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Erasmus+ KA2 Strategic partnerships for school education project
“How to Raise an Inventor. Technology and engineering learning material for schools”

Project no.: 2017-1-LT01-KA201-035284

**MODULE DESCRIPTION AND
RECOMMENDATIONS FOR TEACHERS**



Name of the module	Create an Arm Wrestling Robot
Creators	<u>Robotikos Mokykla (School of Robotics), Lithuania</u>
Main topics	3D modeling, printing and dynamic load testing, intuitive physics and mechanics.
Available in these languages:	English, Dutch, Polish, Lithuanian, Latvian
Recommended age group	7-19 years old
Length of the course	<p>Fusion 360 and Solidworks: 3 intro lessons, 45 minutes each 12 main lessons, 45 minutes each, split into tasks for two lessons at a time (6 objects in total) 1 additional lesson for quicker students or teacher's convenience to use as fit</p> <p>Solidworks Apps for Kids for elementary schoolchildren: 12 main lessons 45 minutes each, split into projects that take two lessons to finish, and into projects, at least 3 every 45 minutes lesson. Additional project added in the beginning to introduce to crafting from 3D models.</p> <p>Apps for Kids course has an extension using Design Thinking methodology.</p>
Duration of each lesson or project	<p>Each project should take approximately 1,5h to finish. Each project is divided into lessons approximately 20 minutes long.</p> <p>When schoolkids are able to finish lessons earlier than planned, it is recommended to offer the additional lessons as well as challenges to continue on their own adding movement and features to the part. Individual lesson additional tasks are provided at the end of the lessons.</p>
Required hardware	<ul style="list-style-type: none"> ● PC for each child capable of running 3D modelling software, ● Internet connection to load lessons from play.gaminu.eu, ● 3D printer, ● A device to destroy 3D printed objects while testing (optional).
Required software	<p>You are able to choose from three tools of 3D modeling:</p> <ul style="list-style-type: none"> ● Autodesk Fusion 360. Note that schools and students are able to get this software for free. Libraries, under current licence are not able to use the software if their income is above 200 000€. ● SolidWorks is very similar in usage to Fusion 360. Solidworks Education is free for schools and libraries in Lithuania. FabLabs are able to use Solidworks free of charge too. ● SolidWorks Apps for Kids– free online 3D modeling and mechanical movement simulator platform for elementary schoolkids. ● 3D printing software to convert models to 3D printer commands (a slicer). We use Cura.
Required skill level (pupils)	Beginner
Required skill level (teachers)	Beginner, but preferably interested in 3D modeling and digital manufacturing.

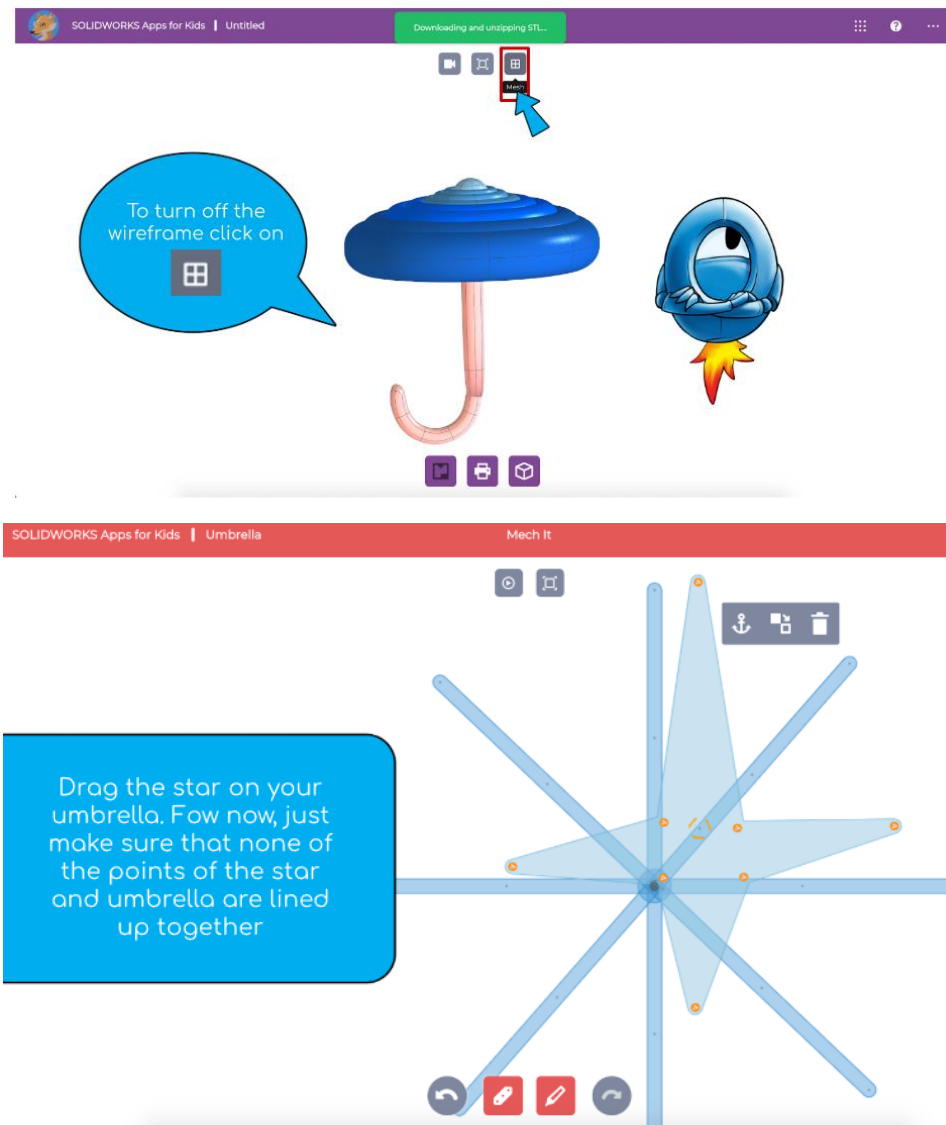


<p>Skills developed in the module</p>	<table border="1"> <tr> <td>Technological and engineering</td> <td>★★★★</td> </tr> <tr> <td>Creativity</td> <td>★★★</td> </tr> <tr> <td>Critical thinking and problem solving</td> <td>★★★★</td> </tr> <tr> <td>Communication</td> <td>★</td> </tr> <tr> <td>Intuitive use of complex tools of engineering</td> <td>★★★★★★</td> </tr> <tr> <td>Grown interest in STEAM subjects</td> <td>★★★★★★</td> </tr> </table>	Technological and engineering	★★★★	Creativity	★★★	Critical thinking and problem solving	★★★★	Communication	★	Intuitive use of complex tools of engineering	★★★★★★	Grown interest in STEAM subjects	★★★★★★
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<p>What pupils will learn?</p>	<p>To create a 3D object from scratch, test dynamic loads in 3D space; think of 3D structures from the perspective of strength, learn about components and processes involved in 3D printing. Pupils will get knowledge in physics such as static, dynamic loads, materials, mass, and acceleration. The students are not required to calculate physics formulae during the course, but the simulation and real-world testing scenarios allow additional tasks of calculation.</p>												
<p>The structure of the course</p>	<p>The module is prepared for 3 different 3D modelling programs: 1. SolidWorks Apps for Kids - for younger and beginner pupils; 2. Fusion 360 and SolidWorks for elder pupils. All three versions have almost the same tasks. Lessons are introduced by illustrated characters of a scientist and his team. Each lesson is accompanied with a teacher's guidebook helping to prepare for the lesson, mentioning the FAQ, and suggesting tasks for more engaged students. First, we introduce students to the interface of the software and basic tools to start making 3D models. The lessons in this part introduces students to safe usage of machinery that builds and that which destroys. Main lesson objects to model are: skyscraper; dome; hook; hammer; helmet; robot arm gripper. We have also made an additional lesson for quicker students.</p>												
<p>What is different about this teaching material comparing to others for the same topic?</p>	<p>There are no 3D modelling and 3D printing courses implemented in public schools as of this day. This course was created and specifically directed to students of described ages. Our course is exceptional in engaging students' curiosity showing how objects break down. Capturing this attention, we show them how to build stronger ones, model and prototype.</p>												
<p>What teaching materials do pupils get?</p>	<p>Learning material – Slides with integrated video parts in our online learning environment. Illustrated story line introducing the tasks -- integrated into the lessons in the online learning environment, also available as a printable PDF file.</p>												
<p>What teaching materials do teachers get?</p>	<p>Teachers guidebook – PDF, printable. Course manual (for students) – online step-by-step presentations. Printable if needed.</p>												
<p>How to reach the material?</p>	<p>Go to play.gaminu.eu select your preferred language, seek for the category "How to grow an inventor". If the teacher and students are comfortable we recommend English because the tools are being used in English and we are updating the English version with additional clarifying remarks and steps quickest.</p>												



Examples of the material

Solidworks Apps for Kids for elementary school kids lesson samples:



Fusion 360 teacher's guidebook:



5-6 lessons. HOOK

DURING THE LESSONS:

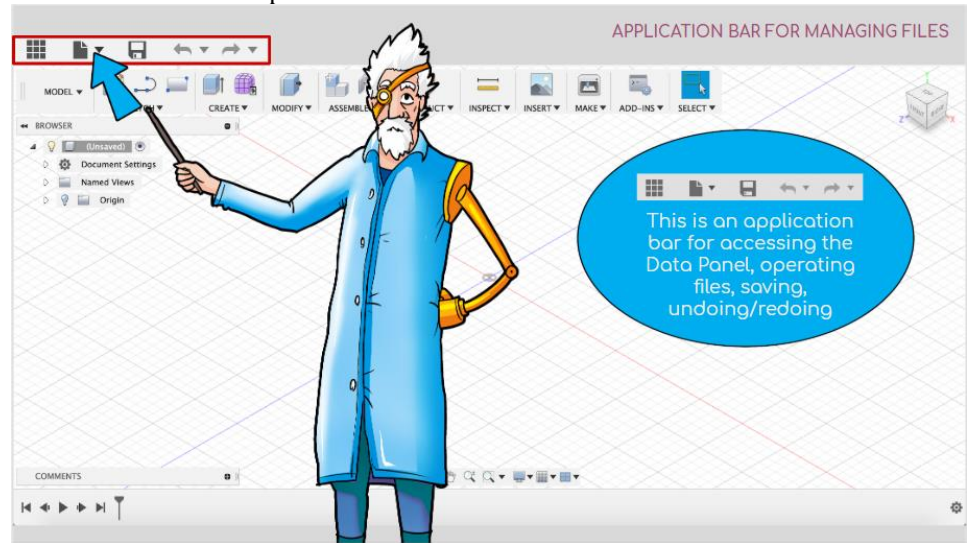
During the lessons students repeat modelling process using most of the sketch tools from previous lessons, as well as performing static simulations. They also explore a new tool called *Sweep* from the Create menu. This tool is more complex than the Extrude tool. It is used to create a solid surface by sweeping closed loop sketch along the selected path.

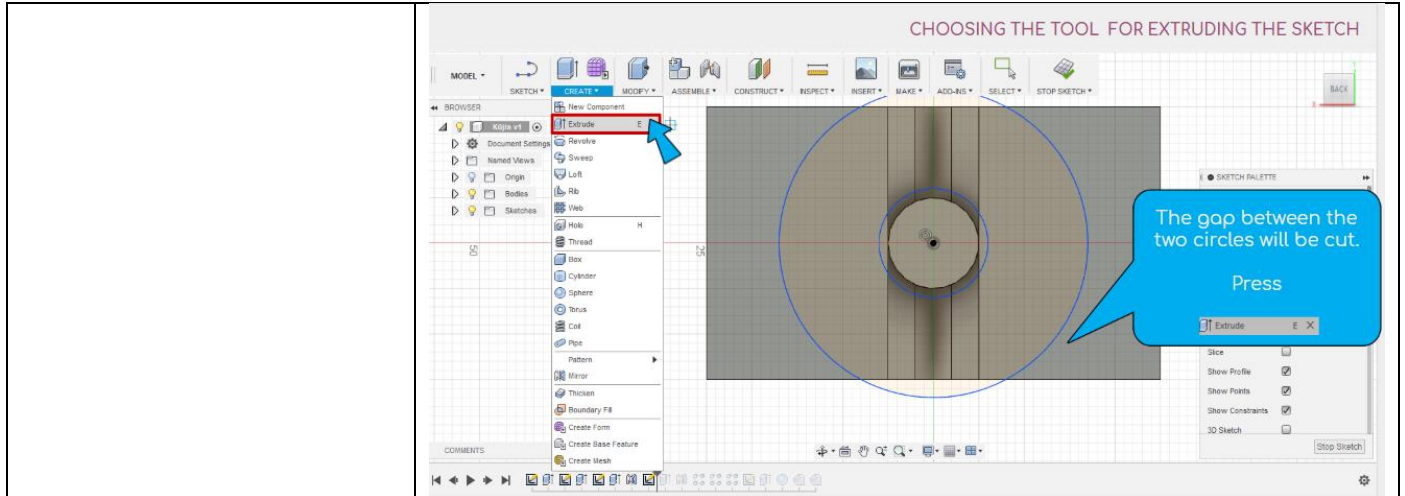
AIM: to design a hook with a hole for hanging and to complete the drag simulation, dragging the hook down with a force of 30 N. The received results should be analyzed, the model's construction, if needed, should be changed and then the simulation has to be repeated.

PREPARATION FOR THE LESSONS:

The dome's model, which was designed during the 3-4 lessons, is printed out (the printing process is expected to take about 4,5 hours) and the breaking tool is prepared for the demonstration. The modular city which was built during 3-4 lessons and another model of the dome (which will become a part of the city) are also prepared for demonstration. Students have an opportunity to rebuild the city. After the lesson the models, which proportions are the most similar to the sample model designed during the lessons, and which simulation results correspond to the task, are saved in the .STL format (MAKE > 3D Print > the chosen model > OK) and printed out. It is recommended that after 12 lessons each student would have at least three printed objects of his/ her own design.

Fusion 360 lesson sample:





Intro and outro comic character sample. The comics introduce each lesson story:





Recommended projects	Spaceship, helmet, dome, glasses could be more interesting and more important lessons providing practical and interesting tasks.
Organization of the course	The course is divided into a project to be finished in 3 hours. Please allocate time for 3D printing after each project. We suggest controlling the size of the objects being designed. 2x larger length gets you an 8x longer 3D print. Leave time for 3D printing, teach children to 3D print and clean the printers on their own.
For teachers with no prior experience in the topic	We recommend a separate course about 3D printing if the teacher is not well versed in it yet. We have prepared an intro to 3D printing course to be found at: cnc4change.org English version, Level 3, Workbook, Additive manufacturing series. Also recommended: https://ultimaker.com/en/resources/23099-unboxing
Additional material for teachers	https://www.solidworks.com/more-software-its-community Upload your designs and download interesting ones at: https://www.youmagine.com https://www.thingiverse.com https://grabcad.com
Suggested next topics for pupils to get into after this course	After completion of this course the students should be engaged in 3D modeling, printing, simulation and general engineering activities. We suggest to ask the nearest university and engineering clubs about partnering on student competitions, participating in hackathons, finding help finding the nearest student mechanics, robotics, engineering competitions.
Support	If you need assistance with the module, please contact us at info@gaminu.eu . We would also be happy to receive your feedback about the module, photos and videos of using our learning material in your classes. We would be glad to receive partnership proposals and inquiries on continuing the module development.