

LESSON 8

Aim of the cycle

To provide the conditions for students to develop creative thinking, acquire basic designing, visualization, spatial expression, computer designing skills; show the integrity and contextualization of engineering; use the acquired skills when designing certain objects and systems.

Objectives of the cycle

The objectives for students are:

- to get acquainted/ improve the application of engineering creative process while solving engineering problems;
- develop reading and visualizing skills of sight, sketches, visualizations;
- develop skills of engineering designing; learn how to design using various technical and programming tools;
- develop the skill to convey the structure, view and materialism of engineering objects, systems and processes; learn to convey proportions and scale;

Topic of the lesson Creation and implementation of engineering ideas using innovative technologies

Methods

Demonstration; use of presentations and / or digital learning objects; brainstorming; understanding students' experience; discussion; mutual teaching/ learning; (self) assessment; questions for reflection.

Materials

Presentations, examples of engineering creative works, educational presentation, computers, programming equipment - Autodesk 123D Design (or Blender, Autodesk Fusion 360, SolidWorks, Autodesk Inventor, SketchUP, MAYA, Autodesk 3DS Max etc., Cura (or SIMPLIFY 3D, Slic3r, Microsoft 3D Builder or others), Ultimaker 2/ 2+ 3D printer (or others regarding the needed parameters), material for 3D printing (3 mm, 60 g (1 unit) PLA filament), internet access.

Objectives

Discussing and analyzing examples you will find out what a module is, discuss using possibilities of modular compositions; using the computer programs (Autodesk 123D Design program, Cura or others), 3D printer:

- you will learn to design a 3D object, prepare a file for printing;
- you will print the detail using the 3D printer.

LESSON 8

Content

Chemistry and Bioengineering. Assessment of the use of natural resources in industry, analysis of samples. Investigation of chemical processes and materials properties, interpretation of practical application possibilities in solving engineering problems. The use of products of diverse origin in the immediate environment and industry, their environmental and health effects. Investigation of material degradation conditions, discussion of the practical application of possible anti-degradation measures. The simplest chemical pollution detection methods, measures. Mathematical concepts, models, methods, calculations used to solve engineering problems. Customizable products and simulation of their production.

Energy Engineering. Electronics and electrical engineering. Analysis of engineering elements, their construction and applications

Design and Civil Engineering. Examining examples of object design. Examples of architectural design, territory / environmental planning in urban engineering. Application of mathematical calculations in the design of engineering elements. 3D design, industrial design, analysis of their specifics and peculiarities of application. Planning and implementation of design processes and solutions. Natural element modeling and engineering application.

Computer Engineering. Construction of selected objects using computer tools, creation, editing, management and application of objects. Designing objects with computer tools, creating, editing, managing and applying objects. Creation and application of building and dynamic elements .

Engineering History and Philosophy. Analysis of engineering and environmental problems, analysis of their solution possibilities. Getting familiar with engineering as a discipline for meeting human needs. Discussion of engineering activities and social interactions. Description and interpretation of interdisciplinary problem in engineering disciplines. Investigation of engineering thinking and practical interaction. Discussion of the main issues of engineering science (the characteristics and purpose of the engineering product, interaction with the user and the external environment). Getting to know engineering hypotheses, test values and engineering. Analysis of engineering methods and their basic principles.

Modeling and management of engineering processes, business and economics. Resources of engineering products. Integrating into mathematics: project budget and its calculation. Project funding opportunities. The engineering products market in Lithuania and abroad. Analysis of product demand and supply.

LESSON 8

1. ACTIVITY. PRESENTING THE TOPIC (6 MIN.)

Activities

1.1. Elucidating the experience (2 min)

Questions for discussion:

1. What is the 3D printer?

/ The tool by which you can produce three-dimensional objects /

2. In which areas might the 3D printing technology be applied?

/ Production, creation of prototypes, medicine, food technologies, building engineering /

Useful info: What is 3D Printing? The definitive guide to additive manufacturing. [checked 2018 04 20]. Internet link:

< <https://www.3dhubs.com/what-is-3d-printing> >.

1.2. Reminding of the topic of the cycle (1 min.)

Cycle 3

DESIGN CHALLENGES AND ECOLOGY

1.3. Announcing the topic of a lesson and discussing the aim and the objectives (3 min.)

Topic. Creation and implementation of engineering ideas using innovative technologies.

The objectives of the lesson are raised and discussed.

Objective

Discussing and analyzing examples you will find out what a module is, discuss using possibilities of modular compositions; using the computer programs (Autodesk 123D Design program, Cura or others), 3D printer:

- you will learn to design a 3D object, prepare a file for printing;
- you will print the detail using the 3D printer.

Tip for the teacher

- Get students interested by visual material, questions and use the “Brainstorming” method.

Tip for the teacher

- During the discussion specific questions might be asked in order to get the right answers from students.

Tips for the teacher

- The aim and objectives are discussed with students.
- The students’ motivation is emphasized – why we concentrate on these objectives; e.g. it is useful in everyday activities, it is interesting, etc.
- The objectives should be not only discussed but it also be attempted to raise them together with students.

2. ACTIVITY. DISCUSSION (2 MIN.)

Questions for discussion:

- In your opinion, what should be done in order to produce an object using the 3D printer?

/ Firstly, an idea must be decided on; then an object must be designed using the 3D modeling program; the file must be prepared for printing and, finally, printed /

Tip for the teacher

- Brainstorming.

Tip for the teacher

- If no answer is provided, specific questions might be given.

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3. ACTIVITY. ANNOUNCING AND PERFORMING THE TASK (33 MIN.)

3.1. Announcing the task (3 min.)

Task

- To design a three-dimensional object using the computer program (Autodesk 123D Design);
- Prepare the file for printing (the program Cura) and print out the detail using the 3D printer.

3.2. Introduction for completing the task (2 min.)

Questions for discussion:

1. Which computer programs might be used in order to design three-dimensional objects?

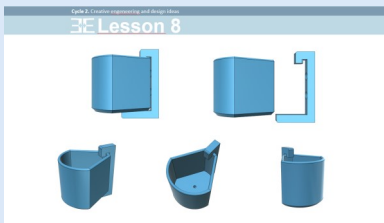
/ Autodesk 123D Design, Blender, Autodesk Fusion 360, SolidWorks, Autodesk Inventor, SketchUP, MAYA, Autodesk 3DS Max or others /

2. Can the created three-dimensional object created by the 3D program be printed at once with the 3D printer?

/ No, it is not possible. For 3D printers files of special format (.gcode) are needed, the programs to prepare the files for 3D printing, for example, Cura, SIMPLIFY 3D, Slic3r, Microsoft 3D Builder or others are also required /

3.3. Discussing the detail/ module (3 min.)

Students are shown the slide *Lesson No.8. Appendix No.1. Detail/module.*



Lesson No.8. Appendix No.1. Detail/module.

Question:

- What is this? Where could such form be used?

/ A flower-pot, decoration... /

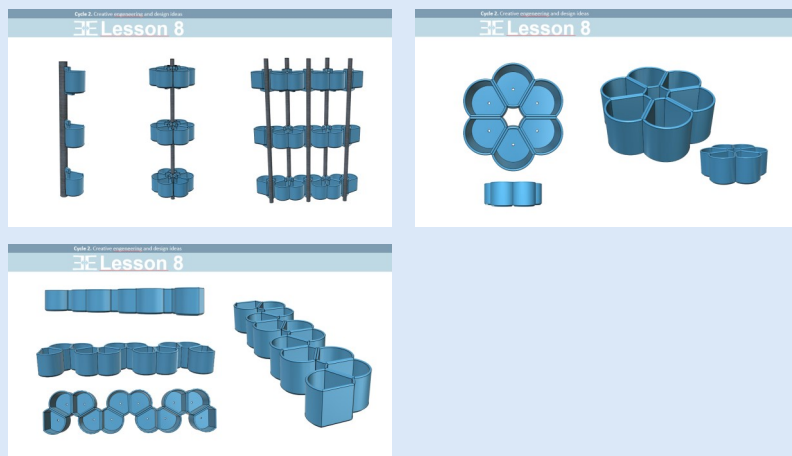
Summarizing: it is a detail-module, from which various objects might be constructed.

Module - a functional part (unit) of a particular assembly structure in a composition

Useful info ⓘ

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The teacher shows possible examples of the details / modules for joining / composing and discusses them with the students Slide *Lesson No.8. Appendix No.2. Modular compositions (Slides 1-3).*



Lesson No.8. Appendix No.2. Modular compositions

3.4. Performing the task (25 min.)

The work process is discussed.

It is indicated that completing the steps shown in the instruction, students will design and prepare the 3D object for printing.

Slide show *Lesson No.8. Appendix No.2. Modular compositions (slide 4)* and navigation in the program environment is discussed. *Useful info* ⓘ



Lesson No.8. Appendix No.2. Modular compositions

Students are suggested to open the presentation/film *Lesson No.8. Appendix No.3. Designing an object and preparation for printing*



Lesson No.8. Appendix No.3. Designing an object and preparation for printing

Recommendation

As the printing of one 3D detail takes from 4 to 5 hours, provide a possibility for students to print details during the free time after the lesson.

The details might not be printed right now (if students need the details during the lessons 9-12, they will print them out later).

Tip for the teacher

- *The possibilities of engineering creation are emphasized.*

Tips for the teacher

- *Teacher consults the students or perform the task together if there is a need.*
- *Time management is emphasized.*

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4. ACTIVITY. DISCUSSION OF WORK RESULTS, REFLECTION

(4 MIN.)

Students discuss their work results.

REFLECTION. Students' assessment and self-assessment, how they succeeded to achieve the objective of the lesson, what the personal progress of each student is.

Questions for reflection:

1. What did I do during the lesson?
2. How (in what way) did I learn?
3. What did I do the best?
4. What was the most difficult?

Tip for the teacher

- A teacher should encourage a student to think and comprehend what things, in what way she/he was learning and what they learned.

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


TERMS AND USEFUL INFORMATION

Module – 1. In technologies, an autonomous unit of an electronic device performing a certain function; 2. In the composition, a functional component of a specific assembly structure.

Modular Systems Design [checked 2018 04 20]. Online access:

< <http://complexitylabs.io/modular-systems-design/> >.

Navigation in the program environment Autodesk 123D Design:

NAVIGATION	
PAN	 (Press and mouse drag)
ORBIT	 (Press and mouse drag)
ZOOM	 (Scroll the wheel)

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SOURCES

Modular Systems Design [accessed, on 2018 04 20]. Internet link: < <http://complexitylabs.io/modular-systems-design/> >.

What is 3D Printing? The definitive guide to additive manufacturing. [accessed, on 2018 04 20]. Internet link: < <https://www.3dhubs.com/what-is-3d-printing> >.

Octobot: A Soft, Autonomous Robot. [accessed, on 2018 04 25]. Internet link: < <https://video.search.yahoo.com/yhs/search?fr=yhs-skylikes-newtab&hsimp=yhs-newtab&hspart=sylikes&p=octobot+robot#id=2&vid=6dec3419f4b55d12f60d60168a724532&action=view> >.

123D Design Tutorials by Library 21c [accessed, on 2018 04 20]. Internet link: < <https://www.youtube.com/playlist?list=PLdF-Obl6Qmeu4GXQ8ltpXcvWiJtpqLYtw> >.

BASED ON

Specializuoto ugdymo krypties programa (pradinio, pagrindinio ir vidurinio ugdymo kartu su inžineriniu ugdymu programų) inžinerinio ugdymo dalis, patvirtinta Lietuvos Respublikos švietimo ir mokslo ministro 2014 m. rugpjūčio 8 d. Internet link: < <https://www.smm.lt/uploads/documents/svietimas/ugdymoprogramos/isakymas%20del%20inzinerines%20programos1.pdf> >.

Žodžio modulis reikšmė. [accessed, on 2018 04 20]. Internet link: < <http://www.lietuviuzodynas.lt/terminai/Modulis> >.

Robotai tampa gyvomis mašinomis. Žurnalas „Iliustruotasis mokslas“. 2017 m. Nr.5