EARLY Teaching Scenario

Topic: 2D Design, 3D Modelling and 3D Printing

Learning outcomes:

Efficient self-expression and dialogue through various design ecosystems

The process of learning through trial and error nurtures accepting challenges and failures honing critical skills of persistence and entrepreneurship.

Creative and conceptual approach to learning math, science and design technology and be more comfortable with various technologies and troubleshooting.

Applying the 7 key competences

Be more collaborative and unleash ideas as a team or independently through various programs and file formats such as PNG (portable graphics), SVG (scalable vector graphics), STL (stereolithography), 3MF (3D manufacturing format), etc.

Cognitive benefits of spatial thinking: Spatial thinking is directly linked to STEM disciplines (science, technology, engineering and math). Students are less intimidated by technology, which is ideal for a Freirean approach where reciprocal mentorship fosters a positive synergy between teachers and students.

Skills pupils develop during the scenario

The prescribed concept proposes that the current basic school syllabus for informatics, which includes two topics: "Computer Tools" at School Level II (4-6 grades) and "Information Society Technologies" at School Level III (7-9 grades), be introduced as "Computer Tools" at School Level I (1-3 grades) as a prerequisite for learning new subjects. The new approach proposes three new topics to be covered in the syllabus, providing schools and students with a wider range of technology and IT-related approaches.

English (TKHK English curriculum chapters - Tomorrow's word, Technology and Computing), Math (three dimensional measurements and their applications in various disciplines), Design & Technology (create, transform and print using various softwares and types of equipment), Art (create logos, artworks, characters, modeling buildings, automobiles, etc), 3D Printing (visualization to physical products and prototypes).

Estonian model of digital competences based on The Digital Competence Framework 2.0 of EU (https://ec.europa.eu/jrc/en/digcomp/digital-competence-framework) states that by the end of 6th class students should be able to:

- find information from different digital sources;
- uses digital information for constructing new knowledge;
- uses different digital technology with the help of the teacher;
- uses and connects different devices for importing and exporting digital information.
- uses digital technology safely in order to protect devices, content, personal data and privacy in digital environments.

3D Printing - 3D printing bridges the gap between concept to life / digital world and physical world while learning practical skills such as problem-solving, creative designing using current technology.

A creative and conceptual approach to learning maths, science and design technology and be more comfortable with various technologies and troubleshooting.

Target group: Beginners to intermediate students in primary school

Age of students: 10-16

Number of pupils: Individual or groups of two-three (synergy is at optimum amongst smaller groups).

Duration (estimated time/number of lessons): 5x60 min lessons

Prerequisites (necessary materials and online resources):

3D Printer. Laptops or desktops with a minimum of 8GB RAM. SD(secure digital) card. Open source softwares - Inkscape (vector based), Blender (3D Modelling) and Cura (Slicing for 3D printer). Paid softwares - Adobe Illustrator, Cinema4D

Introduction to the scenario *(incl. possible applications, alternatives and risks)***:**

Watch the video https://www.youtube.com/watch?v=3xX01NEcmzQ and form groups of two.

Working in groups is preferable as it promotes cohesive thinking towards a common goal. Those who are confident in their skills and abilities can work individually as well.

Possible risks involved are negligible but it is always advisable to keep an eye so as to the students may not abuse or misuse the computer and the software.

Before the program begins (preparatory work for teacher):

Ensure the systems (laptops or desktops) and the softwares are up and running seamlessly. Calibrate the 3D printer.

Main part of the scenario (no. of lessons required 5 for optimal results)

- **Lesson one:**

    Watch the video https://www.youtube.com/watch?v=3xX01NEcmzQ

    The objective of the project or assignment - to create a physical three-dimensional object printed from a virtual two-dimensional image.

    Students are acclimatized to the jargons PNG (portable graphics), SVG (scalable vector graphics), STL (stereo lithography), 3MF (3D manufacturing format), etc. and are given a brief walkthrough of the various design softwares, 3D printer and the role they will play in the current assignment. (Illustrator (paid), Inkscape (free), Blender(free), Maya (paid), Cinema 4D (paid), Tinkercad (free) Cura (free), etc).

- **Lesson two:**

    Vectorization **-** Pixel to Paths

    In this lesson students will start with a PNG file, convert it into a vector image(composed of paths and is scalable) and save it into SVG format which the Blender can read.

    Students will understand the difference between JPG (lossy compressed file) and PNG (lossless compression file) and how the PNG is ideally suited for vector conversion. Once they have been familiarized with the workspace and the essential tools they will open a PNG file and begin the conversion process to vector format.

Image Trace dialogue box to begin the vectorization process. The next step is to ungroup the artwork and go into wireframe mode by pressing crtl/cmd+Y.

In the wireframe mode delete all the unwanted objects, at this stage, it would be wise to save it as a vector file as it is always easier to start afresh with a vector format. The penultimate step before saving is to select the object and create a compound path.

The last step is to create a readable file for Blender, in this case in SVG 1.1 format.

- **Lesson three:**
  Blender - 3D environment

Students will import the SVG file that was created in the previous lesson. Once the object appears, it will be relatively small and off center. Press S (scale) and drag, click on the origin to geometry, which actually brings it flush with the baseplate in the 3D printer.

In the next step students will learn to convert the object into a mesh. To create the mesh they go into - object - convert to - Mesh from curves and then join the objects. Click on the transform dialogue box and make the necessary adjustments in x, y and z axis.

Creating the torus is optional. To make the torus smooth increase the number of major and minor segments under the Add Torus dialogue box. They can use the transform dialogue box and make precise alignments for the torus.

Once the students are happy with the design elements and proportions of the model/object they can go on to export it into STL or OBJ format.

- **Lesson four:**

    Cura - Virtual 3D object to Physical 3D object.

    In the final phase of the project/assignment, students will learn and experience 3D printing. Cura slices the object into layers and generates a G-Code file which is an essential procedure, which is printer-specific for printing the final physical object.

    Students begin the final stage by opening the STL or OBJ file in Cura. To scale - click on the object and press S, use any of the axis to scale or give precise measurements in the dialogue box.

    The final process is to press slice and save the file in G-Code format. Students will save the file onto an SD card and insert it into the Ultimaker SD card slot, scroll to the file and print.

- **Lesson five:**

    The printing process can take many hours depending on the complexity and size of the object, henceforth another lesson is advisable. The last lesson can be used to revise and get feedback from the students based on the learning experience and the possibilities of undertaking such assignments/tasks in the future.

Summary:

Students can effectively acquire skills and knowledge for life to analyze and compare two-dimensional and three-dimensional shapes in varying sizes and orientations. These skills have huge applications in geometry and the real world.

Recreating 2D characters into 3D presents a creative outlet for children resulting in improved ability to construct 3D models from 2D drawings (hand-drawn and scanned) or other images preferably in PNG format.

3D technology offers the teachers a great deal of motivation and confidence to teach as contemporary students are increasingly tech savvy, which plays a significant role in understanding the concepts being taught.