



Short education program Microqualifications (Open Badge)

Realization of projects in 3D technologies

The education program was prepared by

Vocational High School Velika Gorica

Ivan Živković, Marin Širol

Experts:

Ivan Živković

Educational program providers

Project: CL.BVET Education and Training for Collaborative Learning in Blended Learning Environments

Project partners: School center Novo mesto, Euroskill doo (Slovenia), Secondary Vocational School Velika Gorica (Croatia), Technical School Gradiška, Center for Adult Education Banja Luka (Bosnia and Herzegovina), Secondary Vocational School Pljevlja, Innovative Entrepreneurial Center Tehnopolis (Montenegro)

PAGE *
MERGEFOR
MAT3





Basic information about the training program

Name of training program:

Realization of projects in 3D technologies

Duration of the training program:

50 hours

Number of points:

2 ECTS credits

Educational areas:

Mechanical engineering, shipbuilding and metallurgy
Electrical engineering and computing
Information and communications

Certificates and badges obtained:

Upon successful completion of the program, the participant receives a certificate of participation in the training. If they submit the project assignment and successfully complete all the assessments provided in the program, they receive micro-evidence of the training completed with a list of acquired competences and achieved learning outcomes, and a digital open badge with a description of the acquired competences and learning outcomes that they demonstrated in order to earn the badge.

PAGE *
MERGEFOR
MAT3



1. Description and target group of the training program:

Program description

The program takes participants through the complete cycle of working with 3D technologies – from digital design and 3D modeling, through 3D scanning and digitization of physical objects, to the planning and implementation of additive manufacturing of finished objects. The emphasis is on understanding work processes, proper model preparation, and efficient implementation of 3D projects.

Target group

Technicians and engineers in the fields of mechanical engineering, mechatronics, electrical engineering, design and related technical professions

Designers and creative professionals working with digital models and physical prototypes

2. Competencies

Through the training, the participant(s) develops the following professional competencies:

Competencies acquired through the training program

1. 3D modeling and reverse engineering
2. Strategy and management of additive manufacturing
3. digitization and analysis of 3D scans
4. Planning and optimization of work processes

PAGE *
MERGEFOR
MAT3

3. Learning outcomes

Competence: **3D modeling and reverse engineering**

Participant(s)

1. Create a simple 3D model by measuring a real object while following design rules for additive manufacturing.
2. Independently perform basic 3D modeling and reconstruction of 3D geometry through reverse engineering and independently use software for designing 3D models
3. Independently adjust 3D geometry for additive manufacturing processes

Competence: **Strategy and management of additive manufacturing**

Participant(s)

1. Prepare and print a 3D model while respecting process optimization.



2. Correctly select the material and technology for additive manufacturing according to the required characteristics and purpose of the product
3. Prepare a 3D model for additive manufacturing, respecting the chosen technology
4. Independently produce products and properly use additive manufacturing equipment (3D printing)

Competence : digitization and analysis of 3D scans

Participant(s)

1. Perform a 3D scan of the object with the generated model and analysis of possible errors.
2. Explain and differentiate the basic principles of laser scanning, structured light technology, and the photogrammetry method.
3. Independently prepare the object for digitization, which includes proper positioning, application of anti-reflective coatings and placement of reference marks (markers).
4. Perform the scanning process using a 3D scanner and apply software tools (such as Artec Studio or MeshLab) to process, correct and combine the obtained data.
5. Recognize common errors in digital recording during the scanning process and apply appropriate diagnostic methods to eliminate them.

PAGE *
MERGEFOR
MAT3

Competence : Planning and optimization of work processes

Participant(s)

1. Develop a detailed work process plan with resource estimates and cost calculations for a single project.
2. Respect work processes and adequately optimize the production process
3. Independently plan the work process of 3D modeling, 3D scanning and additive manufacturing (3D printing), while respecting the given work procedures and production specifics
4. Prepare tools and machines for 3D scanning, 3D modeling and additive manufacturing (3D printing) according to the needs of the work process and in accordance with the tasks
5. Assess the required materials, tools and other resources for 3D procedures/processes
6. Calculate and explain the price and value of jobs to a superior or customer



4. Training program structure

Z. no.	MODULE NAME	NUMBER OF POINTS Credits (ECTS)	HOURS (h)		
			T	PP	TOTAL
1.	Basics of 3D modeling and digital tools	0.8	8	12	20
2.	Additive manufacturing – Strategies and preparation	0.4	4	6	10
3.	3D scanning and digitization of physical objects	0.4	4	6	10
4.	Planning and organization of work processes in 3D technologies	0.4	3	7	10
TOTAL			14	36	50

Module 1: Basics of 3D modeling and digital tools

PAGE *
MERGEFOR
MAT3

Objectives:

To train students in the critical selection and use of software tools for 3D modeling, design and reverse engineering.

Contents :

- Overview of 3D modeling software tools (eg Fusion 360, Blender, Tinkercad).
- Fundamentals of mechanics and geometry for 3D modeling.
- Reverse engineering: reconstruction of 3D geometry from physical objects.
- DfAM (Design for Additive Manufacturing): adaptation of models for additive manufacturing.

Methods:

The dominant teaching system of the module “Basics of 3D Modeling and Digital Tools” is project-based teaching. Certain digital tools and programs have the ability to create virtual classrooms in which the teacher can control and assist the work of the students. There is also the possibility of collaboration in virtual classrooms where students can solve problem tasks in teams.

During the realization of theoretical teaching content, the teacher will introduce the participants to the application of 3D modeling principles in additive manufacturing. Using created examples, the models will be analyzed and how to improve their physical properties.

Student activity and participation is included through answers to questions and interpretation of comparable and understandable practical examples related to the lecture topic.

During the exercises, the teacher shows and explains practical tasks with a demonstration. Participants will apply the acquired theoretical knowledge practically during 3D modeling with the application of the principles of 3D modeling in additive manufacturing by creating complex three-dimensional models of products and components. Using concrete examples, participants will demonstrate how to prepare a model for additive manufacturing and how to improve the physical properties of the model.

The teacher has the role of a mentor who organizes and directs the activities of the participants with clear deadlines. When performing practical exercises, it is recommended to divide the participants into pairs or teams and assign them roles within the team.

The student is gradually introduced to the world of work and is allowed to participate in the work process under controlled conditions until he or she acquires full competence for independent work.

Students' independent activities include solving given project tasks by applying acquired knowledge and independent study of literature, internet sources and publications as recommended by the teacher, through which they will expand and deepen their knowledge.

PAGE *
MERGEFOR
MAT3

Module 2: Additive manufacturing – Strategies and preparation

Objectives : Understand and apply additive manufacturing strategies, model preparation, and equipment use.

Content:

- Selection of materials and technology according to product characteristics.
- Preparation of 3D models in a slicer (eg Cura, PrusaSlicer) with regard to technology.
- Operating 3D printers: calibration, setup, process monitoring.

Methods:

The dominant teaching system in the module “Additive manufacturing – Strategies and preparation” is project-based teaching. Certain digital tools and programs have the ability to collaborate where participants can solve problem tasks in teams, but the actual printing of the model and commissioning of the printer must take place in a specialized classroom for additive manufacturing.

During the implementation of theoretical teaching content, the teacher introduces students to the advantages and features of 3D printing, as well as to the procedures, techniques, and tools.



During the exercises, the teacher presents and explains practical tasks with a demonstration. Participants will apply the acquired theoretical knowledge practically when solving a project task, which includes independently turning on, connecting and adjusting 3D printers of various technologies for a successful printing process, selecting materials and settings in the CAM program.

The teacher has the role of a mentor who organizes and directs the activities of the participants with clear deadlines. When performing practical exercises, it is recommended to divide the participants into pairs or teams and assign them roles within the team.

The participant is gradually introduced to the world of work and is allowed to participate in the work process under controlled conditions until they acquire full competence for independent work.

Students' independent activities include solving given project tasks by applying acquired knowledge and independent study of literature, internet sources and publications as recommended by the teacher, through which they will expand and deepen their knowledge.

Module 3: 3D scanning and digitization of physical objects

PAGE *
MERGEFOR
MAT3

Objective:

To master the techniques of 3D scanning, object preparation and error diagnostics.

Content:

- Theoretical foundations of 3D scanning (laser, structured light, photogrammetry).
- Preparing the object for scanning: positioning, coatings, markings.
- Using scanners and processing software (eg Artec Studio, MeshLab).
- Identifying and resolving problems during scanning.

Methods:

The dominant form of work is a practical workshop and project-based learning. The teacher demonstrates various scanning techniques and guides the participants through the process of digitizing objects. In groups, the participants will scan simple objects using available 3D scanners and software tools. During the exercises, they will analyze the quality of the scans, identify errors and apply corrective methods. The teacher's role is that of a mentor — he directs the work, controls the procedures and ensures the accuracy of the results. The participants create documentation of the process, describe the methods used and present the final 3D model.



Independent activities include research into the application of 3D scanning in various fields (education, industry, medicine) and analysis of examples from practice.

Module 4: Planning and organization of work processes in 3D technologies

Objective:

Learn to plan, optimize and organize resources for 3D procedures.

Content:

- Optimization of the production process: time, costs, quality.
- Work planning for 3D modeling, scanning and printing.
- Preparation of tools, machines and materials.
- Estimation of required resources and cost calculation.

Methods:

In this module, problem-based and project-based teaching is used. Participants in teams analyze real production tasks and create process plans with an emphasis on efficiency and cost optimization. The teacher demonstrates ways of planning and monitoring projects using digital tools (eg Trello, Excel). Participants apply their knowledge on a concrete example of project planning, which includes all phases of the 3D process — from the idea to the finished product. Independent work includes cost analysis, developed plans and process evaluation. The teacher has the role of a mentor who directs the work and checks the accuracy of the calculations.

PAGE *
MERGEFOR
MAT3

5. Method of execution

Education is conducted in a combined workshop and online classroom:

- **Day 1 live - 4 hours**
- **Day 2 live - 4 hours**
- **Work in the online classroom (videos, problem tasks, forum, creation and submission of an independent project) – 12 hours**
- **Day 3 Live - 4 hours**
- **Work in the online classroom (videos, problem tasks, forum, creation and submission of an independent project) – 6 hours**
- **Day 4 Live - 4 hours**
- **Work in the online classroom (videos, problem tasks, forum, creation and submission of an independent project) – 6 hours**
- **Day 5 Live - 3 Hours**
- **Day 6 Live - 3 Hours**



- **Work in the online classroom (videos, problem tasks, forum, creation and submission of an independent project) – 2 hours**
- **Day 7 live in the workshop - presentation of independent projects and evaluation - 2 Hours**

Teaching methods: explanation, discussion, problem-based learning, practical exercises, project assignment.

6. Knowledge assessment

Adoption is checked through practical knowledge tests and presentation of work .

Practical knowledge testing tests all X competencies of the program:

- **3D modeling and reverse engineering**
- **Strategy and management of additive manufacturing**
- **digitization and analysis of 3D scans**
- **Planning and optimization of work processes**

PAGE *
MERGEFOR
MAT3





The practical knowledge test is held in three parts:

1. **Planning, design and production of products**
2. **presentation of process and results,**
3. **answering before the Commission.**

1. Planning, design and production of products (digital + physical part)

- The candidate prepares a 3D work process strategy
- 3D scans the damaged product
- Performs reverse engineering of 3D modeling
- Adjusts parameters in the slicer depending on requirements
- Selects material depending on requirements
- Creates a calculation and offer for the production process
- Creates a product using 3D printing

2. Presentation of the process and results

The candidate prepares a **short presentation (5-7 minutes)** that shows:

- Approach to solving a problem task,
- Use of technologies and materials,
- Explanation of the calculation

3. Defense

1. The committee asks students **questions about the process**, the chosen solutions, and possible improvements.
2. The candidate answers questions explaining their understanding of the basic principles

PAGE *
MERGEFOR
MAT3

Evaluation criteria:

- Work process planning and resource estimation (0–2 points)
- Preparing the object for scanning (0–2 points)
- Quality of 3D scan and analysis and data processing (0–2 points)
- Reverse engineering with 3D modeling (0–2 points)
- 3D model adaptation and optimization (0–2 points)
- Storage in 3D printing format (0–2 points)
- Setting 3D printer parameters (0–2 points)
- 3D printing production (0–2 points)
- Presentation and defense (0–2 points)

Grades:

- 0–8 points: insufficient
- 9 –13 points: good





- 14 – 18 points: Excellent

To obtain a micro-qualification: min. 9 points (min. good), none of the criteria should be rated with 0 points.

Open Badge approach - Realization of projects in 3D technologies

Secondary Vocational School Velika Gorica, Ulica kralja Stjepana Tomaševića 21,
10410 Velika Gorica

Project: CL.BVET Education and Training for Collaborative Learning in Blended Learning Environments

Website link: <https://www.cl-bvet.eu/education-and-training/>

To obtain an open badge - Realization of projects in 3D technologies it is necessary to successfully complete the training. It is necessary to submit the project task and a short presentation of the project realization using 3D technologies. The project assignment and presentation must be successfully evaluated.

PAGE *
MERGEFOR
MAT3

Task selection:

- Select the damaged product and plan a reverse engineering strategy and manufacture a new object

3D scanning:

- Prepare the object for scanning
- Determine the quality of 3D scans and analyze and process the data

Reverse engineering and 3D modeling:

- Perform reverse engineering with 3D modeling
- Customize and optimize the 3D model according to requirements
- Save in 3D printable format

Work process and production calculation:

- Estimate production time, material consumption and basic manufacturing costs

3D printing of products:

- Set 3D printer parameters and select material according to requirements
- Produce an object by 3D printing





Presentation:

- Prepare a short presentation (2-3 pages) about the approach to solving the problem task, the use of technologies and materials, and the creation of a calculation for production with attached images of the damaged product, scans, models and the printed product
- Submit your presentation at the link below.

Application date:

- Upload digital files and presentations to the link below no later than xx.yy.zzzz

<https://openbadgefactory.com/c/earnablebadge/T419EAaQD80a7B8/apply>

PAGE *
MERGEFOR
MAT3





7. Quality assurance method

Quality assurance is carried out in accordance with the Regulations on the Quality Assurance System for Short Programmes with Microqualifications of the Velika Gorica Secondary Vocational School

PAGE *
MERGEFOR
MAT3



