Trainers for Visually Impaired Students Introduce 3D Printing

"CURRICULUM"

Curriculum for the T4VIS-In3D trainer course

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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	• 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:	1. Fundamentals of training theory 2. Experience in working with people with visual impairments 3. Interest in 3D technology 4. 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 allergy 7. Visual acuity of 0.5 or better

Required material/ infrastructure	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 + 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

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	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***
10 CU's	Introduction – Basics of 3D printing technology. Technical principles. Appropriate 3D technology for tactile teaching materials.	
1 CU	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	Presenting and demonstrating 3D printed examples of tactile teaching materials versus classical produced media
1 CU	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 + Repositories + 3D Scanning of existing models + Own design with CAD + Advantages, disadvantages between a.m. options	Presenting examples and demonstrating printers in operation + Visiting repositories
2 CU	1. Introduction in FDM and SLA 3D printers + 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	Demonstrating different FDM and SLA printers and models
4 CU	Practical introduction 3D printing + Preparing Printfile from available STL File + Commissioning 3D printer + Starting the print process + decommissioning of the 3D printer + Post-processing the model	A prepared file is used, which is easy and quick to print. Each participant prints a model.

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CU's	***Subject***	***Remarks***
10 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, iSense) + stripe 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***
4 CU's	Available Tools and sources	
1 CU	1. Available Tools for Braille learning and printing + Advantages disadvantages, Presenting examples	
3 CU	Opportunities to create tactile maps 1. Touch Mapper 2. Tactile Map Generator 3. Touch Terrain	Testing online tools by creating STL file of maps of all partner organizations

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	Functionality of an FDM slicer. Basic scope of functions and important parameters. User interface.	
2	Operation of the slicer Software + 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
1	Evaluating the quality of the produced G-Code file + Layer Check + Evaluation of the Mesh body with Autodesk Meshmixer + Mesh repair and -improvement	

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	Checking the serviceability + 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	Troubleshooting and problem solving + 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***
12 CU's	Using Fusin360	
1	Autodesk Fusion360 design software 1. Distinguishing features of Autodesk Fusion360 from other well-known CAD products + 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
1	The Fusion360 user interface (GUI) + Projects and files, cloud system + DeepL Access bar, toolbar, + Workspace + Browser palette, perspective view, timeline + Navigation pane, comment field + Context menu + Timeline	
3	Sketching. Creating, editing and moving sketches + 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***
12 CU's	Using Fusin360	
4	Create body with the "Create" menu + 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	Creating simple models - Shopping cart token - Creating tactile site plan from sketch of map - Creating tactile models of a human cell structure - Creating Braille labels
2	Working with STL files in Fusion360 + Editing STL files with Fusion 360 + Insert STL files + Convert STL files + Editing converted STL files	
1	Export of created constructions as STL file + Via File Menu + Via "Workbench" setup + Evaluating the STL file	

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	Principles of model positioning in SLA printers. Differences between FDM slicers	
3	Operation of the slicer Software + 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

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	
2	Checking the serviceability + 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	Troubleshooting and problem solving + No build plate adhesion + Odd surfaces, walls and edges + Deviations in the construction	Explanation by occurring problems or example prints
1	Postprocessing printed parts - Rinsing and cleaning of model - UV curing of models - Application of durable UV protection through varnishing - Adhesive bonding and lacquering options	

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Timetable

Lesson	Monday	Tuesday	Wednesday	Thursday	Friday
1.	Advantages and new possibilities of 3D printing technology for the production of tactile teaching materials	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 • Creating bodies with construction tools • Extrusion	Operation of the slicer Software • 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
2.	Appropriate 3D printing technology to produce tactile teaching materials.	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 • Sweeping • Rotating	Operating an SLA printer • Transfer of the print file • Adjusting and levelling of the build plate • Filling the resin • Start of the print

Lesson	Monday	Tuesday	Wednesday	Thursday	Friday
3.	Introduction in FDM and SLA 3D printing	Opportunities to create tactile maps Tactile Map Generator	Troubleshooting and problem solving	Create body with the "Create" menu • Arrange • Creating tactile surfaces	Operating an SLA printer • Checking the print • correct removal of the printed part • Correct and safe removal of the resin • Required cleaning and maintenance work
4.	Introduction in FDM and SLA 3D printing	Opportunities to create tactile maps Touch Terrain	Autodesk Fusion360 design software	Working with STL files in Fusion360	Troubleshooting and problem solving
5.	Practical introduction 3D printing	Functionality of an FDM slicer.	The Fusion360 user interface (GUI)	Working with STL files in Fusion360	Postprocessing printed parts
6.	Practical introduction 3D printing	Operation of the slicer Software • Positioning of model(s) • Layer Settings • Material Settings • Infill, Wall thickness	Sketching. Creating, editing and moving sketches • The Sketch menu • Grid settings • Units of measurement	Export of created constructions as STL file	Working with 3D scanners • Types of 3D scanners • 3D Scan Apps for Smartphones • Working with QLone

Lesson	Monday	Tuesday	Wednesday	Thursday	Friday
7.	Practical introduction 3D printing	Operation of the slicer Software • Types of build plate adhesion • Support, Support requirements • Executing Slice process and file export	Sketching. Creating, editing and moving sketches • Selecting and deleting sketches • Create selection sets • Edit, move, rotate and copy sketches Copy	Practical Utilization of an SLA Slicer Principles of model positioning in SLA printers. Differences between FDM slicers	Working with 3D scanners • Working with iSense • Export of 3D Scan files
8.	Practical introduction 3D printing	Evaluating the quality of the produced G-Code file	Sketching. Creating, editing and moving sketches • Creating sketches from photos with insert and view area	Operation of the SLA slicer Software • Correct positioning of model(s) • Layer, Printer and material settings	Course Feedback Distribution of the certificates to the participants
9.	Practical introduction 3D printing	Operating an FDM printer • Checking the serviceability • Transfer of the print file • Checking the adjustment of the building plate	Create body with the "Create" menu • Arrange • Creating tactile surfaces	Operation of the SLA slicer Software • Correct positioning and utilisation of support • Amendment of support setup	