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We are the makers - IoT Learning Scenario
parametric vase

1. Title of the Scenario	**Parametric vase**
2. Target group	14 - 18 years
3. Duration	min. 3 hours
4. Learning needs which are covered through the exercise	- Using basic programming to 3d model - Exploring a parametric design space - Seeing some geometrical surfaces get 3d printed - connecting an abstract mathematical formula to a real object - Artistic exploration (using code, rather than sculpting or CAD modeling) - There is no right solution, but also no 'better' solution. Discussing how quantifying the quality of a product is often 'fuzzy'. Imagine product design - Basic 3D printing skills
5. Expected learning outcomes	- Basic coding skills - Testing of developed solution - what is the correlation between the digital model and an object which can be 3d printed? are there fabrication limits and do they inform the design process? - Improving design through iteration loops - Introduction to concepts of creative coding and advanced 3d modeling - Understanding the work process of product design - from design to production and market
6. Methodologies	In this learning scenario the students will be and 3d printing a vase by using basic code to 3d model an object This will be tested on one parameter: a. at the end of each design iteration, the product designers will have a vernisagge where each will present their product to their classmates and try to sell the vase they have made. The assessment is made on how many vases are sold by each student Students will improve their design over two or three iterations so that they get to explore the effect of minor changes in code to produce geometry. This learning scenario allows students to discover powerful and complicated ideas through playful and self driven learning towards the subject matter. As a teacher your role will be to provide questions to make the students reflect on their process (i.e. - what is an extrude function? what is an offset), as well as getting them in a mindset of artistic exploration on using maths and computer science
7. Place / Environment	Classroom with 3D printers, Makerspace, FabLab or similar

8. Tools / Materials / Resources	- projector; - 3D printers and equipment (spatulas, pliers, tweezers, bed adhesive etc.); different flexible or elastic 3d printing filaments; - computers with the following software: OpenScad, a slicing software (which has preferably an option to print in vase mode); - printed handouts;
9. Step by step description of the activity / content	1. Students will work individually and will take turns to use the 3d printer(s) 2. Give the students the design prompt, make sure to let them know that they are expected to experiment with creative coding, so they will not think they need to finish something as soon as possible. Also make sure to let them know that the final products will be assessed by: a. after each design iteration, there will be a vernissage where all students present their work to the classmates and sell their vase 3. When the first print is done talk about the correlation between digital product and manufactured piece. What is an extrude and what is an offset (these concepts are among the most common functions in CAD modeling)? 4. When the first round of vases have been printed, help your students group to organize a vernissage with the sales pitch. 5. You can encourage your students to reflect on the outcome with questions such as: a. What makes a 'good' quality 3d print (layer height, support or no support, number of contour lines, weight of object, size of object, organic vs. straight line shape grammar)? b. What makes a 'good' design for 3d printing? 6. Now have the students improve their design of the vase, and repeat the process as many times as possible within the time constraints of the day. Encourage them to modify the code themselves by adding different functions as opposed to simply playing with the parameters in the beginning of the code.
10. Feedback	a. The number of stress balls sold by each student during the vernissage is quantifiable.
11. Assessment & Evaluation	In the end, the best project is the one which sells the best. talk about the importance of a sales pitch in relation to the quality of a product - hiw important is how someone presents something vs. what a certain product looks like? Which shapes were most preffered? organic (wavy). Talk about the different aspects of design to production to market.