate	**4.61**

These results suggest that the structure and planning of the PBL activity were well aligned with the students' expectations.

6.3 Learning Outcomes

Students also evaluated the extent to which the project contributed to their understanding of the learning topic and its practical applications.

The responses indicate that the majority of students perceived the project as a valuable learning experience.

Learning Outcome Statement	Average Score
The project helped me better understand the learning topic	**4.62**
The project connected theory with real-world applications	**4.58**
The activities were relevant to my field of study	**4.60**

These findings confirm that the integration of **project-based learning with immersive technologies** can effectively support the acquisition of practical knowledge in vocational education.

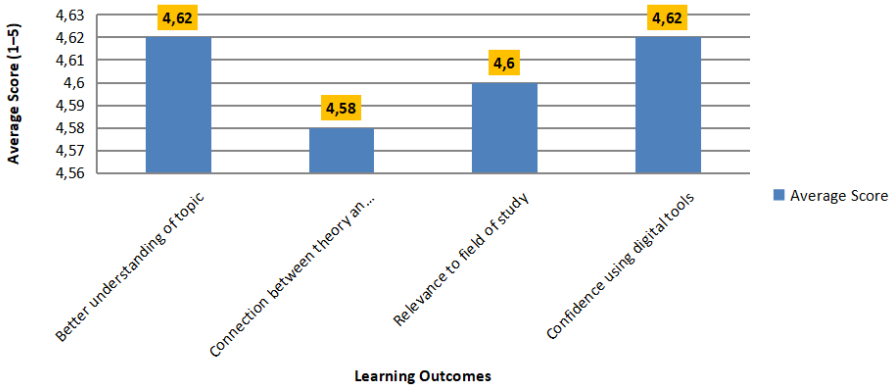

Figure 2 Student Perceptions of Learning Outcomes

6.4 Skills and Competence Development

One of the main objectives of the BIG ART project was to support the development of digital and transversal skills among VET students.

The questionnaire results show very positive outcomes in this area.

Skills Development Statement	Average Score
The project helped me develop digital and technical skills	**4.62**
The project improved my problem-solving skills	**4.62**
The project improved teamwork and collaboration	**4.63**
The project encouraged creativity and critical thinking	**4.64**

The highest score was recorded for the statement related to **creativity and critical thinking**, highlighting the positive educational impact of the project-based learning methodology.

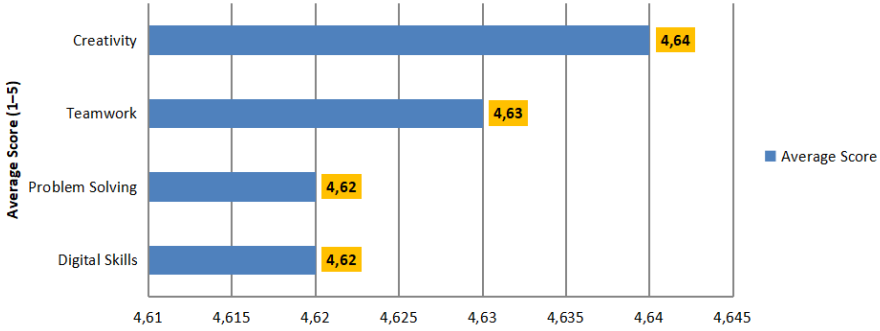

Figure 3 Development of Digital and Transversal Skills

6.5 Mentoring and Support

Students were also asked to evaluate the support they received from their teachers and mentors during the project.

The results show that mentoring was considered highly effective.

Mentoring Statement	Average Score
I received adequate guidance from my mentor	**4.63**
Feedback from the mentor was helpful	**4.58**
I felt supported during the project	**4.57**

These results indicate that the mentoring provided during the activities contributed significantly to the success of the learning experience.

6.6 Overall Satisfaction and Impact

The final section of the questionnaire evaluated the overall satisfaction of students and the impact of the learning experience on their motivation and confidence.

The responses demonstrate that students considered the experience both engaging and educationally valuable.

Satisfaction Statement	Average Score
Overall satisfaction with the PBL experience	**4.64**
The activity increased my motivation to learn	**4.61**
I feel more confident using digital tools	**4.62**

The consistently high scores across all statements confirm the **positive educational impact of the BIG ART pilot activities**.

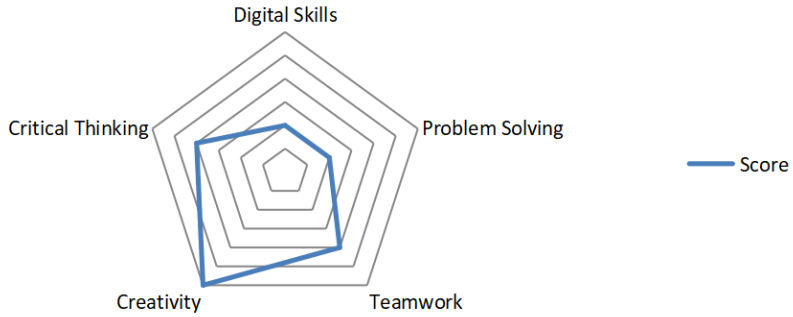

Figure 4 Skills Impact Radar Chart

The radar chart illustrates the overall impact of the BIG ART activities on the development of key digital and transversal skills among participating students.

6.7 Summary of Findings

The statistical analysis of the questionnaire responses indicates that the Project-Based Learning activities implemented within the BIG ART project were highly successful in achieving their educational objectives.

The key findings include:

- high levels of **student satisfaction** with the learning experience
- significant improvement in **digital and technical skills**
- strong development of **teamwork and collaboration competences**
- effective **mentoring and guidance** during the project activities
- increased **confidence in using digital tools and technologies**

Overall, the results confirm that the integration of immersive technologies and project-based learning can significantly enhance the learning experience in vocational education and training.

6.8 Discussion of the Results

The evaluation results collected through the student questionnaire and the project presentations during the national bootcamps indicate that the pilot activities implemented within the BIG ART project were successful in achieving their educational objectives.

Overall, students reported a high level of satisfaction with the learning experience and expressed positive perceptions regarding the integration of immersive technologies into vocational education. The results suggest that the combination of theoretical instruction and project-based learning activities created an effective learning environment that supported both technical and transversal skill development.

One of the most important outcomes of the pilot activities was the development of **digital competences related to immersive technologies and digital twin environments**. Students gained practical experience in capturing and processing spatial data, creating virtual representations of real environments, and integrating multimedia information into digital models.

At the same time, the collaborative nature of the project activities contributed significantly to the development of **transversal skills**, including teamwork, communication, and problem-solving. Students worked in small groups and were required to coordinate their efforts during the different stages of project development, which helped them develop organisational and collaboration skills.

The results of the questionnaire analysis also demonstrate that the **project-based learning approach** used in the BIG ART training programme was particularly effective for vocational education. By engaging students in real-world projects, the training activities allowed them to connect theoretical knowledge with practical applications.

Another important aspect of the pilot activities was the opportunity for students to present their work during the **national bootcamp events**. These events created an environment where students could demonstrate their projects, receive feedback from educators and experts, and reflect on the learning process.

The positive feedback provided by students indicates that the BIG ART training approach successfully supported the development of digital innovation skills while also promoting active learning and student engagement.

Furthermore, the results confirm that immersive technologies such as digital twins and virtual environments can be effectively integrated into vocational education programmes and can contribute to the modernisation of VET training methodologies.

Overall, the findings of the evaluation suggest that the BIG ART pilot activities achieved their intended objectives and provided valuable learning experiences for participating students.

7. Questionnaire Results and Statistical Analysis of the National Bootcamps

To evaluate the effectiveness of the National Bootcamps and the learning experience of participating students, a feedback questionnaire was distributed to all participants.

A total of 46 responses were collected from students who participated in the national bootcamps organised in Greece, Albania and Israel.

The questionnaire examined four main dimensions:

- organisation and logistics
- training quality
- learning outcomes and skills development
- overall satisfaction and impact.

The results demonstrate a very high level of satisfaction and positive educational impact.

7.1 Overall Satisfaction with the Bootcamp

Students were asked to evaluate their overall satisfaction with the national bootcamp.

The results show that:

- **69.6% strongly agreed** that they were satisfied with the bootcamp
- **26.1% agreed**
- **2.2% were neutral**
- **2.2% strongly disagreed**

This means that **95.7% of participants expressed a positive evaluation of the activity**.

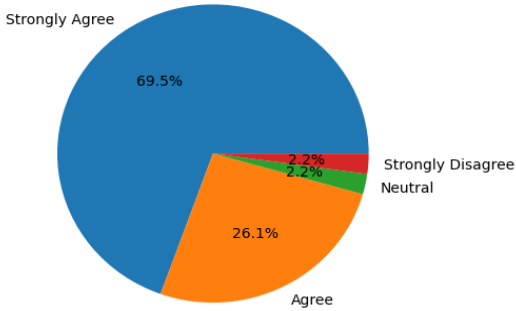

Figure 5 Overall satisfaction with the National Bootcamp

Strongly Agree → 69.6%
Agree → 26.1%
Neutral → 2.2%
Strongly Disagree → 2.2%

These results confirm that the organisation and implementation of the bootcamps were highly appreciated by the participants.

7.2 Achievement of Learning Expectations

Students were also asked whether the bootcamp met their expectations.

The responses indicate that:

- **67.4% strongly agreed** that the bootcamp met their expectations
- **28.3% agreed**
- **2.2% were neutral**
- **2.2% strongly disagreed**

Overall, **95.7% of students reported that the activity met their expectations**.

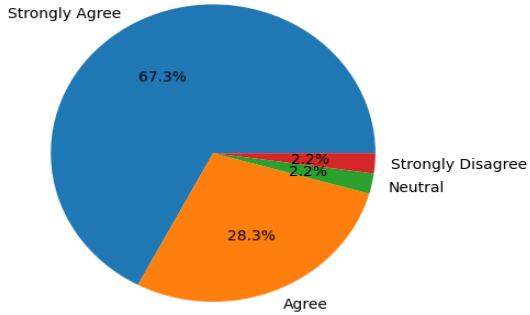

Figure 6 Bootcamp met participants' expectations

Strongly Agree → 67.4%
Agree → 28.3%
Neutral → 2.2%
Strongly Disagree → 2.2%

These results demonstrate that the training activities were well aligned with the expectations and interests of the participating students.

7.3 Development of Knowledge in Digital Twin Technologies

A key objective of the BIG ART project is to enhance students' understanding of **AR/VR technologies and digital twin applications**.

The questionnaire results indicate that:

- **63.0% strongly agreed** that the bootcamp improved their understanding of digital twin technologies
- **30.4% agreed**
- **4.3% were neutral**
- **2.2% strongly disagreed**

This means that **over 93% of participants reported a positive learning impact**.

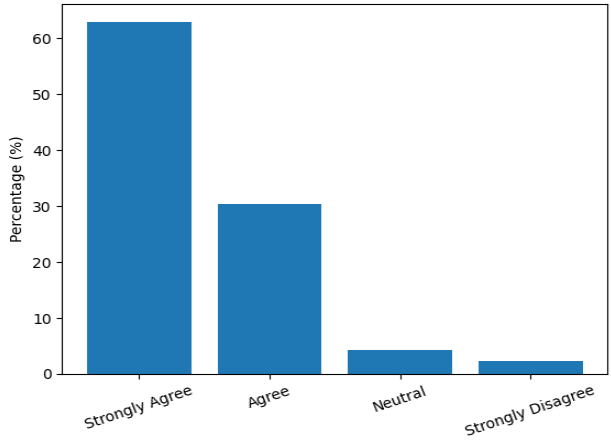

Figure 7 Improvement of knowledge in AR / Digital Twin technologies

Strongly Agree → 63.0%
Agree → 30.4%
Neutral → 4.3%
Strongly Disagree → 2.2%

The results confirm that the training successfully introduced students to emerging immersive technologies used in modern digital environments.

7.4 Development of Practical Skills

Participants were also asked whether the bootcamp helped them develop practical skills applicable in real educational or professional contexts.

The results show that:

- **69.6% strongly agreed**
- **23.9% agreed**
- **4.3% were neutral**

- **2.2% strongly disagreed**

Therefore, **over 93% of students reported that they developed useful practical skills**.

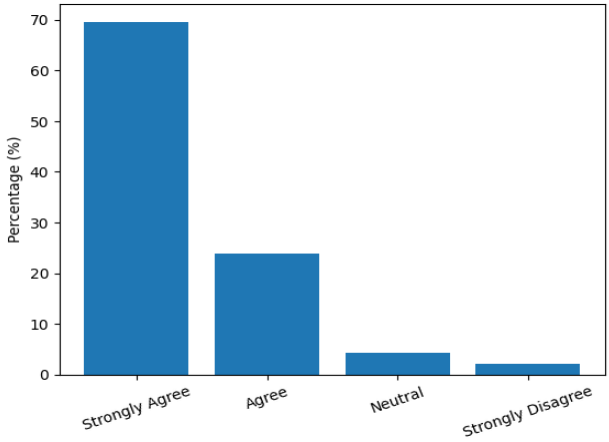

Figure 8 Development of practical digital skills

Strongly Agree → 69.6%
Agree → 23.9%
Neutral → 4.3%
Strongly Disagree → 2.2%

These findings demonstrate the effectiveness of the **project-based learning methodology** applied during the bootcamp.

7.5 Collaboration and Teamwork

Teamwork was another important aspect evaluated through the questionnaire.

Students reported that the bootcamp encouraged collaboration and teamwork during the development of the virtual tour projects.

The results indicate that:

- **65.2% strongly agreed**
- **28.3% agreed**
- **4.3% were neutral**
- **2.2% strongly disagreed**

This means that **over 93% of participants confirmed the positive role of teamwork in the learning process**.

Figure 5 – Collaboration and Teamwork During the Bootcamp (N=46)

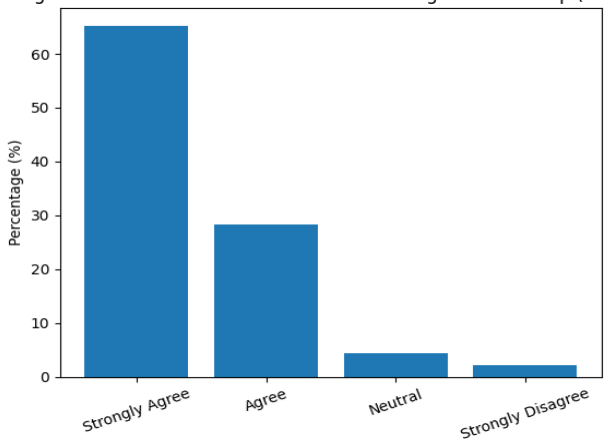

Figure 9 Collaboration and teamwork during the bootcamp

Strongly Agree → 65.2%
Agree → 28.3%
Neutral → 4.3%
Strongly Disagree → 2.2%

The results confirm that the collaborative environment of the bootcamp supported peer learning and knowledge exchange.

7.6 Recommendation of Similar Activities

Participants were also asked whether they would recommend similar bootcamp activities to other students or colleagues.

The responses show that:

- **69.6% strongly agreed**
- **23.9% agreed**
- **4.3% were neutral**
- **2.2% strongly disagreed**

Therefore, **over 93% of participants would recommend similar learning experiences**.

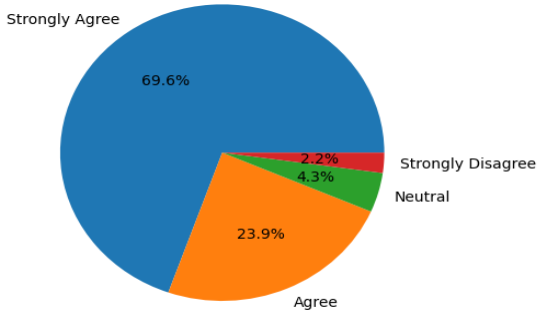

Figure 10 Recommendation of similar bootcamp activitie

Strongly Agree → 69.6%
Agree → 23.9%
Neutral → 4.3%
Strongly Disagree → 2.2%

This result highlights the strong positive impact of the BIG ART training methodology.

7.7 Overall Impact

The questionnaire results reveal consistently high levels of positive feedback across all evaluation dimensions. Overall satisfaction and the extent to which the bootcamp met participants' expectations reached 95.7% positive responses, while perceived improvement in knowledge, practical skills, teamwork, and willingness to recommend similar activities remained above 93%. These results confirm the strong educational impact of the BIG ART national bootcamp activities.

7.8 Discussion and Key Findings

The analysis of the questionnaire responses provides important insights into the effectiveness of the BIG ART national bootcamps and the impact of the project-based learning activities.

The results indicate consistently high levels of positive feedback across all evaluation dimensions. More specifically:

- Over 95% of participants expressed overall satisfaction with the bootcamp activities.
- More than 93% of students reported improved knowledge regarding AR/VR technologies and digital twin applications.
- A similarly high percentage confirmed the development of practical digital skills through the hands-on activities implemented during the bootcamps.

Students also highlighted the importance of teamwork and collaboration, which played a significant role in the development of their virtual tour projects.

The findings demonstrate that the combination of immersive technologies, real-world projects, and collaborative learning provides an effective educational approach for vocational education and training.

Furthermore, the results confirm that the BIG ART methodology successfully integrates digital innovation with vocational training practices, enabling students to develop both technical and transversal competences.

8. Conclusions

The pilot implementation of the BIG ART training programme demonstrated the strong educational potential of immersive technologies in Vocational Education and Training (VET).

Through the activities implemented within Work Package 4, students were introduced to the concepts of digital twins, virtual environments, and immersive technologies, and were given the opportunity to apply these concepts in real-world contexts. The combination of theoretical training, project-based learning, and competitive presentation environments created a comprehensive learning experience that allowed students to progressively develop both technical and transversal competences.

The Pilot Training activities successfully introduced students to the technological foundations of digital twin environments and immersive digital documentation. Through structured learning sessions and hands-on exercises, students developed practical skills in 3D scanning, digital modelling, and the creation of interactive virtual environments.

The Project-Based Learning activities represented a particularly effective pedagogical approach, allowing students to apply theoretical knowledge through the development of digital twin projects based on real environments such as industrial facilities, laboratories, infrastructure installations, and architectural spaces. The collaborative nature of the projects enabled students to strengthen important transversal skills such as teamwork, communication, problem-solving, and project management.

The National Bootcamps organised in Greece, Albania, and Israel provided an additional educational dimension by creating a structured environment for the presentation and evaluation of the student projects. Through this process, students had the opportunity to present their work, receive feedback from educators and experts, and reflect on the learning outcomes achieved during the training activities.

The results of the evaluation questionnaires indicate consistently high levels of satisfaction among participating students. The statistical analysis confirms that the training activities contributed significantly to the development of digital competences, practical skills, and confidence in the use of immersive technologies. Furthermore, students reported increased motivation and engagement when learning through project-based and experiential learning approaches.

Overall, the findings of the evaluation demonstrate that the BIG ART methodology successfully integrates immersive technologies with innovative pedagogical approaches suitable for vocational education. The combination of digital twin technologies, project-based learning, and collaborative activities provides a powerful framework for enhancing the quality and relevance of VET programmes.

The results of the pilot implementation suggest that the training model developed within the BIG ART project can be effectively adopted and adapted by vocational education institutions seeking to integrate emerging digital technologies into their curricula. The experience gained during the project provides valuable insights for educators and institutions aiming to modernise vocational training and prepare students for digitally evolving professional environments.

In conclusion, the BIG ART pilot activities successfully achieved their educational objectives and demonstrated the potential of immersive technologies to support innovative learning experiences in vocational education and training.

9. Annexes

Annex 1 – Evidence and Documentation of Activities 4.1 & 4.2

The implementation of Activities 4.1 and 4.2 is documented through the following evidence:

- Participant Lists (per country)
- Student Certifications (Activities 4.1 & 4.2)
- Student Evaluation Questionnaire Results

All documents are available through the following project repository:

Description of the Pilot Training Course and Project-Based Learning Activity	Piloting Course & Project Based Learning – BigArt VET
Participant List Albania (Tasks 4.1 & 4.2)	Attendance list Albania - Google Drive
Participant List Greece (Tasks 4.1 & 4.2)	Attendance list Greece - Google Drive
Participant List Israel (Tasks 4.1 & 4.2)	Attendance list Israel - Google Drive
Certifications Albania (Tasks 4.1 & 4.2)	Certification Piloting course & PBL Albania - Google Drive
Certifications Greece (Tasks 4.1 & 4.2)	Certification Piloting course & PBL Greece - Google Drive
Certifications Israel (Tasks 4.1 & 4.2)	Certification Piloting course & PBL Israel - Google Drive
Student evaluation questionnaire results	Responses

Annex 2 – Evidence and Documentation of Activity 4.3

The implementation of Activity 4.3 is documented through the following evidence:

- Participant Lists (per country)
- Student Certifications
- Minutes of the National Competitions
- Evaluation criteria
- Student Evaluation Questionnaire Results

All documents are available through the following project repository:

Albania: Participant list signed

Greece: Participant list signed

Israel: Participant list signed

Albania: Certifications

Greece: Certifications

Israel: Certifications

Albania: Minutes National Competition

Greece: Minutes National Competition

Israel: Minutes National Competition

Evaluation criteria

Responses