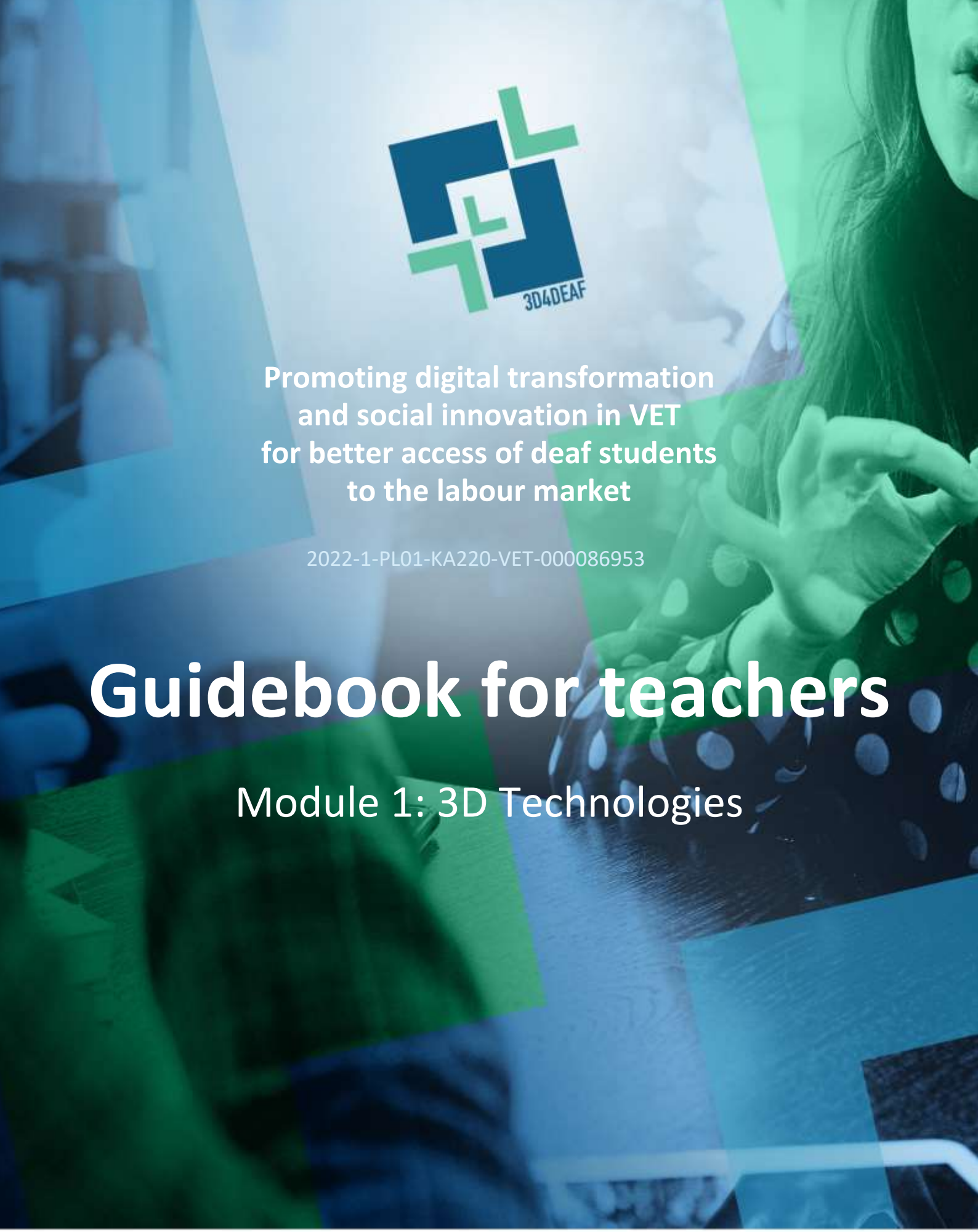

Promoting digital transformation and social innovation in VET for better access of deaf students to the labour market

2022-1-PL01-KA220-VET-000086953

Guidebook for teachers

Module 1: 3D Technologies

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WP2 - A3: Guidebook for teachers (Module 1 - 3D Technologies)

Project acronym:

3D4DEAF

Project title:

Promoting digital transformation and social innovation in VET for better access of deaf students to the labour market

Project Number: 2022-1-PL01-KA220-VET-000086953

CONSORTIUM:

- Coordinator:
  - SPOLECZNA AKADEMIA NAUK, Poland – www.san.edu.pl
- Partners
  - A & A Emphasys Interactive Solutions Ltd, Cyprus - www.emphasyscentre.com
  - European Digital Learning Network ETS, Italy – www.dlearn.eu
  - Fondazione Istituto dei Sordi di Torino ONLUS, Italy - www.istitutosorditorino.org
  - Special High School For the Deaf and Hard of Hearing Thessaloniki, Greece- www. gym-ekv-thess.thess.sch.gr
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Introduction

Welcome to the Guidebook for Educators (part 1) .

This comprehensive guide has been meticulously crafted to equip teachers of deaf individuals with the knowledge and tools necessary to foster creativity, innovation, and economic empowerment among their students. In an age where technology is reshaping the way we live and work, this guidebook aims to bridge the gap and empower educators to inspire their students in the world of 3D design, 3D printing, and social entrepreneurship.

Structure and Scope:

This guidebook is for the Module 1 - 3D Technologies and is organized into 3 main headings which are the three topics of the module 1, each dedicated to a critical aspect of empowering deaf students.

We begin with an "Introduction to 3D Design & 3D Printing," providing a solid foundation in these transformative technologies. The subsequent chapters delve deeper into the 3D printing process and hands-on software practice.

For each topic 3 sub-topics are developed which includes one lesson plan and 5 activities and scenarios in each lesson plan.

By the end of this guidebook, you will be well-equipped to inspire and guide your students on a journey of 3D design and printing, what tools to use in theory and in practice.

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Module 1: 3D Technologies

Topic 1: Introduction to 3D design & 3D printing

Sub-topic 1: What is 3D printing

Lesson plan Name: CLAY ME digitally by hands

Activity and duration	Content
Introduction 10 minutes	Main aim of the lesson is to fully understand how does 3D print work by explaining and experiencing it haptically with clay using art therapy as source of tacit-knowledge production. Another objective is to make it possible for handicap participants to imagine and consolidate basic notions and rules of 3D printing process. Creating empowerment for handicaps by being introduced to up-to-date technology and haptic understanding of 3D print model production. Lesson aims both in developing 3D imagination, sense of scale, axis and quantity of supports in 3D print as well as using art for mnemotechnies methods, building environmental sensitivity and developing social competencies. Enhancing close physical contact during workshop by using performative methods allowing to memorize practically-oriented skills.
Description 215 minutes	Clay is natural, organic substance and can be easily recycled for further practice after being used as a tool to easily explain notions and processes crucial in the field of 3D design and 3D printing. Lesson deepens trust withing the group and focuses on social competences as well as environmental consciousness.
Videos 5 minutes	https://parametrichouse.com/3d-printing-clay/ https://news.harvard.edu/gazette/story/2023/04/artist-demonstrates-harvards-new-3d-clay-printer/
Quiz 10 minutes	1. How many dimensions are there in an object? 2. What are the names of these dimensions? 3. How can an object change in space? 4. What is constructing an object in 3D print? 5. Explain the basics of 3D printing. 6. What does a 3D object need to be printed? 7. What is the name of the material used in 3D printing? 8. What are the requirements for the density of the filament in 3D printing? 9. Can 3D-printed objects be recycled? 10. What are the ways to recycle 3D prints?
Summary 5 minutes	Basic knowledge of 3D print and understanding its technical requirements.

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Activities and Scenarios

Activity #1	
Scenario Name	From thread to a vessel
Duration	45 minutes
Aim	Complete understanding how does 3D print work by experiencing it haptically.
Learning Objectives	Developing 3D imagination and skills. Impacting participants' imagination by immersive experience of sculpting in clay by hand. Motion memory used as a mnemotechnies method.
Relevant competences	Consciousness of object construction and its form further characteristics needed in the context of 3D printing process. Developing social competencies.
Facilities/Equipment	10 kilo clay package, equipped studio for clay/pottery workshop.
Description	Participants sitting together at a table are presented with a solid portion of clay. They can add a bit of water to it and feel how the consistency of the material changes and varies according to temperature or humidity. We discuss our experiences and observations. The 3D printing process is being described by the tutor, while the group is still working with clay in their hands. Given instructions they form an object layer by layer in clay. We discuss the analogies between form's thickness and height. Showing and explaining the similarities between digital foundation of Gcode file and pottery craft as a medium present in human activity for ages.
Activity #2	
Scenario Name	Around the World
Duration	45 minutes
Aim	Understanding the needs of 3D printers by illustrating it in sculpture/object/vessel made on potter's wheel.
Learning Objectives	Knowing types of 3D print and understanding how it reflects shape of the form.
Relevant competences	Consciousness of object construction and its form further characteristics needed in the context of 3D printing process. Haptic feedback in estimating the density of the clay filament.
Facilities/Equipment	Potter's wheel, equipped studio for clay/pottery workshop.

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Description	Participants use the clay piece created during previous activity. Each participant is asked to take their seat in front of potter's wheel. We start with instructions on the equipment, its construction and elements as well as basic rules for secure usage. This time their goal is to improve their sculpture made by hand by centralizing it on potter's wheel. Further workshop focuses on both individual guiding and group discussion concerning current experience by hand and observations of how the material works. Forms change and mutate depending on finding the object axis. Following assumptions make it easier to fully understand technical requirement for 3D print.
Activity #3	
Scenario	Feet of clay
Duration	45 minutes
Aim	Understanding the needs of 3D printers by illustrating it in group sculpture made from pieces created during previous activity on potter's wheel. Haptic feedback in forecasting/estimating quantity of supports needed for 3D print and finding similarities with 3D slicing software and printing process. Creating mnemotechnies methods and social competencies.
Learning Objectives	Understanding how 3D print reflects/distorts the shape of the form.
Relevant competences	Consciousness of object construction and its form further characteristics needed in the context of 3D printing process. Getting to know each other in the group of participants, opening up and preparing for further trust being built in the group.
Facilities/Equipment	Equipped studio for clay/pottery workshop.
Description	Participants use the clay piece created during previous activity. Each participant is asked to pass his piece to the person sitting on their right hand. We take a while discussing shapes of clay pieces and possible ways of using it in everyday life. This exchange lasts as long as everybody has experienced all of clay objects so they can have haptic memory of them. They are asked whether their object can stand with no extra support, noting conclusions and exchanging clay pieces to find different solutions. Experiencing how many supports are crucial for maintaining the form and the necessity of supporting complex form in 3D printing. Following assumptions make it easier to fully understand technical requirements for 3D print.

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Activity #4	
Scenario Name	One for All, All for One
Duration	45 minutes
Aim	Developing social competencies and environmental consciousness.
Learning Objectives	Understanding data preparation process and how 3D print reflects/distorts shape of the form.
Relevant competences	Consciousness of object construction and its form further characteristics needed in the context of 3D printing process. Building trust in the group of participants by using performative methods enhancing close physical contact and using the whole body to experience the importance of finding balance in the 3D construction.
Facilities/Equipment	Equipped studio for clay/pottery workshop.
Description	We continue with clay pieces created during previous activity. Each participant recalls haptic memory of clay objects. They are asked whether their objects can join in one bigger piece and discuss ways of attaching them to create a solid form. Concluding amount of extra support, noting conclusions and performing ourselves in roles of supports. Experiencing how many supports are crucial for maintaining the form by performative balancing and discussion about the necessity of supporting complex form in 3D printing process. Following assumptions make it easier to fully understand technical requirements for 3D print.
Activity #5	
Scenario Name	From dust to dust
Duration	45 minutes
Aim	Developing social competencies and environmental consciousness. Creating motion memory (tacit-knowledge) on the density of the filament in 3D clay-printer.
Learning Objectives	Critical thinking followed by understanding the social and environmental role of the designer and the importance of solid yet recyclable properties of the objects he/she makes/produces/releases.
Relevant competences	Building trust in the group of participants by using performative methods enhancing close physical contact and tacit-knowledge oriented skills.

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Facilities/Equipment	10 kilo clay package, equipped studio for clay/pottery workshop.
Description	Raising discussion among the group about circuit of resources in the nature and planned product aging in the culture. Tacit-knowledge production on the density of the filament in 3D clay-printer by allowing haptic experience of slow art-therapeutic watering and physically touching and mixing clay pieces made during previous activities. Discussing virtual aspects of 3D models and pieces of art.

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Sub-topic 2: Areas where 3D is involved and future of 3D

Lesson plan Name: 3D PRINT it tomorrow

Activity and duration	Content
Introduction 10 minutes	Main aim of the lesson is to be presented with raw 3D prints which helps building consciousness of various fields in 3D labor market and the role 3D post-production plays in prototype's building and presenting the final result to the client. Another objective is to make it possible for handicap participants to haptically experience properties of 3D print and ways of mastering final form. Creating empowerment for handicaps by being introduced to up-to-date technology and understanding 3D print model production. Lesson aims in introducing to 3D software interface (Blender) and its basic Modes, Tools (Extruding, Bevel, Inserting Faces) and Modifiers (Mirror, Screw, Solidify, Subdivision Surface). Objective is to be able to freely experience and experiment independently 3D software.
Description 215 minutes	Lesson enables focusing on software skills, social competences as well as environmental consciousness through series of practical workshops and activities. It help developing critical thinking, networking, developing imagination and creativity according to enviromental aspects. Operating in 3D software and constructing complex forms on given subject as a preparation to be present on labur market and initiate new employment possibilities to the participants. Realization of environmental aspects of virtualization of labor market and design.
Resources 55 minutes	Resources (videos, links, documents etc.): https://www.youtube.com/watch?v=Rqhtw7dg6Wk https://www.youtube.com/watch?v=9xAumJRKV6A
Videos 12 minutes	https://www.youtube.com/watch?v=h6lTo6NIc4Y
Quiz 10 minutes	1. What can a 3D print be used for? 2. How a 3D print can be post-produced? 3. What are the tools we can use in the process of post-production of 3D print? 4. What are various fields in 3D labor market? 5. What 3D software programs do you know? 6. What are the Modes you know in TinkerCAD? 7. What are the Tools you know in TinkerCAD? 8. Explain how does each Tool work. 9. What are the Modifiers you know in TinkerCAD? 10. Explain how does each Modifier work.

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Summary 5 minutes	Making advanced models in 3D, freely operating in different Modes and with different tools (Extruding, Bevel, Inserting Faces) as well as becoming familiar with 3D Modifiers (Mirror, Screw, Solidify, Subdivision Surface).

Activities and Scenarios

Activity #1	
Scenario Name	How it works?
Duration	45 minutes
Aim	Building consciousness of various fields in 3D labor market and the role 3D post-production plays in prototype's building and presenting the final result to the client.
Learning Objectives	Experiencing different types of 3D print on exemplary pieces. 3D post-production and creating 1:1 prototype.
Relevant competences	Basics of 3D post-production workshop and creating a solid prototype.
Facilities/Equipment	Exemplary various 3D raw prints, polishing paper, sprays.
Description	Participants are being introduced to raw 3D prints (with visible slices) deriving from different 3D printing technologies. Explaining their main characteristics and discussion about color textures and post-processing methods. Polishing and spray-coloring workshop. Individual consultations, problem solving and Q&A.
Activity #2	
Scenario Name	Re-work
Duration	45 minutes
Aim	Building consciousness of various fields in 3D labor market and their environmental impact.
Learning Objectives	Developing critical thinking and imagination.
Relevant competences	Social, acting and choreographic competences,
Facilities/Equipment	3D print prototypes, white board, markers, paper.
Description	Participants put prototypes created during previous activity in big paper box, everyone is asked to draw lots and meticulously

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	examine object in their hands with folded eyes trying to guess what they are holding while describing it. They are confronted with objects after unfolding their eyes. They group in pairs and are asked to reflect on the future of the labor market and how the presence of 3D design and 3D print will affect it. Next task is to use prototypes to play roles and activities connected with predicted jobs-to-be in the future. Playing charades, naming and re-imagining new employments. Discussion about environmental aspects of virtualization of labor market.
Activity #3	
Scenario Name	Soft welcome to software
Duration	45 minutes
Aim	Introduction to 3D software interface (TinkerCAD), obtaining skills in changing work modes in 3D as well as geometrical construction of simple forms and performing basic operations (Extruding, Bevel, Inserting Faces).
Learning Objectives	Basic skills operating 3D software.
Relevant competences	Becoming familiar with 3D interface and tools.
Facilities/Equipment	Computers with 3D software (TinkerCAD).
Description	Participants are being introduced to 3D software interface and are taking their first steps in 3D modelling in different Modes and with different tools (Extruding, Bevel, Inserting Faces). Individual consultations, Q&A and problem-solving workshop.
Activity #4	
Scenario Name	Work and form revolution
Duration	45 minutes
Aim	Mastering skills in 3D operations, building complex constructions and choosing accurate commands and tools.
Learning Objectives	Operating in 3D software and constructing complex forms with available operations.
Relevant competences	Being able to make simple sketch in 3D software using basic forms, working with 3D space and navigating it, becoming familiar with 3D Modifiers (Mirror, Screw, Solidify, Subdivision Surface).
Facilities/Equipment	Computers with 3D software (TinkerCAD).
Description	Participants are making more advanced models in 3D, freely operating in different Modes and with different tools

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	(Extruding, Bevel, Inserting Faces) as well as becoming familiar with 3D Modifiers (Mirror, Screw, Solidify, Subdivision Surface). Individual consultations, Q&A and problem-solving workshop.
Activity #5	
Scenario Name	Thinkers of tomorrow
Duration	45 minutes
Aim	Building consciousness of 3D software possibilities and mixing different operations, mastering skills in 3D, building complex constructions and choosing accurate commands and tools when being asked to design model on given subject.
Learning Objectives	Critical thinking, networking, developing imagination and creativity. Operating in 3D software and constructing complex forms.
Relevant competences	Getting prepared for 3D labor market, designing on given subject.
Facilities/Equipment	Computers with 3D software (TinkerCAD).
Description	Brainstorming about the future and reimagining tomorrow with no limitations. Model designing by responding to given subject: Spaces infected by 3D print. Participants are making advanced models in 3D, freely operating in different Modes and with different tools (Extruding, Bevel, Inserting Faces) as well as becoming familiar with 3D Modifiers (Mirror, Screw, Solidify, Subdivision Surface). Individual consultations, Q&A and problem-solving workshop.

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Sub-topic 3: How does 3D printing work for the deaf people

Lesson plan Name: CAST me in

Activity and duration	Content
Introduction 10 minutes	Lesson plan aims in becoming acquainted with 3D software (TinkerCAD) and being equipped with skills allowing its further examination in practice. Empowering handicap participants by using their sharpened senses in an unexpected context of knew medium and tools. Broadening participants' chances and possibilities in the labor market and further development of imagination and creativity as it describes process of 3D modelling and 3D print. Equipping with consciousness of various possibilities of 3D (modelling in software, photogrammetry, 3D print). Building environmental sensitivity and developing social competencies.
Description XX minutes	Following activities give basic level yet broad range of various possibilities given in 3D production (modelling and texturing in 3D software, photogrammetry, 3D print). Using analogies occurring between 3D modelling and traditional sculpting by hand collides both methods and allows quicker memorization of basic 3D notions and rules. Being introduced with alginate casting tactics facilizes understanding the difference and practical usage of both positive and negative matrix in virtual space. Showing photogrammetry process, becoming acquainted with Mesh Room interface and learning how to export OBJ file format for further operations in 3D print and its post-production.
Resources 20 minutes	Resources (videos, links, documents etc.): https://docs.blender.org/manual/en/latest/sculpt_paint/sculpting/tools/clay.html https://alicevision.org/ https://www.textures.com/library
Videos 5 minutes	https://www.youtube.com/watch?v=fZSD7pVIUkY&t=823s
Quiz 10 minutes	1. What are the possible ways of importing 3D model to the software? 2. Explain how does photogrammetry works. 3. Explain how does modelling in 3D software works. 4. Explain how does texturing works. 5. What is the name of the Tool that enables movement in TinkerCAD 3D space? 6. How should be exported an 3D object before printing it? 7. What photogrammetry software do you know? 8. Explain what is positive and negative matrix. 9. How to export an 3D object? 10. What are the differences between Sculpt and Edit Mode in software?

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Summary 5 minutes	Introduction to casting followed by photogrammetry and 3D texturing.

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Activities and Scenarios

Activity #1	
Scenario Name	Digital clay
Duration	45 minutes
Aim	Building participants' consciousness of tools available in 3D software interface by providing analogies in pottery craft. Becoming familiar and fluent in notions concerning sculpting and modelling a form as well as naming needed tools.
Learning Objectives	Knowledge of tools by hand, facilitating digital understanding of their impact on the form and experiencing strength and direction of virtual sculpting activity. Choosing and naming needed tools in 3D interface.
Relevant competences	Understanding the sculpting process and memorizing analogical tools available in 3D software makes it possible to freely work with 3D print, basic knowledge of Sculpt Mode in Blender.
Facilities/Equipment	10 kilo clay package, various pottery tools, computers with 3D software (TinkerCAD).
Description	Participants sit in front of a table and each of them is presented with various pottery tools. The general idea of 3D software and its interface is being explained. Lecture about tools and ways of sculpting while experiencing material possibilities by hand. Everyone is given a solid portion of clay and is being asked to perform different actions/motions/operations on it.
Activity #2	
Scenario Name	AnaLOGICAL sculpture
Duration	45 minutes
Aim	Building participants' further consciousness of tools available in 3D software. Becoming familiar and fluent in notions concerning sculpting and modelling a form as well as naming needed tools.
Learning Objectives	Memorization and practical use of 3D notions, processes and communicating them. Knowledge of tools by hand, facilitating digital understanding of their impact on the form and experiencing strength and direction of virtual sculpting activity. Choosing and naming needed tools in 3D interface.

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Relevant competences	Being able to describe one's intention in clay modelling by hand as well as mastering communication skills in re-doing similar activities digitally.
Facilities/Equipment	10 kilo clay package, various pottery tools, computers with 3D software (TinkerCAD).
Description	Participants join in pairs; one person is performing sculpture in real clay and the second one is following their instructions in virtual space (Sculpt Mode in TinkerCAD). We discuss limitations and possibilities following this experience. Participants switch their roles in pairs, at the end we summarize which experience was harder and what derives from that process.
Activity #3	
Scenario Name	Cast away
Duration	45 minutes
Aim	Understanding the difference and practical usage of positive and negative matrix. Introducing participants with practical alginate casting method.
Learning Objectives	Learning how to perform as a cast member.
Relevant competences	Becoming fluent in casting and solving spatial problems, development of 3D imagination.
Facilities/Equipment	Alginate casting powder, equipped studio for sculpting workshop, access to water.
Description	Lecture online production from a model or matrix, discussing its pros and cons for environment and human beings. Showing casting workshop and describing whole process step by step. Individual activities in casting parts of body (face, ear, mouth, nose).
Activity #4	
Scenario Name	Ear me out!
Duration	45 minutes
Aim	Introducing participants with photogrammetry-oriented photographic documentation, Mesh Room software and exporting spatial scan to TinkerCAD's Edit Mode.
Learning Objectives	Learning how to perform photogrammetry and possibilities of editing it using proper file format (OBJ).

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Relevant competences	Becoming familiar with photogrammetry process and spatial editing, development of 3D imagination.
Facilities/Equipment	Mobile phones, computers with 3D (TinkerCAD) and photogrammetry software (Mesh Room).
Description	Participants are asked to take 360 degrees pictures of one of their casts from the previous activity. Showing how to take care of the even light in the scene, explaining how picture from motion works and introducing to Mesh Room interface. First trials in rendering OBJ files and exporting them to 3D software for further edition (Edit Mode in TinkerCAD). Discussing obligatory conditions to be fulfilled for succeeding in well-performed spatial scan.
Activity #5	
Scenario Name	Photogrammetric magic
Duration	45 minutes
Aim	Introduction to texturing, navigating with 3D mouse and experiencing immersive 3D space with VR googles.
Learning Objectives	Learning how to place and edit textures as well as how to navigate in 3D virtual space or experience it with different tools.
Relevant competences	3D navigation, presence and texturing possibilities.
Facilities/Equipment	Computers with 3D (TinkerCAD) and photogrammetry software (Mesh Room), 3D mouse, and VR googles.
Description	Participants work on computers, introducing skills of texturing 3D model and navigating in the space with both regular and 3D mouse as well as VR googles. Individual consultations, Q&A and problem-solving workshop.

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Topic 2: The 3D Printing Process

Sub-topic 1: Introduction to Tinkercad online software (theoretical part)

Lesson plan Name: A Comprehensive Exploration of 3D Design

Activity and duration	Content
Introduction	Delve into the fundamentals of 3D printing through an exploration of Tinkercad online software. This series of activities takes you through key stages, from ideation to slicing, while enhancing technical drawing skills and understanding the impact of materials on design stability. Ideal for beginners and educators, this module lays the groundwork for a practical journey into the world of 3D printing.
Description	This learning experience aims to foster proficiency in 3D design, covering ideation, technical drawing, software navigation, measurement essentials, and the impact of material choices.
Resources	Resources (videos, links, documents etc.): https://recreamaths.eu/3d-guides/ https://www.tinkercad.com/learn https://www.youtube.com/watch?v=YE0oZZO7vbk
Videos	Powtoon video
Quiz 20 minutes	1.What are the four fundamental steps in the 3D printing process? a) Cutting, Printing, Slicing, Finishing b) Ideation, Model Design, STL Conversion, Slicing c) Sketching, Coloring, Exporting, Scaling d) None of the above 2. Tinkercad is described as a: a) 2D Animation Tool b) Web-based 3D Modeling Tool c) Graphic Design Software d) Video Editing Platform 3.How is Tinkercad accessed? a) Through a downloadable software b) Via a web-based platform

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	c) Only by experts d) None of the above 4. Why is the conversion to STL format an essential step in the 3D printing process? a) Enhances colors in the model b) Converts 2D images to 3D c) Prepares the model for printing d) None of the above 5.Which step emphasizes the importance of measurements in 3D design? a) Ideation b) Model Design c) Conversion to STL Format d) Slicing 6.Why is precise measurement crucial in 3D printing? a. It makes the models look better b. It ensures the printer works faster c. It prevents errors and produces accurate prints d. It reduces the cost of materials 7.How does scaling affect the size of a 3D printed object? a. It changes the color of the object b. It adjusts the size proportionally c. It alters the shape of the object d. It has no impact on the printed object 8.What types of perspective are most commonly used in technical drawing? a. Frontal b. Two-point c. Three-point d. All of the above

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	9. What does "composing shapes" mean in the context of 3D design? a. Creating simple geometric shapes b. Combining multiple shapes to form more intricate designs c. Ignoring shapes in the design process d. Using only one shape in a design 10. How does the design of complex shapes contribute to the overall creativity in 3D modeling? a. It limits creativity in the design process b. Creativity is not affected by the complexity of shapes c. Designing complex shapes allows for more creative and unique models d. Creativity is only influenced by the use of color in the design
Summary	3D printing steps, Tinkercad, Design, Technical drawing

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Activities and Scenarios

Activity #1	
Scenario Name	In-depth Insight: The Essential Steps in 3D Printing
Duration	30 mn
Aim	This activity aims to provide a comprehensive understanding of the stages involved in the 3D printing process, focusing on four fundamental steps: ideation, model design, conversion to STL format, and slicing.
Learning Objectives	Knowledge: Understand the key stages of 3D printing: ideation, model design, STL conversion, and slicing. Conceptual Understanding: Recognize the significance of each stage in the 3D printing process.
Relevant competences	Ideation Skills: Develop the ability to choose suitable 3D printing projects. Basic Model Design: Introduction to CAD software and sketching techniques. Conceptual Understanding: Visualize the slicing process in 3D printing.
Facilities/Equipment	Projection Setup: Projector and screen for presentations. Computers: Access to computers with internet connectivity. Writing Materials: Paper and pens/pencils. CAD Software: Installed on computers or accessible online.
Pre-requisites	Basic Computer Literacy: Fundamental computer usage skills. Design Awareness: Basic understanding of design concepts. Curiosity and Creativity: Openness to exploration and creativity.
Description	Step 1. Ideation (5 mn Ask participants to identify an object they would like to create through 3D printing. It can be anything from a simple item to a more complex creation. Encourage them to start with basic projects to gain confidence in the process. Each participant will share their chosen object and motivations. As a group, discuss potential challenges and considerations in selecting the first project. Step 2. Model design

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	Introduce the use of CAD software for model design. Participants can use paper and pen to create an initial sketch of their project. Ask users to share their sketches and discuss design choices. Focus as a group on how CAD software might facilitate the design process. Step 3. Convert to STL format Illustrate the step of converting the model to STL format. Provide practical examples using available online CAD software. Ask users to export their sketch to STL format using online CAD software if available, or by imagining the process. Discuss any challenges encountered. Step 4: Slicing Explain the concept of slicing the model into layers. Use visual examples (youtube videos) or online simulators to show how the 3D model is transformed into understandable instructions for the printer. Have users imagine the slicing process of their model and identify potential parameters to consider. Share reflections as a group.
Activity #2	
Scenario Name	From Lines to Dimensions: A Primer on Technical Drawing and Perspective
Duration	30 mn
Aim	This activity introduces the fundamental concepts of technical drawing and perspective through a hands-on exercise.
Learning Objectives	Understand the definition and importance of technical drawing in conveying construction and functionality information. Introduce basic concepts of one-point, two-point, and three-point perspectives.
Relevant competences	Develop the ability to create clear and accurate technical drawings. Acquire fundamental skills in one-point, two-point, and three-point perspective drawing.

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Facilities/Equipment	Projection Setup: Projector and screen for presenting key concepts. Writing Materials: Paper and pens/pencils for participants. Examples and Visuals: Visual aids or examples illustrating perspective drawing concepts.
Pre-requisites	Basic Understanding: Participants should have a basic understanding of design concepts.
Description	Step 1: Define Technical Drawing (5 minutes) Briefly explain the definition of technical drawing and its crucial role in clear communication within the realms of industry and engineering. Emphasize the importance of representing objects accurately, using the example of drawing a pencil from different perspectives. Step 2: Perspective Drawing Exercise (15 minutes) Introduce the concept of one-point, two-point, and three-point perspectives. Provide simple examples and discuss when each perspective is applied. Instruct participants to attempt drawing a cube in one-point and two-point perspectives, emphasizing key elements. Step 3: Challenges of Freehand Perspective (5 minutes) Discuss the difficulty of drawing perspectives by hand. Highlight how 3D modeling software assists in visualizing scenes accurately. Step 4: Link to 3D Printing (5 minutes) Connect the importance of accurate perspectives to 3D printing. Stress the need for specialized software in designing 3D models for successful printing. Step 5: Overview of Technical Drawing in 3D Printing (5 minutes) Introduce the types of software necessary for 3D printing. Relate the discussion to the technical drawings used in the production process, emphasizing the importance of clear visuals and information.

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Activity #3	
Scenario Name	Tinkercad Essentials: Navigating the World of 3D Modeling
Duration	40 mn
Aim	This workshop is designed to introduce educators to Tinkercad, a user-friendly web-based 3D modeling tool. The session consists of a guided walkthrough with hands-on exploration.
Learning Objectives	Introduction to Tinkercad: Familiarize participants with the fundamentals of Tinkercad, focusing on its user-friendly interface. Hands-On Exploration: Empower participants to confidently navigate Tinkercad, manipulate shapes, and grasp essential design principles.
Relevant competences	Gain the ability to access and use Tinkercad's web-based platform effectively. Develop proficiency in moving, resizing, and adjusting the height of shapes within Tinkercad.
Facilities/Equipment	Computers: Ensure each participant has access to a computer with internet connectivity. Projection Setup: Utilize a projector and screen for presenting key concepts during the workshop. Tinkercad Accounts: Participants are required to have Tinkercad accounts ready or create them during the session.
Pre-requisites	Basic Computer Skills: Participants should possess fundamental skills in computer navigation.
Description	Step 1. Quick Tinkercad Introduction (5 minutes) Tinkercad, powered by Autodesk, is a user-friendly, web-based 3D design platform. It's designed for everyone, from beginners to experts, making it a go-to choice for intuitive 3D modeling. In your presentation, clearly highlight the Tinkercad' features: user-friendly, the convenience of web-based technology, usability for inexperienced users, and the versatility of the models. Step 2. Hands-On Exploration (20 minutes) Log in to Tinkercad. Navigate the workspace using tools on the left and the mouse.

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	Explore the shape menu on the right for foundational design elements. Practice moving, resizing, and adjusting the height of shapes. Step 3. Discussion (15 minutes) Discuss Tinkercad's intuitive features suitable for educators and students. Encourage participants to reflect on potential projects applicable in various subject areas. Note: The trainer should support learners in online exploration.
Activity #4	
Scenario Name	Precision in Practice: Understanding 3D design measurements
Duration	90 mn
Aim	Participants will gain a foundational understanding of measurements in 3D design, emphasizing their importance in the creation and assembly of objects. This activity serves as a propaedeutic step before engaging with 3D modeling software.
Learning Objectives	Acquire basic knowledge of common measurements used in 3D design. Recognize challenges related to assembly without precise measurements. Apply measurement concepts in the conceptual design of 3D objects.
Relevant competences	Identify and understand various measurements used in 3D design. Develop problem-solving skills through hands-on assembly experience. Apply basic measurement knowledge in the conceptual phase of design.
Facilities/Equipment	Computer and Projector: Needed for the introductory presentation. Tactile Modeling Kits: Simple object kits for hands-on activities. Sketching Materials: Paper, pencils, etc., for the conceptual design exercise.
Pre-requisites	Basic knowledge of 3D design. Familiarity with elementary measurement concepts.

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Description	Step 1. Introduction (10 minutes): Provide a brief overview of the importance of measurements in 3D design. Step 2. Interactive Discussion (15 minutes): Facilitate a discussion on common measurements used in 3D design, such as dimensions, angles, and scale. Encourage participants to share their experiences or thoughts on the significance of accurate measurements. Step 3. Model Assembly (20 minutes): Distribute simple, tactile model kits that represent basic 3D objects (e.g., cubes, cylinders). Instruct participants to assemble the models without any numerical measurements. After the activity, discuss the challenges and limitations faced during assembly without precise measurements. Step 4. Measurement Basics (15 minutes): Introduce fundamental measurement concepts, including units (e.g., millimeters, inches) and precision. Step 5. Design Concept Sketching (20 minutes): Divide participants into small groups. Assign each group a simple object to design on paper without using any software. Each group shares their sketches and discusses the measurements considered. Step 6. Conclusion and Q&A (10 minutes) Open the floor for questions and reflections.
Activity #5	
Scenario Name	Balancing Acts: Creative 3D Assembly with Upcycled Materials
Duration	60 mn
Aim	In this session, participants will use common and recycled materials to assemble various shapes and create balanced structures. The activity aims to understand the impact of material choices on design stability.
Learning Objectives	Understand the principles of 3D assembly and the importance of balance in structures. Familiarize oneself with common and recycled materials.

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Relevant competences	Ability to assemble shapes in a balanced manner to create three-dimensional structures. Understanding of how material choices impact design stability. Improved creative and collaborative skills.
Facilities/Equipment	Common and recycled materials (paper, plastic, cardboard, etc.). Basic tools such as scissors, glue, and other fastening materials.
Pre-requisites	Basic knowledge of 3D design.
Description	Step 1. Design with recycled material (5 minutes) Distribute a variety of shapes, sizes, and materials to participants. Step 2. Assemble (15 minutes) Ask them to assemble multiple shapes to create a unique and balanced structure. Encourage creativity in design while highlighting the significance of balance. Facilitate peer interactions for idea exchange and collaboration. Step 3. Balancing (15 minutes): Engage participants in a discussion on the challenges and discoveries during the assembly. Share insights on how different shapes and materials contribute to overall equilibrium. Step 4. Material Matters (10 minutes): Brief overview of how material properties impact the balance and strength of structures. Introduce common materials used in 3D printing without going into intricate details. Step 5. Collaborative Design Concept Sketching (15 minutes): Participants form small groups. Assign each group a more complex object to design on paper, considering multiple assembled shapes. Emphasize the importance of a balanced composition in their sketches. Groups share their sketches and engage in discussions on design choices.

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Sub-topic 2: Introduction to CURA slicing software (theoretical part)

Lesson plan Name: Introduction to CURA: Basic 3D Printing Know-How

Activity and duration	Content
Introduction	Introduce participants to 3D printing with a focus on CURA slicing software at a beginner-to-intermediate level. Through practical activities and accessible insights, empower learners to grasp fundamental slicing concepts, gain theoretical proficiency with UltiMaker CURA software, optimize basic printing conditions, understand the role of support structures in design, and explore the dynamics of 3D printing timelines.
Description	Throughout the five interconnected activities, participants will delve into slicing concepts, optimize printing conditions, understand the significance of support structures in design, and critically analyze 3D printing time.
Resources	Resources (videos, links, documents etc.): https://enter-moodle.eu/pluginfile.php/84/mod_page/content/1/WEBINAR%203%20-%20SLICING%20IN%203D%20PRINTING%20ITA_compressed.pdf https://www.youtube.com/watch?v=l_wDwySm2YQ https://www.raise3d.com/academy/when-and-how-to-use-3d-printed-support-structures/#:~:text=What%20is%20a%20Support%20Structure,the%20filament%20layer%20by%20layer.
Videos	Powtoon video
Quiz 20 minutes	1.In 3D printing, what does the term "slicing" refer to? a. Cutting the 3D model into pieces b. Adding intricate details to the model c. Combining multiple models into one d. Preparing a digital model for layer-by-layer printing 2.What is UltiMaker CURA used for in the context of 3D printing? a. Slicing software b. Adding textures to the model c. Creating 3D models from scratch d. Printing in multiple colors simultaneously

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	3.Which of the following best describes the level of difficulty for individuals using CURA for slicing in 3D printing? a. Beginner to Intermediate b. Advanced c. Expert d. Beginner 4.What role does filament material play in determining the properties of a 3D printed object? a. It has no effect on the properties b. It only affects the color c. It significantly influences strength and characteristics d. It determines the printing speed 5.How does filament material choice affect the environmental impact of 3D printing? a. It has no impact on the environment b. Choosing any material is equally environmentally friendly c. Different materials have varying environmental considerations d. The environment is only affected by the printing speed 6.Why is it important to control the temperature during 3D printing? a. It doesn't affect the print quality b. It prevents the printer from getting too hot c. It ensures proper melting of the filament d. It adds complexity to the printing process 7.What happens if the temperature is too low during 3D printing? a. The print becomes too large b. The filament may not flow properly c. The printer stops automatically d. The color of the print changes 8.How does filament replacement contribute to the printing process? a. It adds unnecessary complexity b. It allows for the use of only one material throughout c. It enables the use of different materials during a print d. It increases the printing speed

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	9. Which of the following is NOT a reason to replace filament during a print? a. Running out of filament b. Changing the color of the print c. Using a different material d. Printer maintenance 10.What is the significance of understanding support structures in 3D printing? a. They make the print look fancy b. They add weight to the object c. They improve design stability d. They influence the color of the print
Summary	Slicing, CURA, 3D filament, Support structures

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Activities and Scenarios

Activity #1	
Scenario Name	Slice by Slice: Understanding the Core of 3D Printing
Duration	60 mn
Aim	Immerse participants in the concept of slicing in 3D printing through a hands-on exploration of progressively sliced models.
Learning Objectives	Understand the concept of slicing in 3D printing. Explore the practical implications of slicing choices on print quality.
Relevant competences	Knowledge of practical considerations in selecting slicing settings.
Facilities/Equipment	Transparencies or slides displaying sequential slices of a 3D model Markers Flip chart or whiteboard Magnifying glasses/window
Pre-requisites	Basic knowledge of the concept of 3D printing. Familiarity with three-dimensional modeling concepts.
Description	Step 1. Introduction (5 minutes): Provide a brief overview of the slicing process in 3D printing. Emphasize the significance of slicing for translating digital models into printable layers. Step 2. Visual Journey Setup (10 minutes): Arrange participants into small groups. Distribute transparencies or slides showcasing various stages of slicing for a 3D model. Ensure each group has markers for annotations. Step 3. Application Discussion (20 minutes): Address any questions or uncertainties raised by the participants. Use a flip chart or whiteboard to illustrate how the visual exploration relates to the practical application of slicing in 3D printing. Discuss key considerations in slicing settings and their impact on print quality.

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	Step 4. Reflection (5 minutes): Conclude the activity by asking participants to reflect on what they've learned about the intricacies of slicing. Invite participants to share their takeaways and any newfound appreciation for the slicing process.
Activity #2	
Scenario Name	UltiMaker CURA: Fundamental Steps in 3D Printing Prep
Duration	60 min
Aim	This activity is designed to provide participants with a foundational understanding of UltiMaker CURA software. The primary goal is to familiarize learners with key concepts and functionalities, preparing them for effective utilization in subsequent practical sessions.
Learning Objectives	Understand CURA's role in preparing 3D models for printing. Identify key phases from model import to G-code generation. Explore basic settings in CURA for configuring 3D prints.
Relevant competences	Software Proficiency: Develop familiarity with UltiMaker CURA's interface and features. Conceptual Understanding: Gain foundational knowledge of key 3D printing concepts and software functionalities. Preparation for Practical Application: Ready for hands-on 3D printing exercises using UltiMaker CURA.
Facilities/Equipment	Projector to display CURA's interface. Sample 3D models.
Pre-requisites	Basic knowledge of 3D printing concepts. Familiarity with 3D models.
Description	Step 1. Introduction to 3D Printing Process (10 min): Brief explanation of slicing and model preparation for 3D printing. Discussion on CURA's advantages and significance in the process.

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	Step 2. Navigating CURA's Interface (15 min): Showcase CURA's interface without diving into complex details. Explanation of main sections: Model Import, Printer Configuration, Print Settings, etc. Step 3. Analysis of Basic Settings (20 min): Discussion on key settings like temperature, print speed, infill density. Explanation of how these settings impact the final print. Step 4. Virtual Configuration Practical Exercise (15 min): Provide sample 3D models. Guide learners through the virtual process of importing and configuring a model using CURA. Step 5. Discussion and Q&A (10 min): Open floor for questions and discussion on learners' experiences during the exercise.
Activity #3	
Scenario Name	Optimal Printing Conditions Workshop
Duration	80 min
Aim	Enhance participants' understanding of temperature control and material replacement concepts in 3D printing through hands-on explorations.
Learning Objectives	Develop practical knowledge of temperature impact on different filaments. Enhance problem-solving and critical thinking skills in the context of 3D printing challenges.
Relevant competences	Filament categorization based on temperature. Analysis of 3D models to identify filament change points.
Facilities/Equipment	Different filament samples (e.g., PLA, ABS). Information sheets detailing optimal printing temperatures for each filament. 3D models printed with intentional filament change points. Whiteboard or flipchart for group discussions.
Pre-requisites	Basic awareness of 3D printing concepts
Description	Step 1. Filaments & Temperature introduction (10 minutes)

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	The trainer delivers a concise overview of various 3D printing filaments and their respective optimal operating temperatures. Step 2. Temperature Control Exploration (25 minutes): Divide participants into small groups. Provide each group with different types of filaments (e.g., PLA, ABS) and information about their optimal temperature ranges. Instruct groups to discuss and categorize the filaments based on their optimal printing temperatures. Facilitate a group discussion on the potential challenges and benefits associated with printing at higher or lower temperatures. Step 3. Filament change points explanation (10 minutes) The trainer will explain to participants the need for changing filament in 3D printing to ensure the stability of their projects. Step 4. Material Replacement Simulation (25 minutes): Distribute 3D models printed with multiple filament types but with intentional pauses. Explain that these pauses simulate the need for material replacement during a print. In groups, participants analyze the models, identify the filament change points, and discuss strategies for successful material replacement. Each group presents their findings, discussing challenges and proposing solutions. Step 5. Discussion and Q&A (10 min): Open floor for questions and discussion on learners' experiences during the exercise.
Activity #4	
Scenario Name	Designing Stability: Architectural Insights for 3D Printing
Duration	80 mn
Aim	Enhance participants' understanding of the importance of proper supports in 3D printing by drawing inspiration from architectural structures and their construction processes.
Learning Objectives	Develop a comprehensive understanding of the role and importance of support structures in 3D printing. Encourage critical thinking by analyzing different architectural constructions and deducing appropriate support structures for 3D printing.

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Relevant competences	Participants will enhance their ability to analyze and recognize the structural elements of architectural designs. Develop problem-solving skills by identifying effective support structures suitable for various 3D printing scenarios. Promote collaboration and communication skills through group discussions, where participants share ideas and provide constructive feedback.
Facilities/Equipment	Visual references of diverse architectural designs showcasing different construction phases. Drawing Materials: paper, pencils, and erasers. Projector/Display for showcasing images and supporting the trainer's explanations.
Pre-requisites	Basic 3D Printing Knowledge Basic familiarity with architectural structures and their construction processes would be beneficial Drawing Skills
Description	Step 1. Introduction (15 minutes): The trainer presents examples of various architectural structures and emphasizes the role of supports in their construction. Showcases images of buildings, bridges, and towers in different construction phases, highlighting the scaffolding and supports. Step 2. Functional Support Structures (20 minutes): Introduce functional support structures used in 3D printing, explaining their significance. Provide insights into common types of supports and their applications. Step 3. Practical Drawing Exercise (25 minutes): Distribute images of different architectural structures to participants. Instruct participants to envision the construction phases and draw support structures they believe would be effective. Encourage creativity and discussion among participants during the drawing process. Step 4. Group Discussion (20 minutes):

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	Facilitate a group discussion where participants share their drawn support structures, explaining the reasoning behind their choices. Encourage comparisons and debates on the effectiveness of different support designs.
Activity #5	
Scenario Name	3D printing and time required
Duration	60 min
Aim	Participants will critically analyze time-lapse videos of various prints, estimating real-time durations and engaging in discussions that explore the factors influencing 3D printing time.
Learning Objectives	Understand the concept of 3D printing time. Identify factors influencing the duration of 3D printing.
Relevant competences	Critical assessment. Understanding of 3D printing principles. Temporal analysis skills.
Facilities/Equipment	Projector for video display. Selection of time-lapse videos showcasing different 3D prints. Whiteboard or visual-sharing software.
Pre-requisites	Basic understanding of fundamental 3D printing concepts.
Description	Step 1. Introduction (5 minutes): Briefly explain the concept of 3D printing time. Present the activity's objective. Step 2. Video Time-Lapse (15 minutes): Project various time-lapse videos of 3D prints. Ask participants to estimate the real-time duration of each print. Step 3. Group Discussion (15 minutes): Divide participants into groups. Each group discusses and estimates the actual time for each video. Consider different factors influencing printing duration.

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	Step 4. Sharing and Discussion (15 minutes): Each group shares their estimates and reasoning. Class discussion on differences between estimates and actual times. Step 5. Explanation (10 minutes): Provide the correct solution and explain factors influencing printing time. Discuss structural principles affecting print duration.

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Sub-topic 3: Preparation of 3D Printer (material to be used, the temperature of the nozzle/bed etc.)

Lesson plan Name: Eco-Conscious Design: The Intersection of 3D Printing and Sustainability

Activity and duration	Content
Introduction	This learning experience aims to cultivate proficiency in 3D design, encompassing ideation, technical drawing, software navigation, measurement essentials, and informed material selection.
Description	This lesson covers various aspects of 3D design, with a focus on eco-sustainability and sustainable design in five activities. Participants will engage in discussions and debates exploring the potential of 3D printing, with an emphasis on making optimal design choices to minimize environmental impact and encourage eco-friendly practices.
Resources	Resources (videos, links, documents etc.): https://greenfill3d.com/filaments/ https://jackiecolburn.medium.com/3-creative-sketching-exercises-to-include-in-your-next-workshop-89879f5e3712 https://www.liberatingstructures.com/17-conversation-cafe/
Videos XX minutes	Powtoon video
Quiz 20 minutes	1.In the context of 3D design, what does "eco-sustainable" refer to? a. Materials that are harmful to the environment b. Materials that can be recycled or have a low environmental impact c. Expensive materials d. Materials used in traditional art 2.How can 3D designers contribute to eco-sustainability? a. By using materials with high environmental impact b. Ignoring the impact of their designs on the environment c. Choosing materials with low environmental impact d. Avoiding 3D design altogether 3.Why is it important to understand the strengths and weaknesses of different materials in 3D design? a. To make the project more expensive

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	b. To ignore structural requirements c. To achieve vibrant color combinations d. To create a well-balanced and functional design 4.Which factor is NOT relevant when balancing sustainability and efficiency in 3D design? a. Material strengths and weaknesses b. Structural requirements c. Environmental impact d. Aesthetic appeal 5.Why is it crucial for young adults to learn how to balance sustainability and efficiency in 3D design? a. It has no impact on their future careers b. To contribute to creating functional and environmentally conscious designs c. Purely for academic reasons d. To use only the most expensive materials in their projects 6.Why are supports important in 3D printing? a. To make the object heavier b. To add unnecessary complexity c. To ensure stability and aesthetic results d. To avoid printing altogether 7.How should the number of supports be determined in 3D printing design? a. Use as few as possible b. Add as many as you can c. Ignore the design and add a standard number d. Base it on the design's needs for stability 8.What is the consequence of not cutting supports after 3D printing? a. It has no impact on the final result b. The object will be more stable c. The aesthetic quality will be compromised

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	d. Supports will automatically dissolve after printing 9.In 3D design, what does the term "shape subtraction" refer to? a. Adding more shapes to a design b. Removing parts of a shape to create a new form c. Ignoring shapes altogether d. Changing the color of a shape 10.How does designing a product from scratch contribute to sustainability in 3D printing? a. It has no impact on sustainability b. By using pre-designed templates c. By allowing customization for eco-friendly materials and processes d. Sustainability is only achieved through mass production
Summary	3D Design, Sustainable Design, Material Selection, Conversationcafe

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Activities and Scenarios

Activity #1	
Scenario Name	Eco-Filament Proficiency: Balancing Sustainability and Stability
Duration	45 min
Aim	This activity aims to develop participants' ability to discern eco-sustainable filament choices in 3D printing projects. Through a guided observation of filament samples and a presentation, learners will gain insights into the environmental impact and structural stability considerations for different materials.
Learning Objectives	Develop the ability to identify different 3D printing filaments based on visual characteristics. Understand the ecological impact of various filament choices in 3D printing. Learn to evaluate filaments for their suitability in meeting structural requirements of 3D printed objects. Develop skills in making informed choices by considering both environmental and structural factors.
Relevant competences	Participants will become proficient in recognizing and categorizing different types of 3D printing filaments. Acquire awareness of the ecological implications of filament choices in the context of 3D printing. Enhance decision-making skills.
Facilities/Equipment	Filament Samples. Image Boards of 3D printed objects. Filament Cards: Printed cards detailing characteristics, weaknesses, and strengths of different filaments. Object Cards: Printed cards describing structural features and potential uses of 3D printed objects.
Pre-requisites	Basic Understanding of 3D Printing Familiarity with Filament Types Awareness of Environmental Impact
Description	Step 1. Introduction (5 minutes): Brief overview of the ecological impact of 3D printing filaments.

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	Step 2. Filament Observation (15 minutes): Participants observe and interact with live filament samples, considering their physical characteristics. Trainer presents a comprehensive overview of various 3D printing materials, focusing on their environmental impact and structural attributes. The trainer will provide Filament Cards, printed cards detailing characteristics, weaknesses, and strengths of different filaments. Step 3. Object Assessment Exercise (25 minutes): Participants analyze images of 3D printed objects, considering their structural requirements, and choose suitable filaments. Trainer will provide Object Cards, printed cards describing structural features and potential uses of 3D printed objects. Open discussion on the choices made, emphasizing the importance of balancing ecological considerations with structural needs in filament selection.
Activity #2	
Scenario Name	Support Strategies: A Practical Approach to 3D Printing
Duration	90 min
Aim	Enhance participants' understanding of the strategic placement of support structures in 3D printing by combining structural stability considerations with aesthetic elements.
Learning Objectives	Develop an understanding of strategic support placement in 3D printing for both structural stability and aesthetic considerations.
Relevant competences	Learn to enhance the structural integrity of 3D printed objects using supports. Develop the ability to make support placement decisions considering the visual appeal of the final product. Acquire practical experience by replicating shapes with supports using modeling clay.
Facilities/Equipment	Modeling Clay Wooden Sticks Cutting Tools

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Pre-requisites	Basic Understanding of 3D Printing
Description	Step 1. Introduction (10 minutes): Brief overview of the importance of support structures in 3D printing. Explanation of strategic support placement for both structural stability and aesthetic considerations. Step 2. Theoretical Instruction (15 minutes): Demonstration on how to insert supports at key points in a 3D model. Discussion on the visual impact of support structures on the final printed product. Step 3. Practical Exercise Setup (10 minutes): Distribution of modeling clay to participants. Providing wooden sticks for use as support structures. Step 4. Hands-On Exercise (30 minutes): Shape Replication (15 minutes): Participants replicate a simple shape or object using modeling clay. Instruct participants to consider the need for support structures within their designs. Support Placement (15 minutes): Participants strategically place wooden sticks within their clay models to act as supports. Emphasis on considering both structural stability and the visual impact of support placement. Step 5. Trimming and Smoothing (15 minutes) Allow sufficient time for the modeling clay to dry and harden, ensuring stability in the final design. Once dry, participants will engage in trimming wooden supports, ensuring a neat finish by carefully filing any protrusions for a polished result. Step 6. Discussion and Reflection (10 minutes): Participants share their creations, discussing the decisions made in support placement. Note: Depending on the drying time required for the modeling clay, this exercise can be split into two separate sessions if needed.

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Activity #3	
Scenario Name	Sculpting Complexity: Shape Removal in 3D Printing
Duration	40 min
Aim	Enhance participants' understanding of shape subtraction in 3D design, starting with optical illusions and transitioning to practical applications in 3D modeling.
Learning Objectives	Recognize the presence of shapes within ambiguous images. Apply the concept of shape subtraction in 3D design.
Relevant competences	Ability to analyze and interpret optical illusions. Skill in identifying complex shapes in ambiguous contexts. Practical knowledge of applying shape subtraction in 3D design.
Facilities/Equipment	Materials for projecting optical illusions. Sheets with ambiguous images. Visual support for presentation.
Pre-requisites	Basic knowledge of visual perception. Familiarity with basic concepts of 3D design.
Description	Step 1. Introduction to Optical Illusions (10 minutes): Showcase various optical illusions related to shape perception. Stimulate a brief discussion on visual perception and how the brain interprets objects. Step 2. Practical Activity: Identifying Shapes (15 minutes): Provide sheets with different optical illusions or ambiguous images. Ask participants to identify and discuss the shapes they see in each image. Facilitate a discussion on the challenges of identifying complex shapes. Step 3. Presentation on Shape Subtraction in 3D Design (10 minutes): Introduce the concept of shape subtraction in 3D design. Illustrate how this principle can be used to create details and complex geometries in models. Step 4. Application Discussion (10 minutes):

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	Ask participants how they could apply shape subtraction in their 3D projects. Collect ideas and responses from the class.
Activity #4	
Scenario Name	Green Horizons: Discussions on Sustainable 3D Printing Futures
Duration	60 min
Aim	Facilitate an inclusive and open discussion on sustainability in 3D printing, emphasizing optimal design choices to reduce environmental impact and promote eco-friendly practices.
Learning Objectives	Understand sustainable materials for 3D printing. Apply principles of eco-friendly design. Actively participate in thematic discussions. Reflect on sustainability in design contexts.
Relevant competences	Sustainable Design Proficiency Eco-Friendly Material Selection Communication Skills Critical Reflection on Environmental Impact Environmental Awareness in 3D Printing
Facilities/Equipment	Thematic tables with informational materials. Note sheets and pens. Visual presentation on screens (optional). Communication supports for participants with disabilities (e.g., visual aids, interpreter, communication boards).
Pre-requisites	Basic knowledge of fundamental concepts in 3D printing and environmental considerations
Description	Step 1. Introduction (5 minutes): Briefly present the importance of sustainability in 3D printing. Discuss environmental challenges related to 3D object production. Step 2. Thematic Table Rotations (30 minutes): Organize different thematic tables covering topics such as sustainable materials, efficient design, and eco-friendly practices.

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	Provide suggested discussion themes at each table, ensuring diversity and inclusivity (e.g., "Recyclable Filaments," "Energy-Efficient Printing," "Accessible Designs for All"). Participants rotate among tables every 5-7 minutes to engage in various discussions. Step 3. Open Discussions (20 minutes): Gather participants for an open discussion on ideas emerging from the thematic tables. Encourage the exchange of opinions, suggestions, and reflections on sustainability in 3D printing. Step 4. Conclusion and Reflection (5 minutes): Summarize key points from the discussions. Reflect on the practical application of discussed ideas in the context of sustainable 3D design.
Activity #5	
Scenario Name	Sustainable 3D Design Workshop
Duration	90 min
Aim	Foster sustainable and functional ideation skills among students for 3D design projects.
Learning Objectives	Collaboration and communication in group settings. Practical application of sustainable design principles in 3D projects.
Relevant competences	Develop skills in integrating sustainability into 3D projects. Enhance teamwork and communication abilities through group discussions. Build critical thinking skills by evaluating project feasibility and considerations. Translate theoretical concepts into practical 3D design applications.
Facilities/Equipment	Paper, pens, and sketching tools.
Pre-requisites	Basic understanding of fundamental concepts in 3D printing and sustainability considerations
Description	Step 1. Theoretical Introduction and Guided Brainstorming (20 minutes):

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	Theoretical Introduction (5 minutes): The instructor presents key principles of sustainable design and criteria for evaluating the practical utility of an object. Relevant examples of 3D projects integrating sustainability and functionality are discussed. Guided Brainstorming Activity (15 minutes): Students engage in a guided brainstorming session, reflecting on daily needs, environmental issues, and practical challenges. Guiding prompts and questions are provided to steer the ideation process. Step 2. Individual Sketching Phase (15 minutes): Students individually create sketches of a 3D object on paper, focusing on sustainable and functional ideas. The prior theoretical introduction and brainstorming session inform their ideation process. Step 3. Classroom Discussion (15 minutes): In a structured class discussion, students share their individual ideas, highlighting sustainable aspects and practical benefits of their proposals. This open exchange encourages a diverse exploration of concepts. Step 4. Project Selection Phase (10 minutes): Each student selects their own idea or chooses a project proposed by a classmate (1 project per 5 students). This selection phase sets the groundwork for the subsequent group work. Step 5. Group Collaboration (30 minutes): Students form groups and collaboratively assess the feasibility, required materials, structure, and other practical aspects of the selected project. Emphasis is placed on aligning the design with sustainability goals and functional utility. Step 6. Group Presentations and Reflection (10 minutes): Each group presents its selected project, discussing the considered sustainable elements and practical advantages. The session concludes with a brief reflection on the importance of sustainability in 3D design.

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Topic 3: Hands-on practice on software

Sub-topic 1: Introduction to TinkerCAD online software & CURA slicing software (practical part)

Lesson plan Name: First steps on TinkerCAD and Cura software

Activity and duration	Content
Introduction 20 minutes	Aims and objectives of the lesson plan: Aims: Familiarization with Tinkercad Basic Navigation Skills Understanding 3D Design Concepts Familiarization with CURA Objectives: Log in and Navigate Create Basic Shapes Navigate through CURA software Demonstrate Creativity
Description 15 minutes	In this sub-topic, you need to describe the lesson plan and connect the 5 activities below. This sub-topic, will introduce the TinkerCAD and CURA slicing software. You will navigate and see the features of those 2 software in this sub-topic
Resources 10 minutes	Resources (videos, links, documents etc.: https://www.TinkerCAD.com/ https://ultimaker.com/software/ultimaker-cura
Videos 20 minutes	Powtoon video
Quiz 20 minutes	1. In Tinkercad, designs are created using a combination of different shapes. True / False

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	2. Tinkercad is primarily used for advanced 3D printing tasks and is not suitable for beginners. True / False 3. Cura is a 3D printing slicer software that prepares 3D models for printing. True / False 4. Tinkercad allows users to import and modify existing 3D models. True / False 5. Tinkercad is a paid software and requires a subscription for full access to its features. True / False 6. Cura allows users to customize printing settings such as layer height, infill density, and print speed. True / False 7. Tinkercad is suitable for professional engineers and designers but may not be ideal for educational purposes. True / False 8. Cura provides features for adjusting supports, which are structures that help prevent overhangs during 3D printing. True / False 9. You can print a 3D object directly from TinkerCAD True / False 10. TikerCAD allows teachers to create classes. True / False
Summary 10 minutes	In this lesson, the student has to get familiar with TinkerCAD and CURA environment before moving to sub-topic 2.

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Activities and Scenarios

Activity #1: Open TinkerCAD and create account	
Scenario Name	TinkerCAD account creation
Duration	5 minutes
Aim	To create account on TinkerCAD
Learning Objectives	Log in to TinkerCAD
Relevant competences	N/A
Facilities/Equipment	TinkerCAD software
Pre-requisites	Module 1: 3D Technologies, Topic 3
Description	Student must be able to create an account on TinkerCAD
Activity #2: Install CURA software	
Scenario Name	CURA software installing
Duration	10 minutes
Aim	To install CURA software
Learning Objectives	Install CURA software
Relevant competences	N/A
Facilities/Equipment	CURA software
Pre-requisites	Module 1: 3D Technologies, Topic 3
Description	Student must be able to install CURA software
Activity #3: Navigate on the TinkerCAD 3D design platform	
Scenario Name	Navigation to CURA software
Duration	10 minutes
Aim	To be familiar with TinkerCAD environment
Learning Objectives	Navigate to CURA
Relevant competences	N/A
Facilities/Equipment	CURA software
Pre-requisites	Module 1: 3D Technologies, Topic 3
Description	Student must navigate to TinkerCAD to explore the software's features

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Activity #4: Navigate to CURA's environment	
Scenario Name	Navigation to CURA software
Duration	10 minutes
Aim	To be familiar with CURA environment
Learning Objectives	Navigate to CURA
Relevant competences	N/A
Facilities/Equipment	CURA software
Pre-requisites	Module 1: 3D Technologies, Topic 3
Description	Student must navigate to CURA and see the software's features
Activity #5: Change the name of the TinkerCAD project to 3D4DEAF	
Scenario Name	Change the name of the project
Duration	5 minutes
Aim	To know how to change project's name
Learning Objectives	Change the project's name
Relevant competences	N/A
Facilities/Equipment	TinkerCAD software
Pre-requisites	Module 1: 3D Technologies, Topic 3
Description	Student must be able to change the name of the project on TinkerCAD

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Sub-topic 2: Create your own design

Lesson plan Name: Design a phone stand with TinkerCAD

Activity and duration	Content
Introduction 20 minutes	Aims and objectives of the lesson plan: Aims: *Introduction to 3D Design* Creativity and Innovation Hands-On Learning Problem-Solving Skills Understanding 3D Printing Collaborative Learning Objectives: Basic Tinkercad Skills Creation of a 3D Design Troubleshooting Critical Thinking Understanding Design for 3D Printing Presentation Skills
Description 15 minutes	In this lesson plan, students will engage in a sub-topic focused on creating a 3D object using TinkerCAD. Following this sub-topic, they will proceed to design a 3D phone stand. The lesson will consist of five connected activities designed to enhance their understanding and skills in 3D modeling.
Resources 10 minutes	Resources (videos, links, documents etc.): https://www.TinkerCAD.com/
Videos 20 minutes	Powtoon video
Quiz 20 minutes	1. You can add only a limited number of shapes on the workplane. Tue / False 2. There is a tab that connects the shapes together. True / False 3. After connecting 2 shapes, there is no option to separate them again. True / False 4. The measuring units of the shapes can change. True / False

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	5. The alignment tool can align multiple shapes in different positions. True / False 6. To add a shape to the workplane you can just drag and drop it. True / False 7. The name of the shape is given by TinkerCAD and it cannot change. True / False 8. The text shape cannot be connected to the shape. True / False 9. The shape is automatically saved on the TinkerCAD account. True / False 10. The student can access the TinkerCAD class without having account. True / False
Summary 10 minutes	Follow the steps that are given to the 3D4DEAF material in order to complete the Phone stand

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Activities and Scenarios

Activity #1: Add a cylinder to the workplane	
Scenario Name	Adding cylinder shape to the workplane
Duration	5 minutes
Aim	To know how to add a shape on the workplane
Learning Objectives	To be able to add a shape on the workplane
Relevant competences	N/A
Facilities/Equipment	TinkerCAD software
Pre-requisites	Module 1: 3D Technologies, Topic 3
Description	Student must be able to add a shape on the workplane
Activity #2: Change the height of the cylinder to 45 mm	
Scenario Name	Change the height of the object
Duration	5 minutes
Aim	To know how to change the height of the object
Learning Objectives	To be able to change the height of the object
Relevant competences	N/A
Facilities/Equipment	TinkerCAD software
Pre-requisites	Module 1: 3D Technologies, Topic 3
Description	Student must be able to change the height of the object
Activity #3: Add a cone to the workplane	
Scenario Name	Adding cone shape to the workplane
Duration	5 minutes
Aim	To know how to add a cone shape
Learning Objectives	To be able to add a cone shape
Relevant competences	N/A
Facilities/Equipment	CURA software
Pre-requisites	Module 1: 3D Technologies, Topic 3
Description	Student must be able to add another shape at the workplane

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Activity #4: Rise the cone 45 mm above the workplane	
Scenario Name	Rise the object
Duration	5 minutes
Aim	To know how to rise an object
Learning Objectives	To be able to rise an object
Relevant competences	N/A
Facilities/Equipment	TinkerCAD software
Pre-requisites	Module 1: 3D Technologies, Topic 3
Description	Student must be able to add rise the object in a specific height
Activity #5: Centre align the cone with the cylinder and connect them	
Scenario Name	Allign the 2 shapes
Duration	5 minutes
Aim	To know how to use group tab
Learning Objectives	To be able to connect 2 shapes together
Relevant competences	N/A
Facilities/Equipment	TinkerCAD software
Pre-requisites	Module 1: 3D Technologies, Topic 3
Description	Student must be able to group shapes

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Sub-topic 3: 3D printing (finalization)

Lesson plan Name: Create a toolbox with TinkerCAD

Activity and duration	Content
Introduction 20 minutes	Aims and objectives of the lesson plan Aims: Creativity and Innovation Hands-On Learning Problem-Solving Skills Understanding 3D Printing Collaborative Learning Understanding File Export Introduction to 3D Printing Slicing Software Objectives: Creation of a 3D Design Troubleshooting Critical Thinking Understanding Design for 3D Printing Presentation Skills Export the Tinkercad Design Preview the Print in Cura Initiate the Printing Process
Description 15 minutes	In this lesson, students will engage in a sub-topic focused on creating a 3D object using TinkerCAD and exporting that object to CURA slicing software. Following this sub-topic, students will apply their skills by 3D-printing a toolbox. The lesson plan integrates five activities, connecting the process seamlessly to ensure a comprehensive learning experience.
Resources 10 minutes	Resources (videos, links, documents etc.): https://www.TinkerCAD.com/ https://ultimaker.com/software/ultimaker-cura
Videos 20 minutes	Powtoon video
Quiz	1. When the object is ready, it can be exported as STL form.

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20 minutes	True / False 2. A shape can be used to remove material from an object by choosing 'hole' option. True / False 3. A text shape cannot change to 'hole' True / False 4. To export the object from TinkerCAD we use gcode True / False 5. To import the file to CURA, we import the exported file from TinkerCAD True / False 6. Once the object is imported, we can change the infill density. True / False 7. We cannot change the print speed of the object. True / False 8. We export the sliced object in gcode form. True / False 9. It is not possible to know the printing time of the object. True / False 10. To send the code to the 3D printer, we use a USB or an SD card True / False
Summary 10 minutes	Follow the steps that are given to the 3D4DEAF material in order to complete the design and slicing of the object.

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Activities and Scenarios

Activity #1: Create a shape and add a hole on it	
Scenario Name	Hole creation on a shape
Duration	10 minutes
Aim	To know how to make a solid shape as a hole
Learning Objectives	To be able to make a solid shape a hole
Relevant competences	N/A
Facilities/Equipment	TinkerCAD software
Pre-requisites	Module 1: 3D Technologies, Topic 3
Description	Student must be able to make a specific solid object as a hole
Activity #2: Align and group those 2 shapes	
Scenario Name	Shapes allignment
Duration	10 minutes
Aim	To know how to align 2 or more shapes
Learning Objectives	To be able to align 2 or more shapes
Relevant competences	N/A
Facilities/Equipment	TinkerCAD software
Pre-requisites	Module 1: 3D Technologies, Topic 3
Description	Student must be able to align 2 or more shapes
Activity #3: Export this 3D object as STL form	
Scenario Name	Export the 3D object from TinkerCAD
Duration	10 minutes
Aim	To know how to export the 3D object
Learning Objectives	To be able to export the 3D object
Relevant competences	N/A
Facilities/Equipment	TinkerCAD software
Pre-requisites	Module 1: 3D Technologies, Topic 3
Description	Student must be able to export the object in .stl form

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Activity #4: Import this stl form to the CURA software and slice it	
Scenario Name	Import the 3D object to CURA software
Duration	10 minutes
Aim	To know how to import a 3D object
Learning Objectives	To be able to import a 3D object to CURA software
Relevant competences	N/A
Facilities/Equipment	CURA software
Pre-requisites	Module 1: 3D Technologies, Topic 3
Description	Student must be able to import a 3D object to CURA software
Activity #5: Export the sliced model in a gcode format	
Scenario Name	Export the final sliced object
Duration	10 minutes
Aim	To know how to export the sliced object in gcode
Learning Objectives	To be able to export the sliced object in gcode
Relevant competences	N/A
Facilities/Equipment	CURA software
Pre-requisites	Module 1: 3D Technologies, Topic 3
Description	Student must be able to export the sliced ovject in gcode

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The answer key for Module 1: 3D Technologies

Topic 2: The 3D Printing Process

Sub-topic 1: Introduction to Tinkercad online software (theoretical part)

Lesson plan Name: A Comprehensive Exploration of 3D Design

1B	2B	3B	4B	5B	6C	7B	8D	9B	10C

Sub-topic 2: Introduction to CURA slicing software (theoretical part)

Lesson plan Name: Introduction to CURA: Basic 3D Printing Know-How

1D	2A	3A	4C	5C	6C	7B	8C	9D	10C

Sub-topic 3: Preparation of 3D Printer (material to be used, the temperature of the nozzle/bed etc.)

Lesson plan Name: Eco-Conscious Design: The Intersection of 3D Printing and Sustainability

1B	2C	3D	4D	5B	6C	7D	8C	9B	10C

Topic 3: Hands-on practice on software

Sub-topic 1: Introduction to TinkerCAD online software & CURA slicing software (practical part)

Lesson plan Name: First steps on TinkerCAD and Cura software

1 True	2 False	3 True	4 True	5 False	6 True	7 False	8 True	9 False	10 True

Sub-topic 2: Create your own design

Lesson plan Name: Design a phone stand with TinkerCAD

1 False	2 True	3 False	4 True	5 True	6 True	7 False	8 False	9 True	10 True

Sub-topic 3: 3D printing (finalization)

Lesson plan Name: Create a toolbox with TinkerCAD

1 True	2 True	3 False	4 False	5 True	6 True	7 False	8 True	9 False	10 True

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