



Trainers for Visually Impaired Students Introduce 3D Printing

“CURRICULUM”

Curriculum for the T4VIS-In3D trainer course

Published by the
T4VIS-In3D project consortium



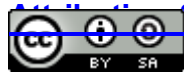
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Curriculum of the T4VIS-In3D Trainer course In the frame of the T4VIS-In3D project

Number of modules	:	7 Modules
		Approx. hours: 42 Total 42 hours (44 CU)
Group Size	:	Instructor: 1 Participants: 3-10
Target group		<ul style="list-style-type: none">• Mobility trainers for VIP• ADL trainers for VIP• Physiotherapy teachers for VIP• Teachers for MINT and technical professions for VIP• Occupational therapists
Prerequisites of participants:		<ol style="list-style-type: none">1. Fundamentals of training theory2. Experience in working with people with visual impairments3. Interest in 3D technology4. Ability to learn and execute technical maintenance and minor repairs on the 3D printers used.5. No restriction with regard to the operation of machines.6. No diagnosed plastic allergy7. Visual acuity of 0.5 or better

<p>Required material/ infrastructure</p>	<ol style="list-style-type: none"> 1. For each participant 1 Notebook or PC/MAC with min 12 GByte RAM and 3D compatible graphic adapter 2. Internet connection 3. 1 SLA and 1 FDM printer for 3 participants 4. Required Software <ul style="list-style-type: none"> + Autodesk Fusion360 Education or Regular Version + Autodesk Meshmixer + Autodesk Netfabb + Ultimaker Cura or Slicer software supported by utilised 3D printer -+ Chitubox SLA slicer 5. Tutorials of this course for participants 6. Manuals of utilised 3D printers 7. 500 g PLA filament/ participant 8. 250 ml Resin for each participant 9. 5 l Isopropyl 99% 10. Adhesive for acrylic and hard plastic 11. Deburring tool and key files 12. Wet sandpaper grain 500 13. 3 Rinsing containers in a dimension larger than building plate of utilised SLA printer 14. 1 Safety goggles/ participant 15. Disposable silicone or nitrile gloves in appropriate sizes for participants 16. Work coats for participants 17. 4 rolls of paper towels
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List of abbreviations:

CU: Course units (1 CU corresponds to 45 min)
VIP: Visual impaired people

Module 1 – Introduction in 3D printing and potential applications in the education of VIP

Learning Aim	<p>The learning objective of this module is the introduction to the topic of 3D printing.</p> <p>At the end of this lesson the participants should be able to name the 3D printing processes that are suitable for the production of tactile teaching aids. They should also know which consumables and tools are required for this. They should also be able to explain how FDM and SLA printers work. Guided by the trainer, the participants create a simple component with an FDM printer to get a first practical impression.</p>	
CU's	Subject	Remarks
6 CU's	<p>Introduction – Basics of 3D printing technology. Technical principles. Appropriate 3D technology for tactile teaching materials.</p>	
0,5 CU	<ol style="list-style-type: none"> 1. Fundamental differences between the classical subtractive production methods and the 3D printing technology 2. Advantages and new possibilities of 3D printing technology for the production of tactile teaching materials 3. Required types of software 	<p>Presenting and demonstrating 3D printed examples of tactile teaching materials versus classical produced media</p>
0,5 CU	<p>Appropriate 3D printing technology to produce tactile teaching materials. FDM and SLA method. Advantages and differences concerning tactile acuity and durability. Methods for obtaining 3D models</p> <ul style="list-style-type: none"> + Repositories + 3D Scanning of existing models + Own design with CAD + Advantages, disadvantages between a.m. options 	<p>Presenting examples and demonstrating printers in operation</p> <p>+ Visiting repositories</p>
1 CU	<ol style="list-style-type: none"> 1. Introduction in FDM and SLA 3D printers <ul style="list-style-type: none"> + Basic structure and components + Basic functioning and requirements for printable models + Required consumables and material specifications 2. Limitations of the respective printing process, notes on occupational health and safety 	<p>Demonstrating different FDM and SLA printers and models</p>
2 CU	<p>Practical introduction 3D printing</p> <ul style="list-style-type: none"> + Preparing Printfile from available STL File + Commissioning 3D printer + Starting the print process + decommissioning of the 3D printer + Post-processing the model 	<p>A prepared file is used, which is easy and quick to print. Each participant prints a model.</p>

Learning Aim	The learning objective of this module is the introduction to the topic of 3D printing. At the end of this lesson the participants should be able to name the 3D printing processes that are suitable for the production of tactile teaching aids. They should also know which consumables and tools are required for this. They should also be able to explain how FDM and SLA printers work. Guided by the trainer, the participants create a simple component with an FDM printer to get a first practical impression.	
CU's	Subject	Remarks
6 CU's	Introduction – Basics of 3D printing technology. Technical principles. Appropriate 3D technology for tactile teaching materials.	
2 CU	Re-Design with 3D scanner + Affordable 3D Scan solutions for smartphones (Qlone) + Structured light scanner + Solutions based on Photogrammetry (3DZephyr)	Example 3D scan of medical models

Module 2 – Available tools and sources to create tactile teaching materials

Learning Aim	The learning objective of this module is to present available (online) tools for creating tactile teaching aids. At the end of the module the participants should know and be able to use these tools in a meaningful way.	
Hours	Subject	Remarks
3,5 CU's	Available Tools and sources	
1 CU	Available Tools for Braille learning and printing. Advantages disadvantages, presenting 3D printed examples	
2 CU	Opportunities to create tactile maps Touch Mapper	Testing the online tool by creating STL file of maps of all partner organizations
0,5 CU	Repeating and practising the learning content	At the end of the module

Module 3 – Introduction in FDM Slicing Software (e.g. Ultimaker Cura, Repetier Host)

Learning Aim	The learning objective of this module is to teach the function and importance of these slicers for 3d printing. In addition, the correct operation of this software should lead to the participants understanding which requirements models must have in order to be printed correctly. At the end of this module, the participants should be able to operate the software correctly and create a workable G-code file for the correct printing of a tactile site plan.	
Hours	Subject	Remarks
4 CU's	Practical Utilisation of a Slicer	
1 CU	Functionality of an FDM slicer. Basic scope of functions and important parameters. User interface.	
2 CU	Operation of the slicer Software <ul style="list-style-type: none"> + Positioning of model(s) + Layer Settings + Material Settings + Infill, Wall thickness + Types of build plate adhesion + Support, Support requirements + Executing Slice process and file export 	As model for this module, the STL file of the tactile site plan (Module 2) will be used
0,5 CU	Evaluating the quality of the produced G-Code file <ul style="list-style-type: none"> + Layer Check + Evaluation of the Mesh body with Autodesk Meshmixer + Mesh repair and -improvement 	
0,5 CU	Repeating and practising the learning content	At the end of the Module

Module 4 – Autonomous utilization of FDM printers

Learning Aim	In this module, the participants learn the autonomous and comprehensive operation of an FDM printer. At the end of this module, the participants should independently send, adjust, commission and decommission an FDM printer.	
Hours	Subject	Remarks
4 CU's	Operating an FDM printer	
3 CU	Checking the serviceability <ul style="list-style-type: none"> + Transfer of the print file + Checking the adjustment of the building plate + Adjusting the build plate + Adjustment of the machine parameters for filling the filament + Start of the print + Checking the print + correct removal of the construction part + Removal of the filament + Required cleaning and maintenance work 	The model sliced in Module 3 is printed as the exercise object.
1 CU	Troubleshooting and problem solving <ul style="list-style-type: none"> + No build plate adhesion + Warping + “Elephant feet” (Deformation on the base of the component) + Deviations in the construction dimensions + Under-/Overextrusion + Wrong nozzle temperature + Clogging 	Explanation by occurring problems or example prints

Module 5 – Introduction in CAD Software Autodesk Fusion360

	Learning Aim	In this module, participants learn the basic operation of Fusion 360 and how to create tactile models. At the end of this lesson, participants will be able to create simple tactile models from solids and export them as STL files.	
	Hours	Subject	Remarks
No	19 CU's	Using Fusin360	
1	0,5	<p>Autodesk Fusion360 design software</p> <ol style="list-style-type: none"> 1. Distinguishing features of Autodesk Fusion360 from other well-known CAD products <ul style="list-style-type: none"> + AutoCAD + Inventor + FreeCAD + OpenSCAD + Rhino 2. Technical prerequisites, Licensig model for education centres, installation and Cloud structure 	Each participant is provided with a notebook or a workstation with Fusion360
2	0,5	<p>The Fusion360 user interface (GUI)</p> <ul style="list-style-type: none"> + Projects and files, cloud system + DeepL Access bar, toolbar, + Workspace + Browser palette, perspective view, timeline + Navigation pane, comment field + Context menu + Timeline 	
3	3	<p>Sketching. Creating, editing and moving sketches</p> <ul style="list-style-type: none"> + The Sketch menu + Grid settings + Units of measurement + Selecting and deleting sketches + Create selection sets + Edit, move, rotate and copy sketches Copy + Creating sketches from photos with insert and view area 	Creating sketch from picture of partner institute

Learning Aim	In this module, participants learn the basic operation of Fusion 360 and how to create tactile models. At the end of this lesson, participants will be able to create simple tactile models from solids and export them as STL files.		
Hours	Subject	Remarks	
No	19 CU's	Using Fusin360	
4	5 CU	Create body with the "Create" menu <ul style="list-style-type: none"> + The difference between direct and parametric modelling + The "Model" workspace + Combining bodies + Creating bodies with construction tools + Extrusion + Sweeping + Rotating + Arrange + Creating tactile surfaces + Using the Braille Addin "Braille Creator" 	Creating simple models <ul style="list-style-type: none"> - Shopping cart token - Creating tactile site plan from sketch of map - Creating tactile models of a human cell structure
5	1 CU	Working with STL files in Fusion360 <ul style="list-style-type: none"> + Editing STL files with Fusion 360 + Insert STL files + Convert STL files + Editing converted STL files 	
6	1 CU	Export of created constructions as STL file <ul style="list-style-type: none"> + Via File Menu + Via "Workbench" setup + Evaluating the STL file 	
7	1 CU	Creating Braille with the Braille Add In Braille Creator <ul style="list-style-type: none"> - Installing Add In - Creating Braille labels - Moving Braille labels 	Creating Braille labels
8	7 CU	Repeating and practising the learning content	1 CU each at the end of No.3 – 6, 2 CU for No. 7

Module 6 – Introduction in SLA Slicing Software (e.g. ChituBox, Lychee)

Learning Aim	The learning objective of this module is to teach the function and importance of these slicers for SLA 3D printing. In addition, the correct operation of this software should lead to the participants understanding which requirements models must have in order to be printed correctly. At the end of this module, the participants should be able to operate the software correctly and create a workable file for the correct printing of a Braille label.	
Hours	Subject	Remarks
4 CU's	Practical Utilization of an SLA Slicer	
1 CU	Principles of model positioning in SLA printers. Differences between FDM slicers	
2,5 CU	Operation of the slicer Software <ul style="list-style-type: none"> + Correct positioning of model(s) + Layer, Printer and material settings + Infill, Wall thickness + Types of build plate adhesion + Support, Support requirements and strength and support positioning + Manual removing and creation of support + Create hollow models and positioning of drainage holes + Executing Slice process and file export 	As model for this module, the STL file of the Braille label from Module 5 will be used
0,5 CU	Repeating and practising the learning content	At the end of the module

Module 7 - Autonomous operation of SLA printers

Learning Aim	In this module, the participants learn the autonomous and comprehensive operation of an SLA printer. At the end of this module, the participants should independently send, adjust, commission and decommission an SLA printer.	
Hours	Subject	Remarks
4 CU's	Operating an SLA printer	
1 CU	Checking the serviceability <ul style="list-style-type: none"> + Transfer of the print file + Adjusting and levelling of the build plate + Filling the resin + Start of the print + Checking the print + correct removal of the printed part + Correct and safe removal of the resin + Required cleaning and maintenance work 	The Braille label from Module 5 is printed as the exercise object.
1 CU	Troubleshooting and problem solving <ul style="list-style-type: none"> + No build plate adhesion + Odd surfaces, walls and edges + Deviations in the construction 	Explanation by occurring problems or example prints
1 CU	Postprocessing printed parts <ul style="list-style-type: none"> - Rinsing and cleaning of model - UV curing of models - Application of durable UV protection through varnishing - Adhesive bonding and lacquering options 	

Time Schedule

Lesson	Monday	Tuesday	Wednesday	Thursday	Friday
1.	Appropriate 3D printing technology to produce tactile teaching materials. FDM and SLA method. Advantages and differences concerning tactile acuity and durability. Methods for obtaining 3D models Advantages and new possibilities of 3D printing technology for the production of tactile teaching materials	Repeating and practising the learning content from the previous day	Repeating and practising the learning content from the previous day	Repeating and practising the learning content from the previous day	Repeating and practising the learning content from the previous day
2.	Introduction in FDM and SLA 3D printers	Functionality of an FDM slicer. Basic scope of functions and important parameters. User interface	Repeating and practising the learning content from the previous day	Working with STL files in Fusion360	Repeating and practising the learning content from the previous day
3.	Practical introduction 3D printing + Preparing Printfile from available STL File + Commissioning 3D printer + Starting the print process	Evaluating the quality of the produced G-Code file	Sketching. Creating, editing and moving sketches	Export of created constructions as STL file	Practical Utilization of an SLA Slicer Postprocessing printed parts
4.	Practical introduction 3D printing + decommissioning of the 3D printer + Post-processing the model	Operating an FDM printer + Transfer of the print file + Checking the adjustment of the build plate + Adjusting the build plate	Sketching. Creating, editing and moving sketches	Creating Braille with the Braille Add In Braille Creator	Re-Design with 3D scanner Affordable 3D Scan solutions for smartphones (Qlone)
5.	Available Tools for Braille learning and printing	Operating an FDM printer + Adjustment of the machine parameters for filling the filament + Start of the print + Checking the print	Create body with the "Create" menu	Practical Utilization of an SLA Slicer Principles of model positioning in SLA printers	Re-Design with 3D scanner + Structured light scanner + Solutions based on Photogrammetry (3DZephyr)

Lesson	Monday	Tuesday	Wednesday	Thursday	Friday
6.	Opportunities to create tactile maps Touch Mapper	Operating an FDM printer + correct removal of the construction part + Removal of the filament + Required cleaning and maintenance work	Create body with the "Create" menu	Operation of the SLA slicer Software + Correct positioning of model(s) + Layer, Printer and material settings + Infill, Wall thickness + Types of build plate adhesion	End of course Feedback of participants Distribution of the certificates
7.	Opportunities to create tactile maps Touch Mapper	Operating an FDM printer Troubleshooting and problem solving	Create body with the "Create" menu	Operation of the SLA slicer Software + Support, Support requirements and strength and support positioning + Manual removing and creation of support + Create hollow models and positioning of drainage holes + Executing Slice process and file export	
8.	Functionality of an FDM slicer. Basic scope of functions and important parameters. User interface	Using Fusin360 Autodesk Fusion360 design software The Fusion360 user interface	Create body with the "Create" menu	Operating an SLA printer Checking the serviceability	
9.	Operation of the FDM slicer Software	Sketching. Creating, editing and moving sketches	Create body with the "Create" menu	Troubleshooting and problem solving	