STEAM EmbRaCe

A STEAM project for Empathy, Resilience and Creativity

Introduction to 3D Design

Author(s)	
Kavouni M.P. Nefeli, Karamani Rafailia Eleni	
Summary	
This course is designed to introduce students to the fundamentals of 3D printing. Students will learn how 3D printing works, how to use 3D modeling software to design 3D objects, as well as how to operate a 3D printer. The course will also cover safety considerations and best practices when using 3D printers.	
Key elements	
Keywords	3D printing / CAD design / CNC manufacturing / Design Software / 3D models
Subject	Technology / Computer Science / Any subject where 3D - printed models can be used as a learning material
Age of students	11 - 17
Preparation time	8 hours
Teaching time	3 - 4 hours
Online teaching material	TinkerCad (online app) AUTODESK Fusion 360
Offline teaching material	Steam EmbRaCe “Intro to 3D Printing” presentation
Resources used	3D printer, filament

Licenses
Trends
Bio-printing / Hybrid Manufacturing / Sustainability / Industry 4.0 / Education and Hobbyist 3D Printing / On-Demand Manufacturing
21st century skills
Creativity / Problem Solving / Collaboration and Teamwork / Technology Literacy

Lesson Plan

Activity	Description	Duration
Introduction to problem solving and algorithmic thinking	Using the Steam EmbRaCe “Intro to 3D Printing” presentation, guide your class through the basic meanings of problem solving and algorithmic thinking. 1. Introduce your students to the concept of a “problem” and redefine what we perceive as a problem in algorithmic thinking. 2. Define the notion of an “algorithm” and expand on how one can employ algorithms to solve complex problems.	15 min
Introduction to technical design	Using the Steam EmbRaCe “Intro to 3D Printing” presentation, guide your class through the basic meanings of engineering design, mechanical design and the thinking process for 2d representation. 1. Introduce your students to the concept of “projective theory” and explain this theory both from a math and design perspective. 2. Define the concepts of views and sections when designing 3D models, always connecting it with the notions of projection level and viewing angle. 3. Choose a simple everyday object, such as a Lego brick, and proceed to an “object study”, highlighting the differences between the new concepts introduced in class.	15 min
Software and printing	Start by explaining the concepts of CAD (Computer Aided Design) and CAE (Computer Aided Engineering). Continue with a historical retrospective in order to emphasize the importance of this sector. Cite the software available for both 2D and 3D design, their main features and capabilities. Explain the use of a 3D printer and highlight the differences between 3D printing and CNC Manufacturing (additive / subtractive manufacturing).	15 min
Applications of 3d printing technologies	In order to raise your students’ interest, cite some of the most intriguing and common applications of 3D printers. Indicatively use examples from the industry, architecture, medicine etc.	5 min
Software demonstration	Familiarize students with the software you are about to use. You may choose between AUTODESK’s Fusion 360 (free educational license) or TinkerCad, a free online alternative (https://www.tinkercad.com/).	15 min

Lesson Plan

Activity	Description	Duration
Implementation	Choose an easy - medium object and guide your class to a step - by - step implementation and design, depending on the age and experience of the students. Ensure that you are familiar with the design yourself in order to better assist your students during the process. 1. Emphasize on the basic layout of the software (planes, tools, orientation). 2. Start with the 2D design without many details, using the appropriate tools. 3. Transcend to the 3D object using the main command Extrude. 4. Add details such as new bodies, holes or more complex edges. It is recommended that you use an additive approach when designing.	25 min
3d printing demonstration	If you have a 3D printer available, devote some time to demonstrate to your class its operation. 1. Participants can learn how to operate a 3D printer, including how to load filament, prepare a print bed and start a print job. They can also learn about common issues that may arise during printing and how to troubleshoot them. 2. Cover safety considerations when using 3D printers, including proper ventilation, fire safety and avoiding burns. 3. Offer tips and discuss best practices when using 3D printers (how to properly clean and maintain a printer, how to select the right filament, etc.).	45 min

SEL practices

The following techniques support self-awareness and self-management which are the two main domains of the CASEL model in social and emotional learning.

At the beginning of the course we identify students' emotional state by following the activity "Practice for identifying emotional state".

At the end of the lesson students reflect upon their work by following the activity of Reflection.

After the reflection they practice the square breathing technique and the aim is for them to learn to practice this every time they are about to begin a challenging activity.

Assessment

Use the following exercises of graded difficulty for student assessment:

1. Create an interactive trivia using Kahoot! on basic 3D printing terms (see Annex 1).
2. Create an interactive hot spot exercise using H5P or Genially on the basic components of a typical 3D printer.
3. Produce a number of 3D printer problem scenarios (use Annex 2 forums to find) and ask students to research and identify possible solutions.
4. Ask students to reproduce a given 3D model (use Annex 3 repositories) using any of the proposed 3D modelling software.
5. Ask students to produce a 3D model of a specific object.

About STEAM EmbRaCe project

This Learning Scenario has been created in the framework of the STEAM EmbRaCe project.

STE(A)M EmbRaCe aims to promote inclusion by engaging and inspiring students from different backgrounds. Students work on real-world STE(A)M problems, which will help develop their cultural empathy, resilience, and creative thinking. The idea is to create digital content which will be ready to be used by teachers in any classroom setting. More specifically, the project will allow the development of a 7-week course and teacher training on how to use the developed material with students.

Find out more about the STEAM EmbRaCe project:

https://steamingthefuture.gr/steam-embrace/

Annex 1
Use the following 3D printing glossaries to familiarize yourself and your students with typical 3D printing terminology: https://www.3dsourced.com/rigid-ink/ultimate-3d-printing-glossary/ https://3dsolved.com/3d-printing-terms-the-ultimate-glossary/ https://guides.lib.purdue.edu/3dprinting/glossary
Annex 2
3D printing forum communities: https://3dprintboard.com/ https://forum.3dprintbeginner.com/
Annex 3
Repositories of 3D models: https://www.thingiverse.com/ (free) https://www.printables.com/model (various licenses) https://cults3d.com/en/creations/selected (free and paid)