Co-funded by the Erasmus+ Programme of the European Union

PONTAL

PONTAL: Preventing NEETs status through active learning

Intellectual output 2:

A set of courses based on the „action learning“ method - 3D printing

Content:

Introduction

This material was created as a tool to support technical education involving Action learning and 3D technologies.

Aim of the course:

After completing the course, participants will gain the ability to work independently and in groups on various real-life examples that will be developed in a virtual environment in **CoSpaces Edu** and other tools for effective work in VR and AR with an overlap into the real world and the use of 3D technologies (3D printer, 3D scanner).

Action learning:[1]

Picture 1: Action learning

Action Learning is a process for developing creative thinking to solve complex problems of individuals, groups of people and corporations. It involves taking steps to solve a problem and consequently evaluating the effectiveness of those steps. In other words, one tries to learn from solving real problems. Later on, we can formulate a new, more effective solution to the problem and put that solution into practice.

Building teams and transforming organisations is being promoted as one of the most effective and cost-effective tools for problem solving, developing management and leadership skills. The great potential of Action Learning lies in the simultaneous achievement of all the described objectives.

This is an effective approach to development at all levels (e.g. individual or organisational). It is considered particularly well suited to team approaches to problem solving, effective learning, and to assist in team building within lessons, groups and organisations.

Action Learning uses cyclical learning. The acquisition of new experiences (ACTION) is followed by the need to look closely and think carefully about them (EXPLORATION). This is followed by forming general conclusions based on previous experience and comparing them with theory (LEARNING). The next step is a practical test (APPLICATION). It naturally leads to gaining new experiences, reviewing them.

Benefits of Action learning approach:

[1] Source: https://www.tcbs.cz/cs/action-learning/

- by using this method, participants learn from the consequences of their own actions, find their own solutions and reach their own conclusions,
- students learn by experience and are thus able to remember much more
- they develop imagination, creativity and social communication,
- students learn to overcome obstacles individually and in groups,
- feedback and reflection are important,
- motivates learners and set a goal, showing, how to achieve it,
- competition has a positive effect on the method, it motivates learners to perform better,
- combines play and education,
- acqusition of key competences.

Picture 2: Actiopn learning vs academic education

ACTION LEARNING	ACADEMIC EDUCATION
Asks questions. Students are searching for answers with lectors.	Asks questions. Answers are given by teachers.
Students are working in teams.	Students are searching for answers individually.
Develops creativity and forces to think in a broader context.	Supports the context-sensitive perception of reality.
Experience and knowledge can be practically and very quickly applied in practice.	Knowledge needs to be verified over a long period of time, repeatedly, and then only practically used. The opportunity for this does not always arise.
The aim is the student's ability to apply the acquired knowledge in solving real situations with measurable benefits.	The aim is to pass a test demonstrating the ability to repeat the theory.
The result is the student's understanding of the context, "I taught them".	The result is the student's completion of a written, oral or other formal examination.

History of the Action learning:

The spiritual father and pioneer of the Action Learning method is the world-renowned english manager and university professor Reginald William Revans (1907-2003). In the 1950s, he came up with the revolutionary idea that a successful organization must be constantly learned. R.W.Revans found that people learn much more easily, quickly and permanently by sharing their mistakes. Much more than by absorbing theoretical knowledge. He developed and promoted the method called the Action learning trougthout his life.

3D modeling

Three-dimensional (3D) computer graphics

A branch of computer graphics that uses three-dimensional representation of geometric data stored on a computer for visual computing purposes. Such images can be stored for viewing later, real-time display or the creation of a tangible product.

3D computer graphics are based on many of the same principles as 2D computer vector graphics and fully rendered 2D computer raster graphics. In computer graphics software, the distinction between 2D and 3D is occasionally blurred; 2D applications may use 3D techniques to achieve effects such as lighting, and primarily 3D may use 2D rendering techniques. 3D computer graphics are often referred to as 3D models.

3D models are usually called 3D computer graphics. However, there are differences. A model, in addition to the graphics representing it, is stored in a graphical data file. A 3D model is the mathematical representation of any three-dimensional object. The model is not technically a graphic until it is rendered. A model can be displayed visually as a two-dimensional image through a process called 3D rendering, or used in non-graphical computer simulations and calculations. In 3D printing, virtual models are similarly generated into a three-dimensional physical representation of approximate accuracy.

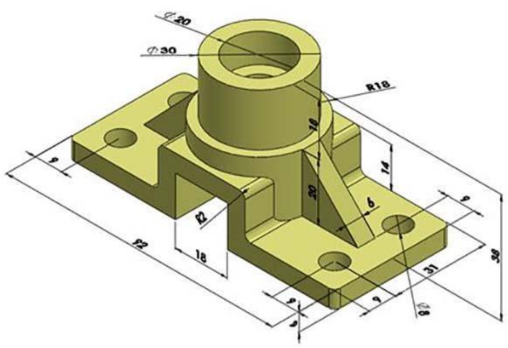
Source: https://www.sciencedaily.com/terms/3d_computer_graphics.htm

3D modelling can be divided into several types:

- CAD modelling;
- Creating visualizations;
- Artistic modelling.

CAD modelling

This is one of the most commonly used 3D modelling techniques, where a 3D model of the required part is created with the help of computer software. Modelling can be based on sketches, drawings, samples or photographs. The 3D model created is suitable for a variety of manufacturing techniques such as 3D printing, milling, cutting, etc. With a CAD model, computer simulations, testing and strength tests can be carried out in the future on the designed part. The formats in which works are usually saved: .stp, .step, .3dm, .igs, .iges, .obj, .stl and others.



Example of a CAD model

Creating visualizations

It's a way to make it easier to imagine the object you're creating on your computer in reality. Realistic, full-color visualizations are created by applying the desired colors and textures to the modelled object, placing it in the right environment, etc. Such models can be integrated into real environments to see if an object, piece of furniture or other item fits the environment. You can also create a visualization of an entire room, house, building, etc.

3D visualization of the apartment

Artistic modelling.

This simulation is usually designed to reproduce real objects from photographs, sketches and drawings. Buildings that no longer exist can be modelled, and virtual exhibitions can be created based on them. Human portraits and statues are recreated and animated characters for films and games can be modelled.. There are no large restrictions when it comes to creating artwork, and it doesn't have to be the same as reality.

3D character models

Source: https://foyr.com/learn/types-of-3d-modeling/

3D modelling programs

Blender

Blender is a free, open-source 3D development software. It supports a wide range of 3D modelling features - modeling, rigging, animation, rendering, compositing and motion tracking, even video editing and game development. Advanced users use Blender's API for Python scripting to customize the application and write specialized tools, often included in future Blender releases. "Blender is perfect for individuals and small studios that benefit from a unified use and development process.

"Blender works with Linux, Windows and Macintosh operating systems. Its interface uses OpenGL to provide a consistent experience.

Blender user interface

Cinema 4D

Cinema 4D is professional 3D modelling, animation, simulation and rendering software. A fast, powerful, flexible and stable toolset makes 3D workflow more accessible and efficient for the professionals in the areas of design, motion graphics, VFX, AR/MR/VR, game development and all types of visualization.

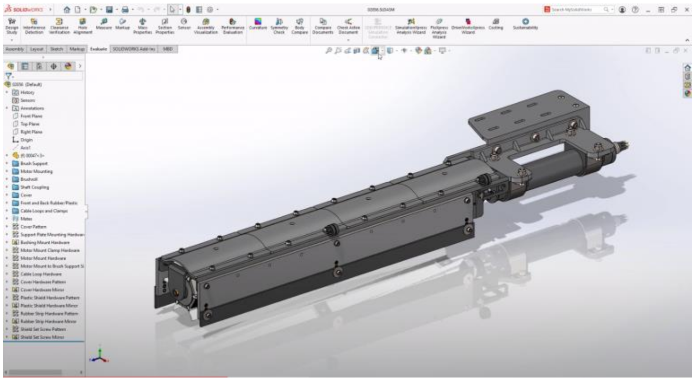
Cinema 4D application user interface

SolidWorks

Solidworks, a solid modelling computer-aided design and computer-aided engineering software, is one of the most popular software options for mechatronics engineers.

Solidworks was developed by MIT graduate John Hirschtick and bought by Dassault Systems in 1997. Software now includes a wide range of applications that can be used for both 2D and 3D design.

Solidworks is used to build mechatronic systems from start to finish. In the initial phase, the software is used for planning, visual thinking, modelling, possibility assessment, prototyping and project management. The software is then used to design and develop the mechanical, electrical and software elements. Finally, it can be used for management, including device management, analytics, data automation and cloud services.



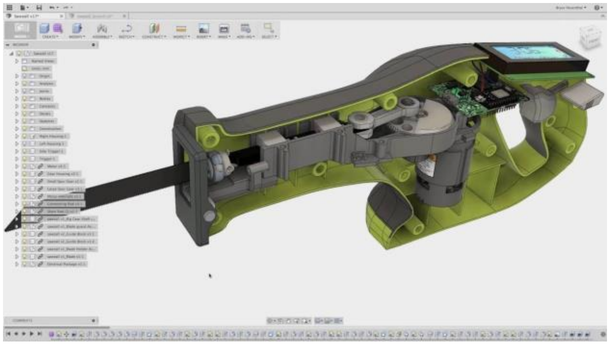
SolidWorks user interface

Fusion 360

"Fusion 360" is a cloud-based 3D modelling, CAD, CAM, CAE and PCB software platform for product design and manufacturing.

During the design process, the impact of engineering and PCB changes can be monitored and production adaptability can be ensured using simulation and generative design tools.

Fusion 360 is a great tool for accurate 2D and 3D object modelling, but it can also be used to animate your designs, render objects, simulate loads and prepare models for CNC machining. Many small and large companies use the platform to design and prototype their products because "Fusion 360" offers CAD, CAM and CAE capabilities.



Fusion 360 user interface

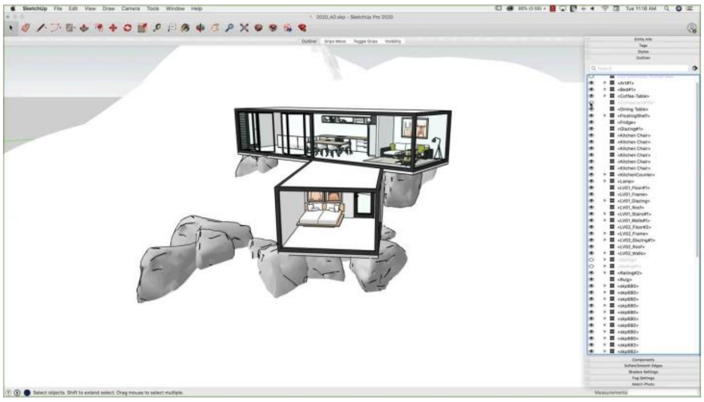
SketchUp

SketchUp is a 3D modelling computer program for a wide range of drawing and design applications, including architectural, interior design, industrial and product design, landscape architecture, civil and mechanical engineering, theatre, film and videogame development.

"Trimble Inc." owned by program is currently available as a web-based application called SketchUp Free and a paid version with additional features called SketchUp Pro is available.

The application includes drawing layout functionality, surface rendering in various "styles", and allows you to host its models on Google Earth.

Sketchup is a 3D modelling application that allows you to create 3D objects in a 2D environment. Whether you plan to model for 3D printing or for other purposes, Sketchup offers all the tools you need to achieve professional and high-quality results, even for beginners.



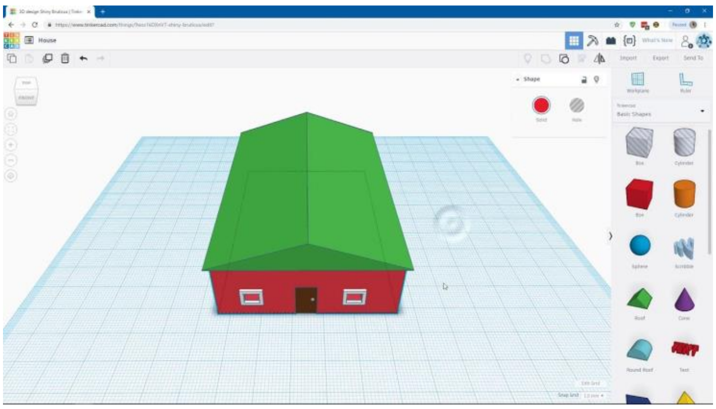
SketchUp user interface

TinkerCAD

"TinkerCAD" is a general-purpose, free 3D modelling software. It is made with the intent of designing objects of any desired size and allows you to modify them at any step of the design process. Unlike other 3D design software, "TinkerCAD" does not require you to draw a blueprint; the desired objects are created from premade 3D shapes.

Tinkercad is an online suite of Autodesk software tools that allows complete beginners to create 3D models. This CAD software is based on Constructive Solid Geometry (CSG), which allows students to create complex models by combining simpler objects. This makes this 3D modelling software easy to use and it is currently a favorite with many, especially teachers, children, hobbyists and designers. Best of all, the app is free and only requires an internet connection to use. The software allows users to create models compatible with 3D printing, laser technology or even CNC machines.

Tinkercad is a good alternative to other 3D modelling software such as SketchUp or Fusion 360, as these are sophisticated and professional applications that can often be difficult for children due to the number of tools and the complexity of the working environment. The main advantage of this software over the other two is that it is free, but gives you more modelling freedom than meets the eye. It is currently available in 16 languages.



TinkerCAD user interface

3D printing

The history of 3D printing

The first 3D printers

The first documented iterations of 3D printing can be traced back to the early 1980s in Japan. In 1981, Hideo Kodama was trying to find a way to develop a rapid prototyping system. He came up with a layer-by-layer approach for manufacturing, using a photosensitive resin that was polymerized by UV light.

Although Kodama was unable to file the patent requirement of this technology, he is most often credited as being the first inventor of this manufacturing system, which is an early version of the modern SLA machine.

Across the world a few years later, a trio of French researchers was also seeking to create a rapid prototyping machine. Instead of resin, they sought to create a system that cured liquid monomers into solids by using a laser.

Similar to Kodama, they were unable to file a patent for this technology, but they are still credited with coming up with the system.

That same year, Charles Hull, filed the first patent for Stereolithography (SLA). An American furniture builder who was frustrated with not being able to easily create small custom parts, Hull developed a system for creating 3D models by curing photosensitive resin layer by layer.

In 1986 he submitted his patent application for the technology, and in 1988 he went on to found the 3D Systems Corporation. The first commercial SLA 3D printer, the SLA-1, was released by his company in 1988.

Development of 3D printers

In the 90s, many companies and startups began popping up and experimenting with the different additive manufacturing technologies. In 2006, the first commercially available SLS printer was released, changing the game in terms of creating on-demand manufacturing of industrial parts.

CAD tools also became more available at this time, allowing people to develop 3D models on their computers. This is one of the most important tools in the early stages of creating a 3D print.

During this time, the machines were very different from those that we use now. They were difficult to use, expensive, and many of the final prints required a lot of post-processing. But innovations were happening every day and discoveries, methods, and practices were being refined and invented.

3D printing now

In the 2010s, the prices of 3D printers started to decline, making them available to the general public. Along with the lowering prices, the quality and ease of printing also increased.

The materials that printers use have also evolved. Now there are a variety of plastics and filaments that are widely available. Materials like Carbon Fiber and Glass Fiber can also be 3D printed. Some creatives are even experimenting with printing materials like chocolate or pasta!

In 2019, the world's largest functional 3D printed building was completed. 3D printing is now consistently used in developing hearing aids and other healthcare applications, and many industries and sectors have adopted the technology into their everyday workflow.

Source: https://www.bcn3d.com/the-history-of-3d-printing-when-was-3d-printing-invented/

Applications of 3D printing

Automotive industry

3D printing has long been used by car manufacturers. Automotive companies print not only spare parts and tools, but also end-use parts. 3D printing has enabled on-demand production, reducing inventory levels and shortening design and production cycles;

Aviation

The aerospace industry uses 3D printing in many different ways. This example marks a significant milestone in 3D printing production: 30,000 cobalt and chrome fuel injectors for the engines of its LEAP aircraft have been 3D printed by "GE Aviation". They reached this milestone in October 2018;

Construction

Can I print the building? - Yes it is possible. 3D printed houses are already on sale. Some companies print the prefabricated parts, while others do it on site;

Consumer goods

There are now many examples of end-use 3D printed consumer products such as shoes, glasses, jewelry, souvenirs, etc;

Health protection

It is not unusual these days to see headlines about 3D printed implants. Often those cases are experimental, so it may seem that 3D printing is still untapped in the medical and healthcare sectors, but that is no longer the case. "GE Additive" has 3D printed more than 100,000 hip replacements in the last decade. It is also used in dental care services;

Food

Additive manufacturing has been making inroads in the food industry for a long time. Restaurants such as Food Ink and Melisse use it as a unique selling point to attract customers from all over the world. Pasta, confectionery, various food decorations can be printed.

Source: https://3dprinting.com/what-is-3d-printing/

3D Printed Lungs

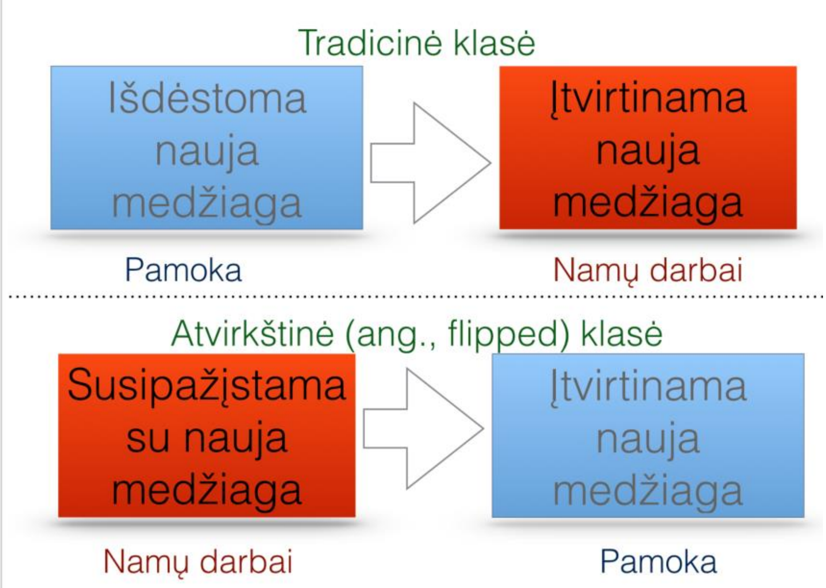
3D printed shoes

Learning methodology

"Flipped Classroom" method

What is a Flipped Classroom?

The method is described as follows: in a traditional classroom, pupils are introduced to a new topic during the lesson and reinforce the knowledge at home; in a flipped classroom, pupils are introduced to a new topic at home and reinforce the knowledge during the lesson in the classroom.



"Flipped Classroom" method

In fact, Lithuanian language teachers work in a very similar way when teaching literature. At home, students have to read a given piece of literature, familiarize themselves with its content, and in the classroom, together with the teacher, they discuss and analyze the work, etc.

This method is ideal for science, history or other subjects, where there is a wealth of interesting video material, articles, literature, etc. The teacher can assign students to watch a recorded video lesson or read an article on a particular topic at home, and in class they discuss what they have learned, the topic of the video or article, etc.

Tools for applying this method

Of course, to make the material available to students at home, it needs to be made available online. You can use existing resources on YouTube, various education portals, etc. You can also publish your own material. But in any case, you need a tool to share links to learning materials with students. It can be a website, a personal blog, a Facebook group, a Moodle environment, an e-diary entry or simply an email.

For those using iOS devices, "iTunes U" is a great tool. Each teacher can create their own course and share it with their students, it may contain not only articles or videos, but also links to e-books, apps or other online resources.

"Edmodo" - is also a great tool for those using the flipped classroom method. All the tools you need are available in this system: sharing, publishing, communicating, evaluating, etc. Read more about this tool in our article "Edmodo - it's where the learning happens!".

What are the advantages and challenges of this method?

The most important advantage is that students go from being passive listeners to active organizers of their own learning process - making learning more effective and developing important independent learning skills. Secondly, studying new material at home means that students are not distracted by lesson time, classmates, etc. The student can watch the material several times until they understand it. In addition, home schooling allows students to study at a time that suits them, when they are in the right frame of mind, and for as long as their abilities and interests allow.

Of course, this approach also presents challenges. Students need to be prepared for this approach not only in terms of their attitude, responsibility and motivation, but also in terms of access to and ability to use online resources. In addition to finding or preparing materials for home learning, teachers need to be prepared to answer a range of questions from students in the classroom, which can often be unexpected, and to make wider connections to particular topics, sources, etc.

Our work using the Flipped classroom method

We'll use similar methods in our classes, but without the need for students to study the material separately. The theoretical part will be introduced at the beginning of the lesson, but it will be used immediately during the practice to consolidate and assimilate the knowledge. Each program will introduce the task to be completed, the tools we will use and the result we will achieve. In this task, students will ask questions from both the theory and the practical part of the task to confirm their own knowledge and deepen it through questions and exercises. If some information is not covered in the theory part, it will be needed in the practice part and students will have to ask questions about it anyway.

Source: https://www.iklase.lt/kas-yra-flipped-classroom/

3D design and printing tasks

1. Task. Designing and printing a 3-storey maze with TinkerCad.

Student age: 12-16 years.
Main topics: 3D printing, technical drawing, geometry, mathematics, information technology, 3D modelling and design.
Duration: 120-150 min.

Key aspects of the task:

- TinkerCad program operation;
- Understanding three-dimensional space;
- Using TinkerCad program in practice;
- 3D printing and print preparation.

Brief description of the task:

TinkerCAD will be used to explore the 3D space, as it is a simple way to create 3D models and adapt them for printing. Drawing and calculations are also an integral part of 3D design. Before doing the task on the screen, students will first prepare their work by drawing sketches on a piece of paper to make it easier for them to work on the computer. Material, teacher-created outcomes will be shown before the performance of the task, so that children can clearly see the goal of the class.

Measures

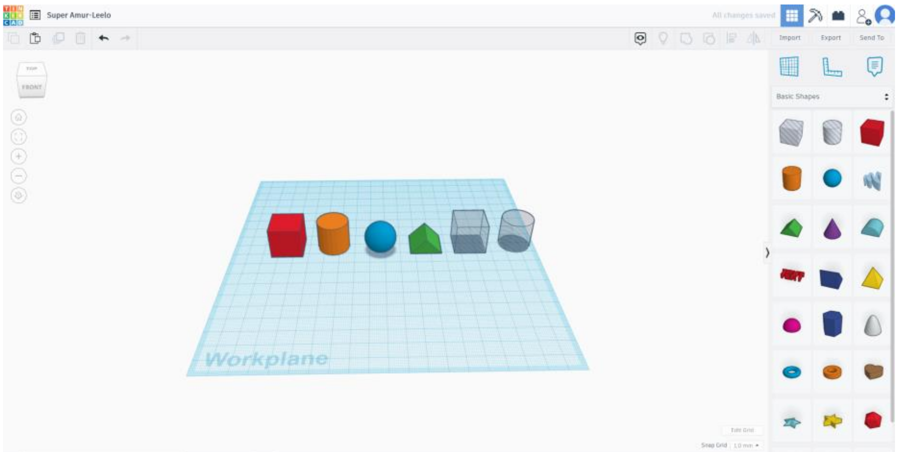
- Writing instruments;
- A sheet of paper;
- Ruler;
- Computer;
- Internet;
- Prepared TinkerCAD class logins;
- 3D printer.

Steps to complete the task:

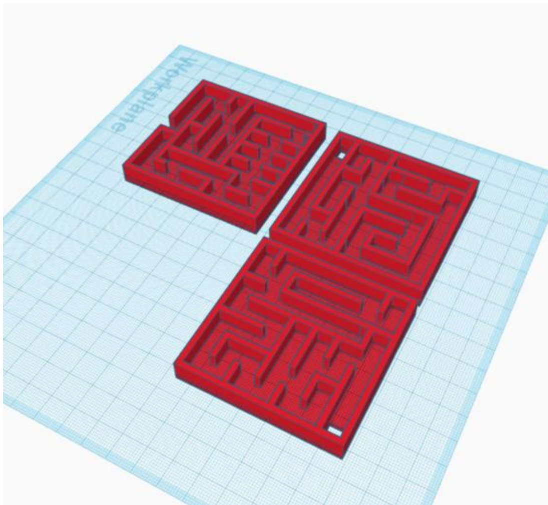
1. The assignment, the results to be achieved and the progress and stages of the activities are presented;
2. Two different mazes are drawn. The dimensions of the maze are given to limit the size. All three floors of the maze must be the same length, width and height, only the internal layout of the maze must differ;
3. The TinkerCAD program is presented: the class is being taught what it is used for, what technologies it is based on, and what kind of works can be created with its help;
4. Demonstration of TinkerCad tools and their use. After the teacher demonstrates how one of the tools works, each student also tries out the tool on his/her own computer to understand how it works;

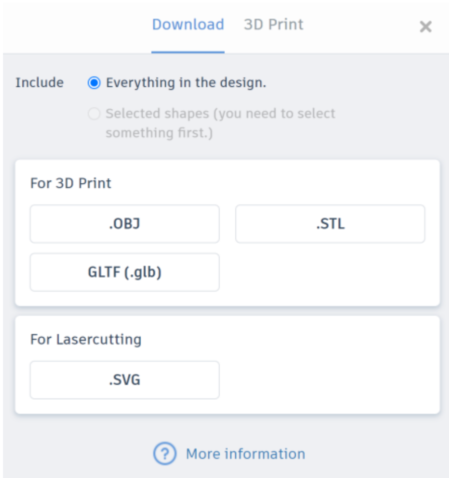
5. Students start to create the first floor of the labyrinth To help students master the software, the teacher demonstrates each step, tells them the dimensions of the maze walls, and the students repeat what the teacher shows them;
6. The remaining two floors of the maze are designed independently by the pupils based on their own drawings. During the process, the teacher is constantly observing, helping and answering any questions that arise. If necessary, the teacher shall also demonstrate how certain tools work or explain the theory that may be needed for the task, the teacher will also show students what to look out for and common mistakes;
7. Once the remaining floors have been completed, the mazes are placed in a common cube and grouped together;
8. The work produced is exported in .STL format for printing;
9. The saved work is uploaded to the Simplify program. The application changes the settings according to the 3D printer you have and saves the result. Preparing for uploading to the 3D printer;
10. The work is loaded into the 3D printer and printing begins.

At the end of the class, children will understand the basics of 3D design and printing, needed to make 3D creations from simple shapes. They will be able to adapt and print the work they produce. They will also know about file storage formats - which format is suitable and used for what task.



Getting to know the TinkerCad environment and controls





3-storey maze project in TinkerCAD *Export settings*

2. Task. Room design using TinkerCAD program.

Student age: 12-16 years.
Main topics: technical drawing, geometry, mathematics, information technology, 3D design, architecture, design.
Duration: 120-150 min.

Key aspects of the task:

- Enhance TinkerCAD operation skills;
- Developing awareness of the environment;
- Developing creativity and design thinking;
- Create realistic 3D images.

Brief description of the task:

To develop environmental awareness or artistic skills, we often start with drawings of what is visible. 3D design can also be used to improve environmental perception, creative skills and attention to detail. The idea behind the task is to recreate your room or classroom environment. After replicating existing facilities - to make them more comfortable and practical. And to beautify the spaces created to make them more attractive. Substantiate the choices made.

Measures

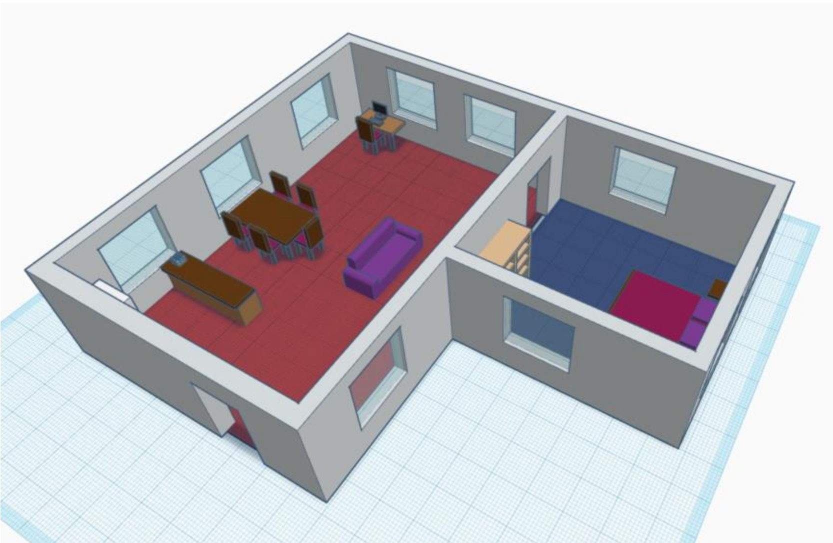
- Writing instruments;
- A sheet of paper;
- Ruler;
- Computer;
- Internet;
- Prepared TinkerCAD class logins;

Steps to complete the task:

1. The assignment, the results to be achieved and the progress of the class are presented;
2. Sketches of rooms are drawn, furniture and wall layouts are made. This is done to prepare for 3D design;
3. The improvements the student would like to make to the chosen room are described or drawn;
4. The teacher reminds students of the TinkerCAD tools and their use;
5. The first design task is to create the walls, floors, windows and doors of the room. This sets the basis for the project;
6. The design of the main furniture - chairs, tables, sofas, beds... Once they are created, they are placed where they should be in reality;
7. Smaller parts are being created: paintings, crockery, electronics, carpets, etc;
8. After this stage, the teacher evaluates the results. If necessary, the teacher advises on what needs to be improved, how the work can be further detailed, and demonstrates the creation of certain parts;

9. Students start to improve the rooms they have created. For example, they find new furniture designs on the internet, replace their tables and chairs with more modern ones, make their windows wider and bigger, or make other similar changes;
10. When the improvement is complete, students argue why they have chosen one or another change. Students explain how it could help to live or work better in the space they creates.

After completing the activity, students will not only have achieved the goal of creating a room or classroom, but they will also have a much better understanding of their surroundings, a better sense of orientation and the ability to recreate what they see. Another important aspect is the development of design thinking, which allows not only to reproduce but also to improve, to see flaws and find solutions. After completing the activity, students will not only have proposed a verbal solution to a given defect, but also have the skills to make and demonstrate technical solutions.



Recreating a room with TinkerCAD

Work chair designed with TinkerCAD

Dining room set designed with TinkerCAD

3. **Task. Designing a house using SketchUp program.**

Student age: 12-16 years.
Main topics: technical drawing, geometry, mathematics, information technology, 3D modelling and project creation, architecture, architectural graphics, design.
Duration: 120-150 min.

Key aspects of the task:

- Operate the SketchUp program;
- Developing awareness of the environment;
- Develop creativity;
- Develop logical thinking;
- Develop an understanding of architectural graphics;
- Create realistic three-dimensional designs.

Brief description of the task:

The aim of this assignment is to introduce the concept of architectural graphics. The main objectives of architecture are to shape the space of the environment and to design buildings. SketchUp allows you to create realistic representations of objects in computer space, which can then be transferred to a real environment using a 3D printer or to a neuro environment using virtual reality glasses.

In this activity, students will learn the basic SketchUp controls, how to draw three-dimensional geometric shapes, and draw a realistic drawing of a house to given dimensions.

Measures

- Computer;
- Internet;
- SketchUp program logins.

Steps to complete the task:

1. The assignment, the results to be achieved and the progress of the class are presented;
2. SketchUp controls and basic tools are introduced;
3. Geometric shapes are drawn - cube, cylinder, pyramid, prism, cone;
4. The teacher defines the main features of the house: the shape, the windows, the doors and the dimensions of the house itself;
5. Students start drawing the walls of the house according to the dimensions given by the teacher;
6. The roof of the house is being created. In this step, students recall the geometric shapes they drew in step 3 and draw the roof based on the given features of the house;
7. Measurements are taken and the locations where doors and windows should be located are marked on the drawing;
8. Drawing doors. It is important to remind students that a door, like all other objects created, is a three-dimensional object. This means that they must not only have height and width, but also depth and some kind of pattern, which must also be three-dimensional. Otherwise, if you print such a house with a 3D printer, the doors will not be different from the walls;

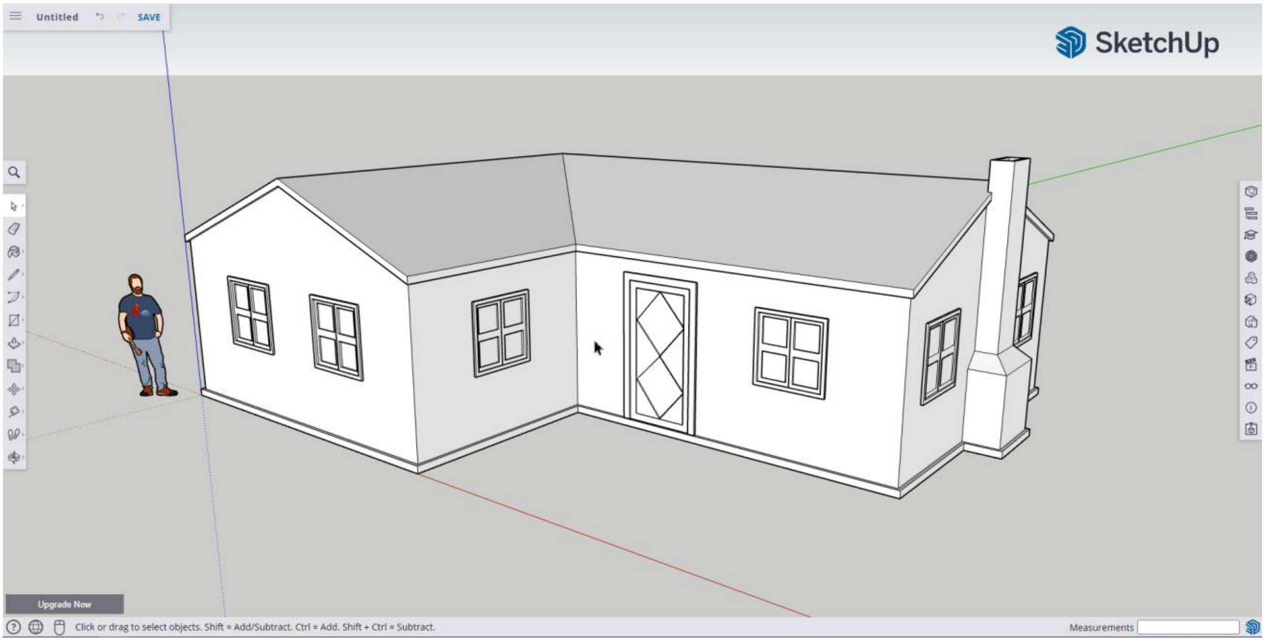
9. Windows are drawn. Similarly to the door drawn in step 8, a window is a three-dimensional object with height, width and depth. The window frame must be spatially distinct both from the glass part of the window and from the walls of the house;
10. Depending on the students' abilities, the task can be supplemented with additional objects such as a chimney, a terrace, stairs, etc.

Summary

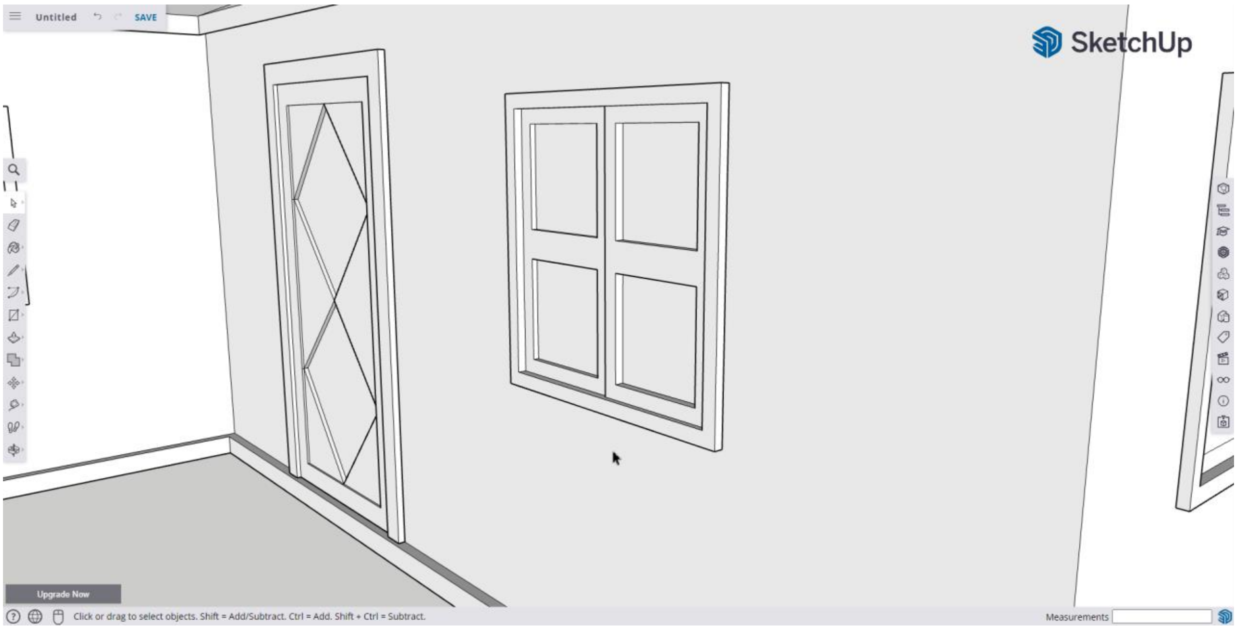
During the task, the teacher clearly defines the result to be achieved - the size of the house, the size of the roof, the shape, the number of doors and windows and other elements needed in the task - but the students are left to work out how to create the objects themselves. If necessary, students are reminded of the SketchUp tools that may be needed to achieve one or another result.

The completion of the activity will give students a better understanding of how three-dimensional objects interact with each other in three dimensions. They will be able to create realistic representations of objects using SketchUp. It will develop logical and creative thinking and problem-solving skills.

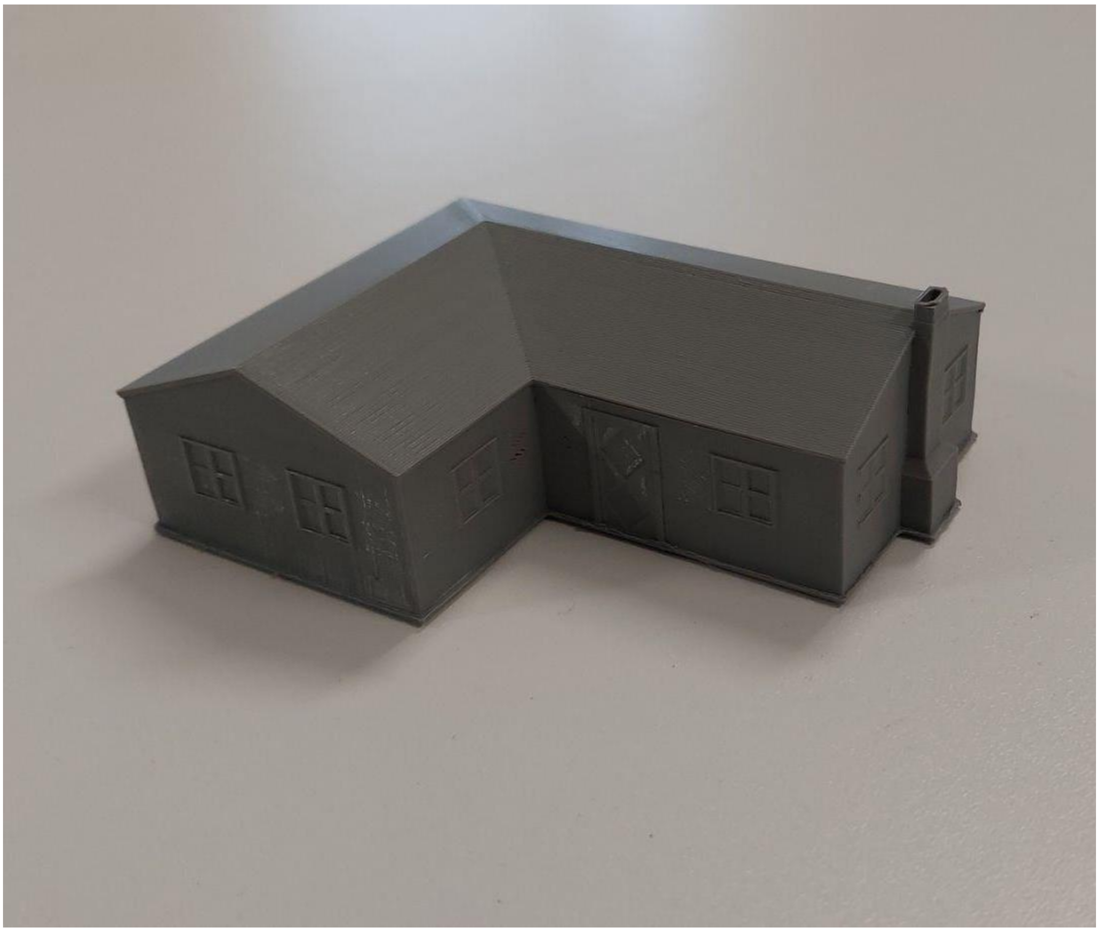
House designed with the SketchUp program



House doors and windows created with SketchUp



House printed with a 3D printer



4. **Task. Designing visited places according to pictures with the SketchUp program.**

Student age: 12-16 years.
Main topics: technical drawing, geometry, mathematics, information technology, 3D modelling and project creation, architecture, , design.
Duration: 120-150 min.

Key aspects of the task:

- Enhance your SketchUp management skills;
- Developing awareness of the environment;
- Develop attention to detail;
- Recreate real objects.

Brief description of the task:

When creating a real object from memory, the human brain often interprets the image in its own way, changing or omitting some details. To reproduce an image as close to the real thing as possible, photographs are taken from as many angles of the object as possible.

This assignment uses photographs of Lithuanian landmarks and monuments to create a 3D model of an object in SketchUp. One of the main tasks is to observe as many features and details of the building or monument in the photographs as possible, in order to recreate as true and realistic a model as possible.

Measures

- Computer;
- Internet;
- SketchUp connections are ready.

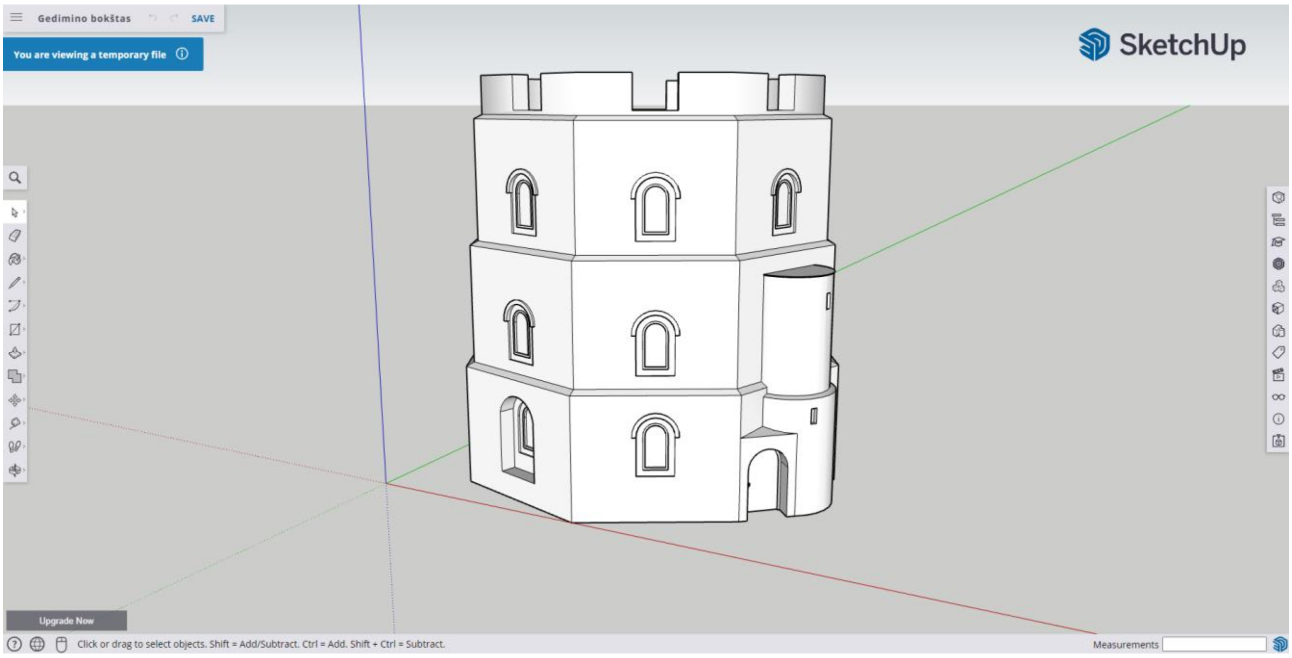
Steps to complete the task:

1. The assignment, the results to be achieved and the progress of the class are presented;
2. Students search the internet for photos of a Lithuanian landmark. At least two photographs from different sides should be taken to reproduce the object as accurately as possible;
3. The photos are saved and uploaded to the SketchUp environment;
4. The teacher reminds students of the SketchUp program tools and their use;
5. The basis for the object to be reproduced is then created. The size of the object is then assessed - although exact measurements are not important for the task, students must get the proportions of the object right, and the size of the object must not be very different from the actual size;
6. Using photographs, the most striking details of the object are being drawn: windows, doors, roof, etc;
7. Then, additional, smaller parts are created. Using photographs, students should observe as much detail as possible and then reproduce it in their technical drawing;
8. All objects created in the drawing must be three-dimensional, meaning they must have height, width and depth. Otherwise, some details will not be visible when the project is printed;

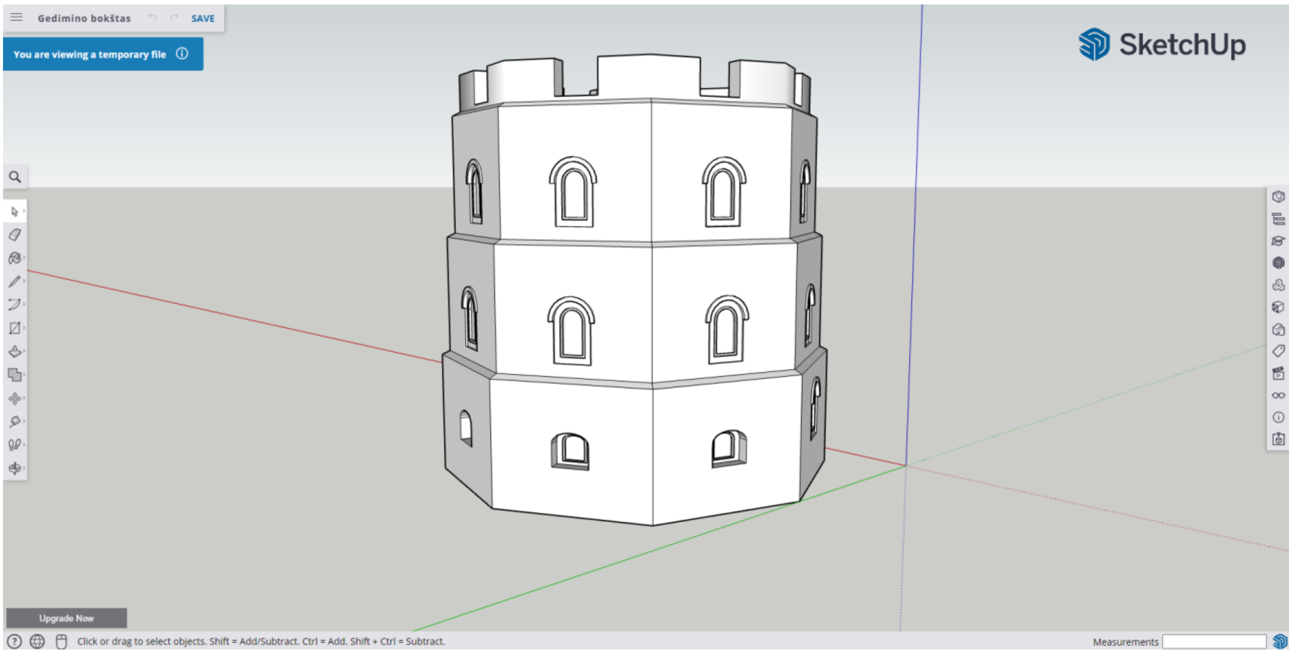
9. During this stage, the teacher evaluates the 3D models of the attraction created by the students and suggests improvements that can enliven the project;
10. When improvements are completed, the work is saved.

Summary

After completing the task, students will have created a three-dimensional model of a Lithuanian landmark that can be printed using a 3D printer. Students will enhance their SketchUp skills and develop their diligence and attentiveness. The main qualities to be developed in this task are environmental awareness and three-dimensional thinking. By drawing this model, students will have a better understanding of the spatial positioning, proportions and perspectives of objects.



Gediminas Castle tower created with SketchUp



Gediminas Castle tower created with SketchUp

Gediminas Castle tower printed with a 3D printer

5. **Task. Modelling a 3D figure on a pencil using Sculptris program.**

Student age: 12-16 years.
Main topics: 3D printing, design, information technology, 3D modelling, art.
Duration: 60 min.

Key aspects of the task:

- Managing and using Sculptris;
- Creativity training;
- 3D modelling basics;
- Applying 3D printing to different ideas.

Brief description of the task:

3D designs go beyond creating accurate models from drawings. 3D modelling is like sculpting, and in the process students will feel like sculptors, creating their own digital sculptures. The aim of the challenge is to create 3D prints using different methods by molding, shaping, reshaping and without the use of precise drawings. The activity will allow children to unleash their imagination even more and create with complete freedom and without strict rules.

Measures

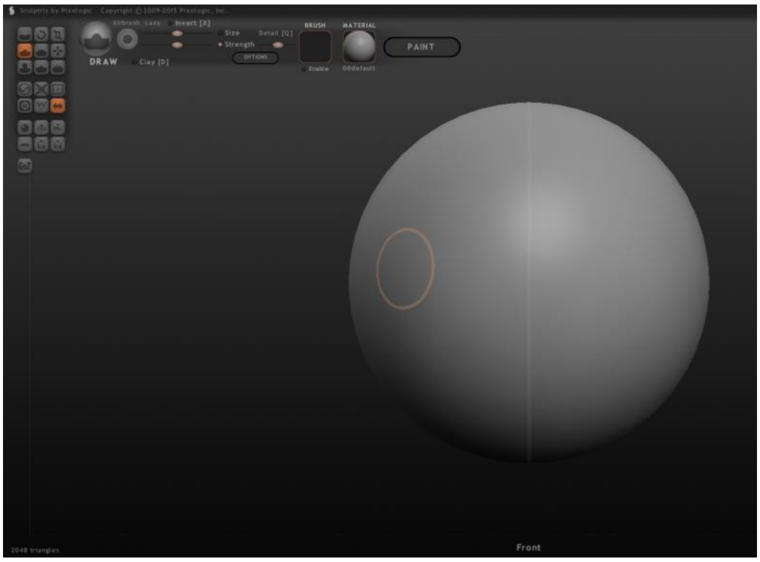
- Writing instruments;
- A sheet of paper;
- Computer;
- Internet;
- Sculptris program.

Steps to complete the task:

1. The assignment, the results to be achieved and the progress of the class are presented;
2. Examples are being sought on the internet. Children are encouraged to look at the works of other artists and the teacher shows them where to find them. It is mentioned that the works cannot be copied, they are just examples to get ideas from;
3. Sketches of the character you want to create are made. It is advisable to make several sketches so that you can choose and assess what is more realistic to create;
4. The Sculptris software, its technical specification and practical applications are presented;
5. The teacher shows examples of his work;
6. Each Sculptris tool is then demonstrated, the teacher explains how they work and additional settings. After being shown one of the tools, students also try them out to get a better understanding of how the software works and what it can do;
7. The first work is created together with the teacher to better understand the use of the software. The teacher shows the process of creating the figure step by step and explains each step. The students repeat the steps and thus create the first figure;
8. The second work is done independently. Students start modelling the figures according to their sketches. The teacher constantly monitors the process and helps if he notices that help is needed;

9. When the student has completed the task, the teacher assesses the performance and, if necessary, gives advice on how the work could be improved. Errors are clarified;
10. Once the figure is complete, the work is saved in .STL format, prepared for 3D printing and placed in the printer.

After completing the activity, students will have a deeper understanding of what 3D design and modelling is and how it can be used. Students will be able to create not only accurate architectural or engineering designs but also artistic 3D models. They will develop their creativity and have another tool that will put almost no restrictions on their creative freedom. The task helps students to further develop and grow because it is done independently, with the teacher acting as a guide and helper who can guide them towards a focused outcome.



Sculptris app user interface


Examples of figures on pencils

6. Task. Modelling a 3D board game piece in Sculptris.

Student age: 12-16 years.
Main topics: 3D printing, design, information technology, 3D modelling, art.
Duration: 90 min.

Key aspects of the task:

- Improving your knowledge of the management and use of Sculptris;
- Creativity training;
- 3D modelling;
- Applying 3D printing to different ideas;

Brief description of the task:

Developing knowledge of how to use apps requires setting bigger goals and finding meaning in the use of these tools. A board game can be a very big goal and needs to be pursued gradually. The first step in developing a board game is to create a game piece, which will allow you to both get creative and start developing the idea of a big project. This work will focus on meticulousness and fine-tuning of details.

Measures

- Writing instruments;
- A sheet of paper;
- Computer;
- Internet;
- Sculptris program.

Steps to complete the task:

1. The assignment, the results to be achieved and the progress of the class are presented;
2. It starts with a search for ideas. First, the teacher shows the examples he has created and suggests where to find more examples online. Students search for and watch trends in board games themselves;
3. Students develop their board game idea, choose a theme, set objectives and briefly describe them;
4. A sketch of a board game figure is made;
5. The teacher reminds the students of the Sculptris tools that will be used in their creation;
6. The first work is created together with the teacher to better remember the use of the software. The teacher shows the process of creating the figure step by step, explaining each step. Students repeat the steps to create their first board game figure;
7. The second work is done independently. Students start modelling the figures according to their sketches. The teacher constantly monitors the process and helps if he notices that help is needed;
8. When the student has completed the task, the teacher assesses the performance and, if necessary, gives advice on how the work could be improved. Errors are clarified;

9. Once the figure is complete, the work is saved in .STL format, prepared for 3D printing and placed in the printer.

At the end of the task, students will have their knowledge of 3D modelling and its applications increased. Such targeted tasks help students to be more motivated and to see a greater purpose in their work. Once they have sufficient skills, the students will be able to continue their work independently, developing and implementing the board game idea by creating a digital prototype and then materializing it into a real project.

Complex works examples

A simple example of a figure

A more complex example of a figure printed with a 3D printer