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

Keychain

SHORT DESCRIPTION

Ask students to create a keychain with your school's name on it. While creating the keychain the students will continue working on the 3D modeling software, FreeCAD and will learn new commands and features. After finalizing the keychain, depending on time, ask them to prepare a gift keychain for someone they want or for themselves.

RATIONALE

This is the second activity that aims to improve students' ability to use the 3D modeling software (FreeCAD in this case) as well as the basics of 3D printers. With this activity, the students will learn different commands and features of the software. Students will design and print a more complex 3d object; a keychain with their school's name.

STUDENT BACKGROUND

- Students need to have basic computer skills.
- Students need to know the basic commands and features of the FreeCAD software.
- Students need to know how to use Cura software for 3d printing.

OBJECTIVES

After this project, students will be able to

- Use basic commands in "Part Design" workbench of FreeCAD.
- Create text string in shapes in Draft workbench of FreeCAD.
- Apply the constraint tools in FreeCAD.
- Use "padding" feature of the FreeCAD.
- Create a keychain with given specifications.
- Explore arc concept.

STEAM CONCEPTS

Technology, Arts and Mathematics

PROCEDURE

1. **Understand the challenge:**
   - Inform students that they will design a keychain with their school's name using FreeCAD. Ask them how they can design this keychain using FreeCAD.
   - Distribute the worksheets to the students. Make sure that students pay attention to the dimensional specifications of the keychain given in the worksheet.

2. **Brainstorm:**
    - Let students discuss what they expect from this experience and what are the possible challenges.
    - After they identified the possible challenges, encourage them to discuss how they will overcome these challenges.
3. **Sketch:**
    - Tell students if they want to, they can make sketches on a milimeter grid paper to make the final design clear on their minds. However, since this is one of the initial activities and all dimensions are specified in the student worksheet already, this step is optional.
    - Introduce students the FreeCAD software. Guide students to follow the instructions given in the worksheet and start designing the keychain.
    - Tell students that the student guide is based on the text “MAKER” and if they want to they can replace this text with a different name preferably less than 8 characters.
4. **Build & Test:**
    - After the students finished modeling the keychain, make sure that they save it. Then, ask them to create an STL file. Use Cura to finalize the STL file for printing.
    - Start the printing proces in the 3D printer and observe.

      Please review the approximate printing durations given in this document. If you have limited time, please consider re-scaling the object in Cura, so that printing duration is shorter.
5. **Evaluate:**
    - Ask students whether they get the design they planned or not. If not, ask them what may be the reason behind the difference(s) between their plans and final products.
    - Encourage students to evaluate their own performance throughout the process.
    - Discuss the difficulties (if there is any) students faced while designing and printing.
6. **Improve & Redesign:**
    - If all groups/students are happy with their final products, ask them what kind of different features might be added to their current designs.
    - If they are not satisfied with their design, ask them what might have gone wrong and encourage them to try again.
    - If enough time is left, as an extension activity, student can prepare a gift keychain for someone they want or for themselves.

* **Share:**
    - Throughout the process, encourage students to openly share their ideas with their group members and other groups. Students should be able to give and receive feedback from each other and their teachers any time they need to.
    - After all students/group finalize their designs, give them time to present their products to each other and share their experiences.

APPENDICES

Worksheet and step-by-step guide.

TIME NEEDED TO PRINT

The following table includes approximate durations for printing the objects. Please note that the durations given below are approximate and may vary based on many factors, including the model of the printer and the quality options of the printing task. Please check with Cura for a more accurate estimate of duration in your equipment.

Infill density	Approximate duration
Light	50 min
Dense	50 min
Solid	1 hr.

3D PRINTED SAMPLES

Declaration

This document has been prepared in the context of the MakeITReal project (Output 2). Where other published and unpublished source materials have been used, these have been acknowledged.

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Funding Disclaimer

The MakeITReal project has been funded with support from the European Commission under the ERASMUS+ Programme, KA2, project number: 2016-1-PL01-KA201-026492. This communication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.