TEACHER TRAINING IN VISUAL CONTENT

3D PRINTING

Biol. Prof. María Zoe Maldonado Vélez

e-CLOSE

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

Lodz University of Technology

Universidad de Alcalá

htw saar
Hochschule für Technik und Wirtschaft des Saarlandes
University of Applied Sciences

universidade de aveiro
theoria poiesis praxis

UNC
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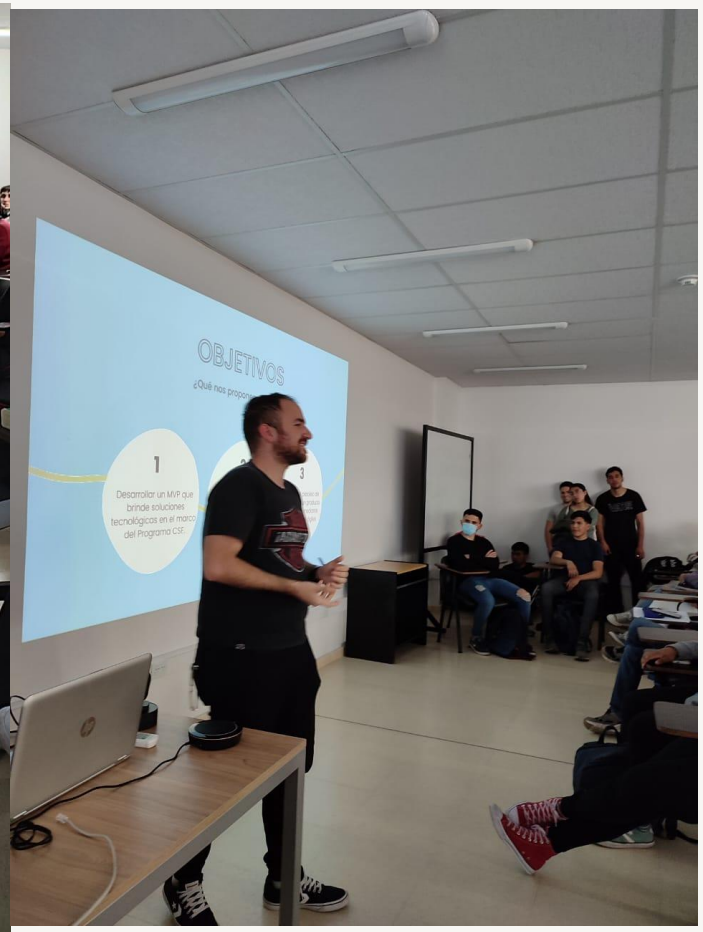
SCHEDULE

13-14 hs

3D Printing in Education

Introduction to 3D modeling software



14-15

Introduction to 3D Printers

15 - 15.30

Interactive Visit to a Print Lab

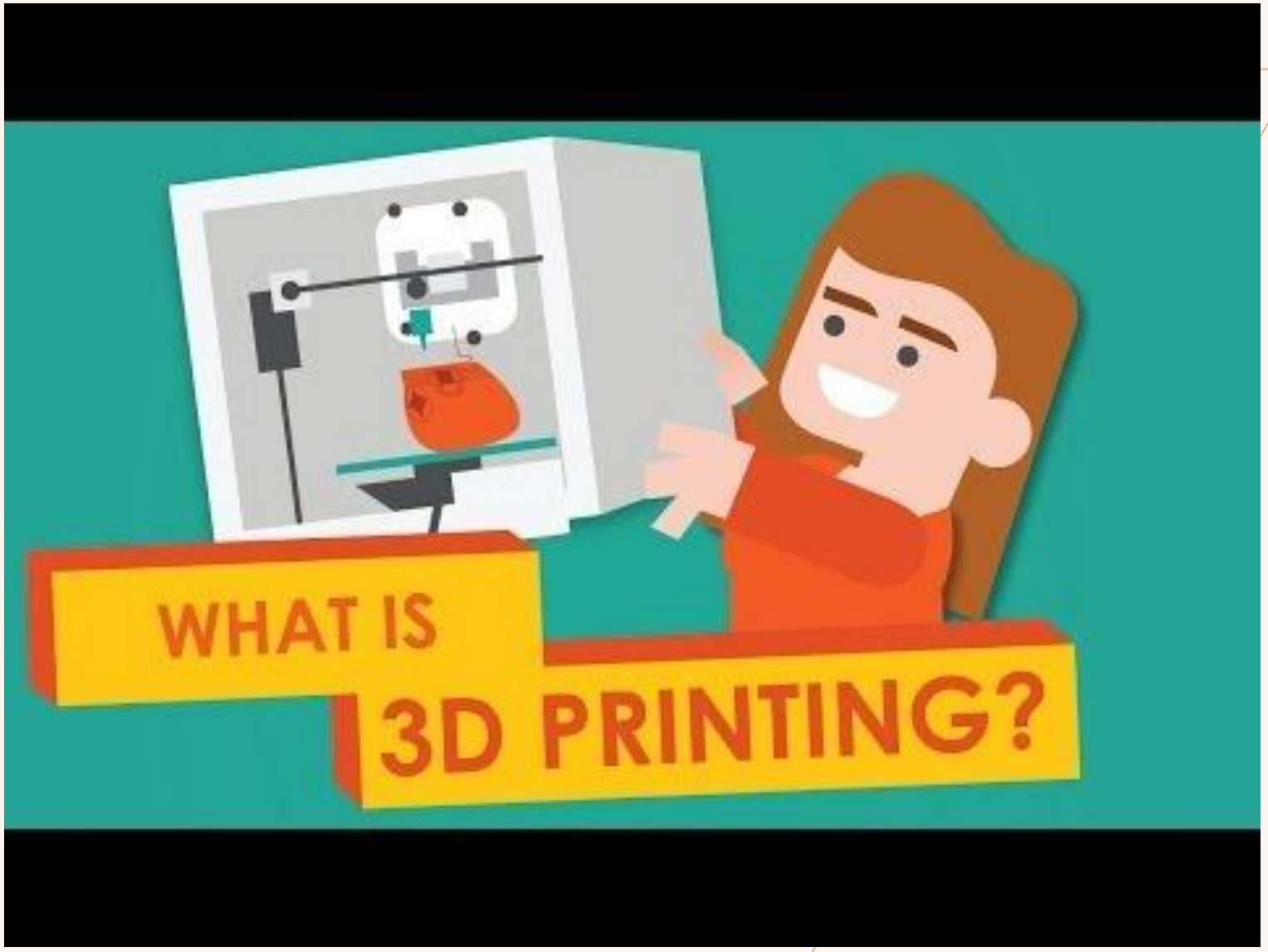
15.30 - 16

Frontexts: Visual Poetry

WHERE WE COME FROM

UNC Universidad Nacional de Córdoba

GENERAL VIEW 3D PRINTING



EDUCATIONAL USES

To teach students about 3DP

To teach educators about 3DP

To teach design and creativity skills and methodologies

To produce artefacts that aid learning

To create assistive technologies.

Additive Manufacturing 25 (2019) 131–150

Contents lists available at ScienceDirect

Additive Manufacturing

journal homepage: www.elsevier.com/locate/addma

Invited review article: Where and how 3D printing is used in teaching and education

Simon Ford[a,b,*], Tim Minshall[a]

- **they can facilitate learning**
- **develop skills,**
- **increase student engagement;**
- **inspire creativity,**
- **improve attitudes towards STEM subjects and careers,**
- **while also increasing teachers' interest and engagement**

Table 4
Subjects in which the use of 3DP has improved student understanding of a topic.

Subject	Topic(s)	Educational context
Biology	Biological molecules	Community college
Chemistry	Atomic structure	High school
	Protein structures	Upper division undergraduate
Design	Co-design and sustainability	Lower division undergraduate
Engineering	Foundations of engineering	Undergraduate
	Material properties	Undergraduate
	Computer-aided simulation and design	Lower division undergraduate
	MEMS design	Upper division undergraduate and postgraduate
Mathematics	Geometry	Middle school
Pharmacology	Enzyme and ligand structures	Upper division undergraduate

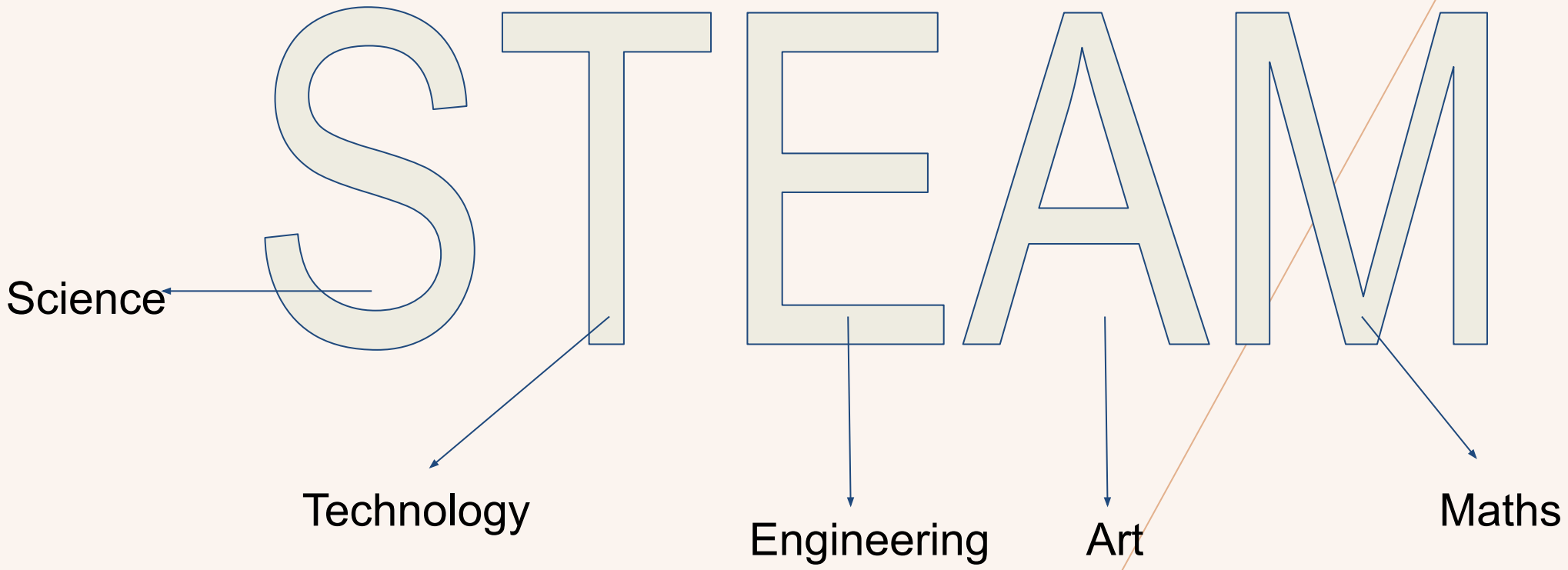
Table 5
Summary of subjects in which 3D printed artefacts are being used to support learning.

Subject	3D printed artefact(s)	Source(s)
Anatomy	Airway models	[270]
	Bones	[31,263,267,289,290]
	Femoral artery	[262]
	Heart	[258,260,261]
	Limb sections	[262,268]
	Lungs	[290]
	Oral surgical model	[269]
	Orbital dissections	[257]
	Prosected human cadavers	[36]
	Skeletal tissues	[255]
Arts	Cultural heritage models	[291]
Biochemistry	Macromolecular structures	[292]
Chemistry	Atomic structure	[293]
	Copolymer nanostructures	[282]
	Crystals	[273]
	Crystal structures	[280,285,287,288]
	Free energy surfaces	[276]
	Hydrogenic orbitals	[274]
	Molecular structures	[281,284,286,288,294]
	Orbitals	[279,294]
	p orbital isosurfaces	[272]
	Potential energy surfaces	[271,276,277,283]
	Reaction progress surfaces	[275]
Dentistry	Cavities	[295]
	Prosthodontic models	[88]
Geosciences	Digital terrain models	[14]
Mathematics	Geometric models	[296,297,298,299,300,301,302]
Paleontology	Extinct shark teeth	[80]
Physics	Mechanisms	[303]
	Mie scattering apparatus	[304]
Zoology	Marine biology specimens	[305]
	Nematodes	[306]

Table 1
Summary of university courses into which 3DP teaching has been actively in
tegrated.

Subject	Source(s)
Computer graphics	[111]
Design and manufacturing with polymers	[162]
Engineering design	[118]
General engineering	[114,163]
Graphic design	[113]
Industrial engineering and business	[85]
Informatics	[164]
Mechanical design and manufacturing processes	[117]
Product and industrial design	[34,165]
Product development	[166]
Product realization	[115]

3D PRINTING IN EDUCATION



3D PRINTING IN EDUCATION - Science & Engineering

Fig. 45.2 Students testing the weight a 3D printed boat could hold using pennies

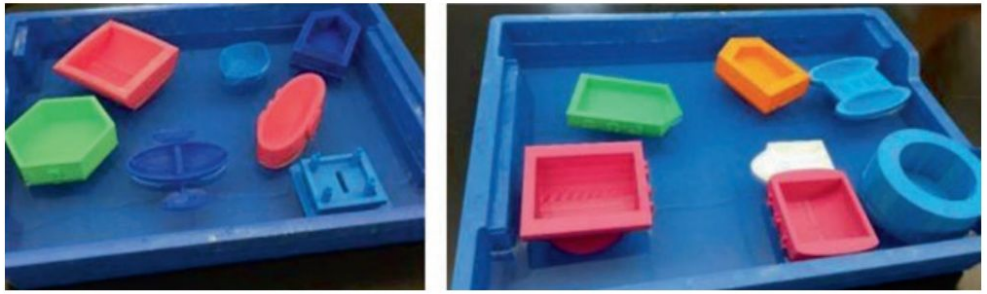


Fig. 45.3 Examples of 3D printed boats created by prospective elementary teachers

Using 3D Printing in Science for Elementary Teachers
Elena Novak and Sonya Wisdom

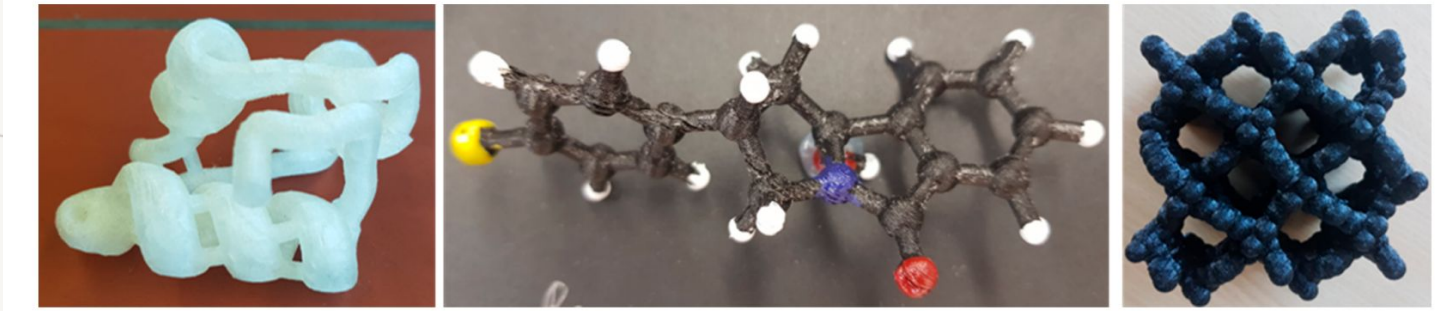
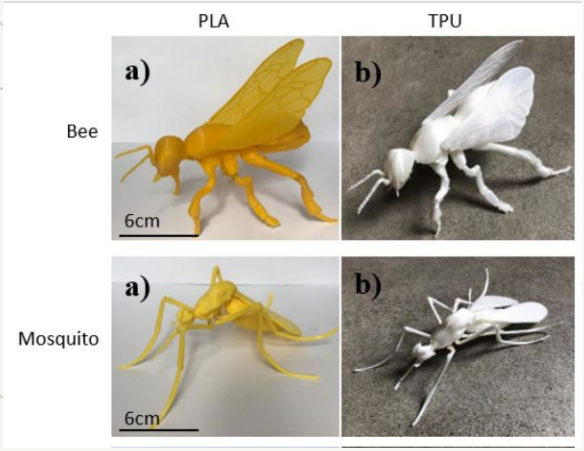
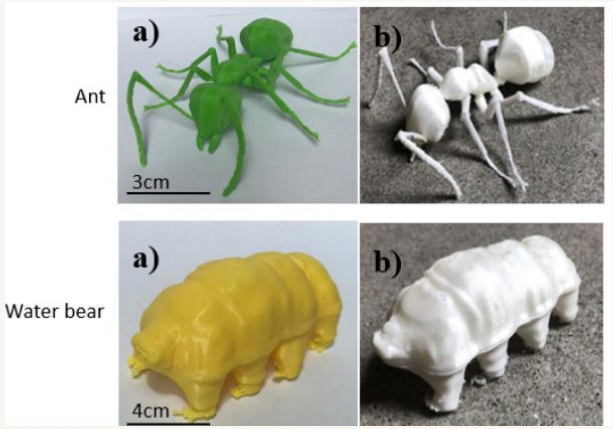


Figure 1. 3D-printed molecules, from left: the tertiary structure of the protein insulin, molecular structure of a photoredox-active dye phthalimide, and the crystal structure of a metal–organic framework (MOF).

Think and Print: 3D Printing of Chemical Experiments
Melissa Renner and Axel Griesbeck

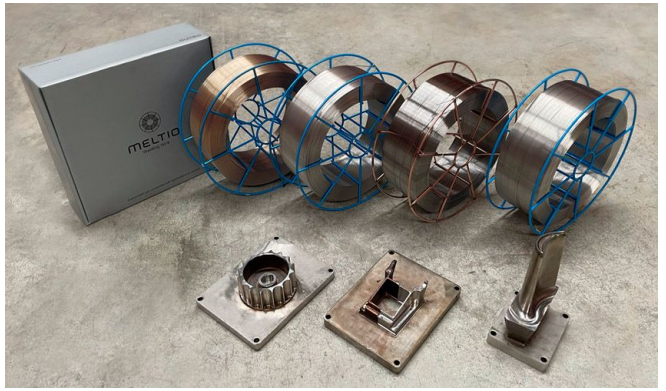




A Combined Strategy of Additive Manufacturing to Support Multidisciplinary Education in Arts, Biology, and Engineering Henry A. Colorado1 · David E. Mendoza1 · Fernando L. Valencia

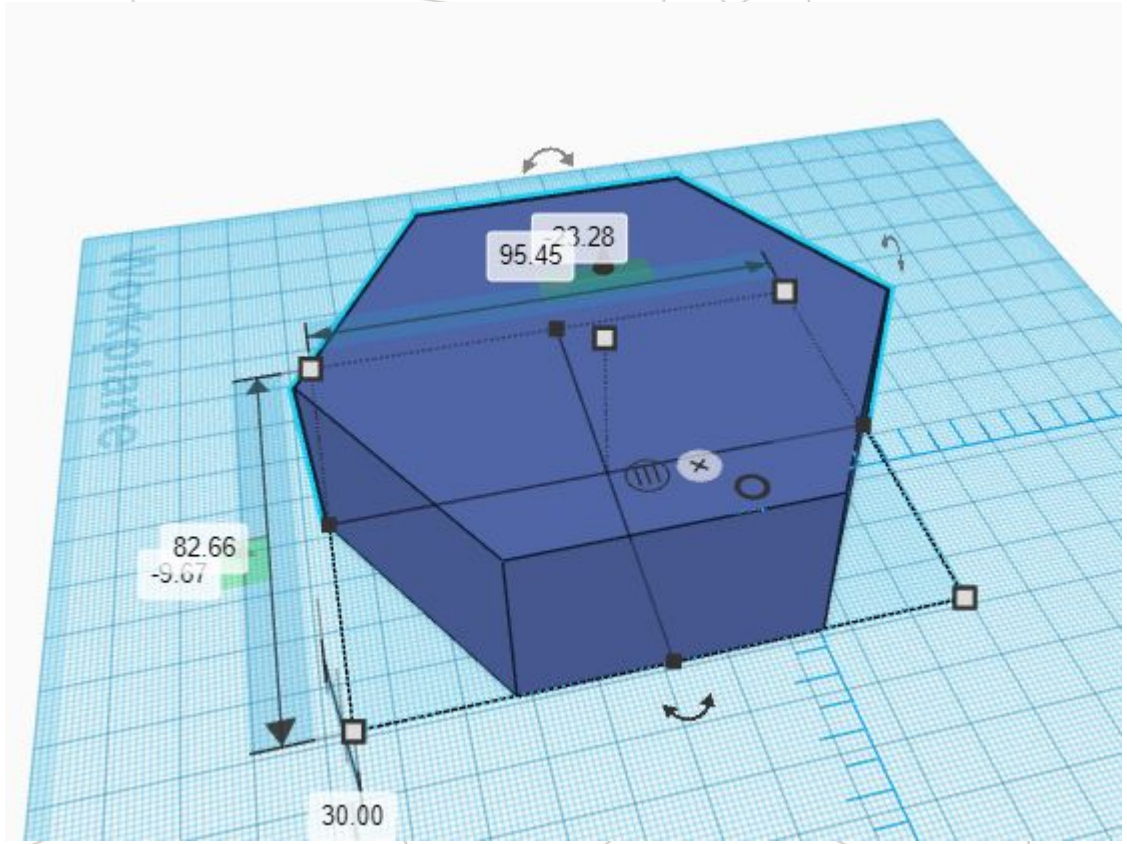
3D PRINTING IN EDUCATION - Technology

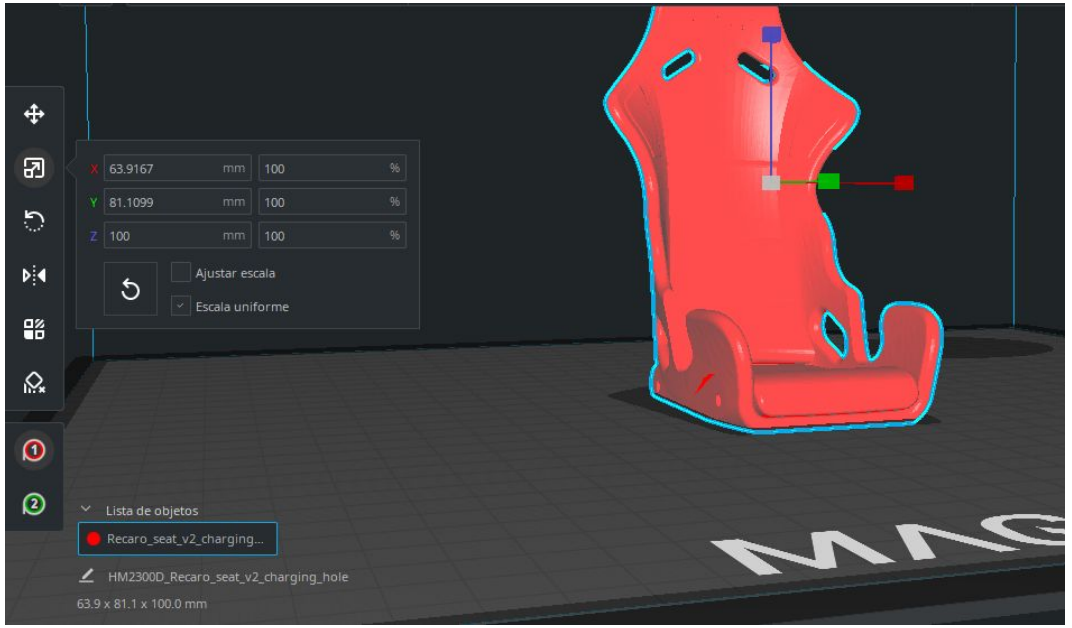
Different kind of materials for all of the projects specifications



3D PRINTING IN EDUCATION - Arts

3D PRINTING IN EDUCATION - Maths



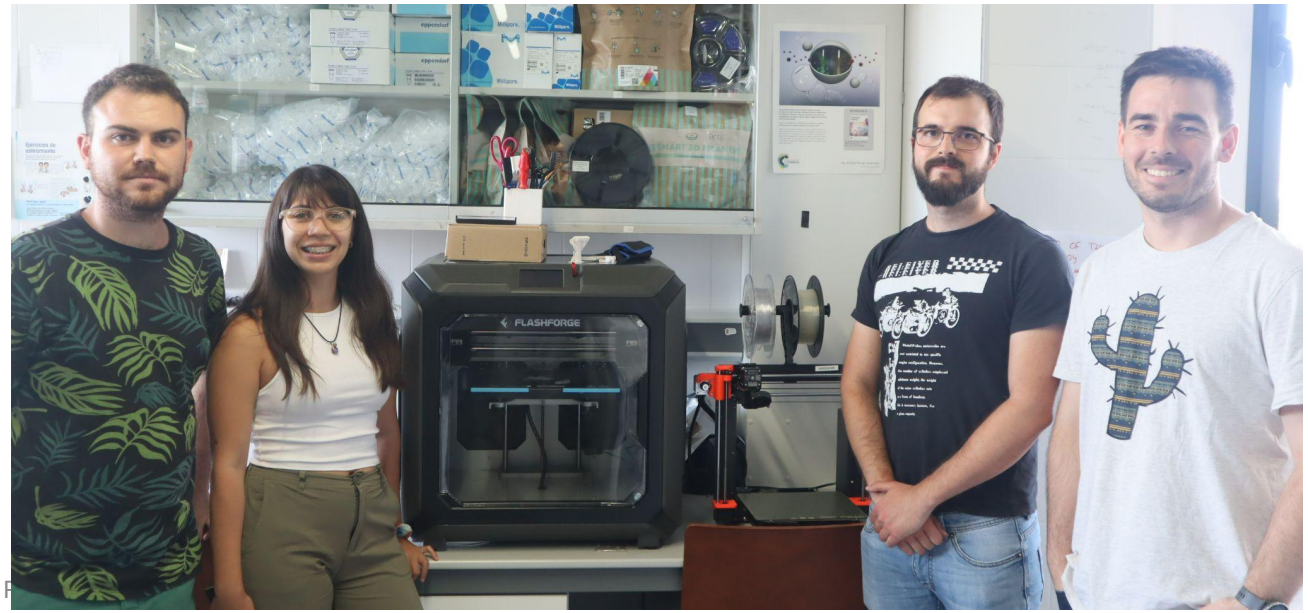


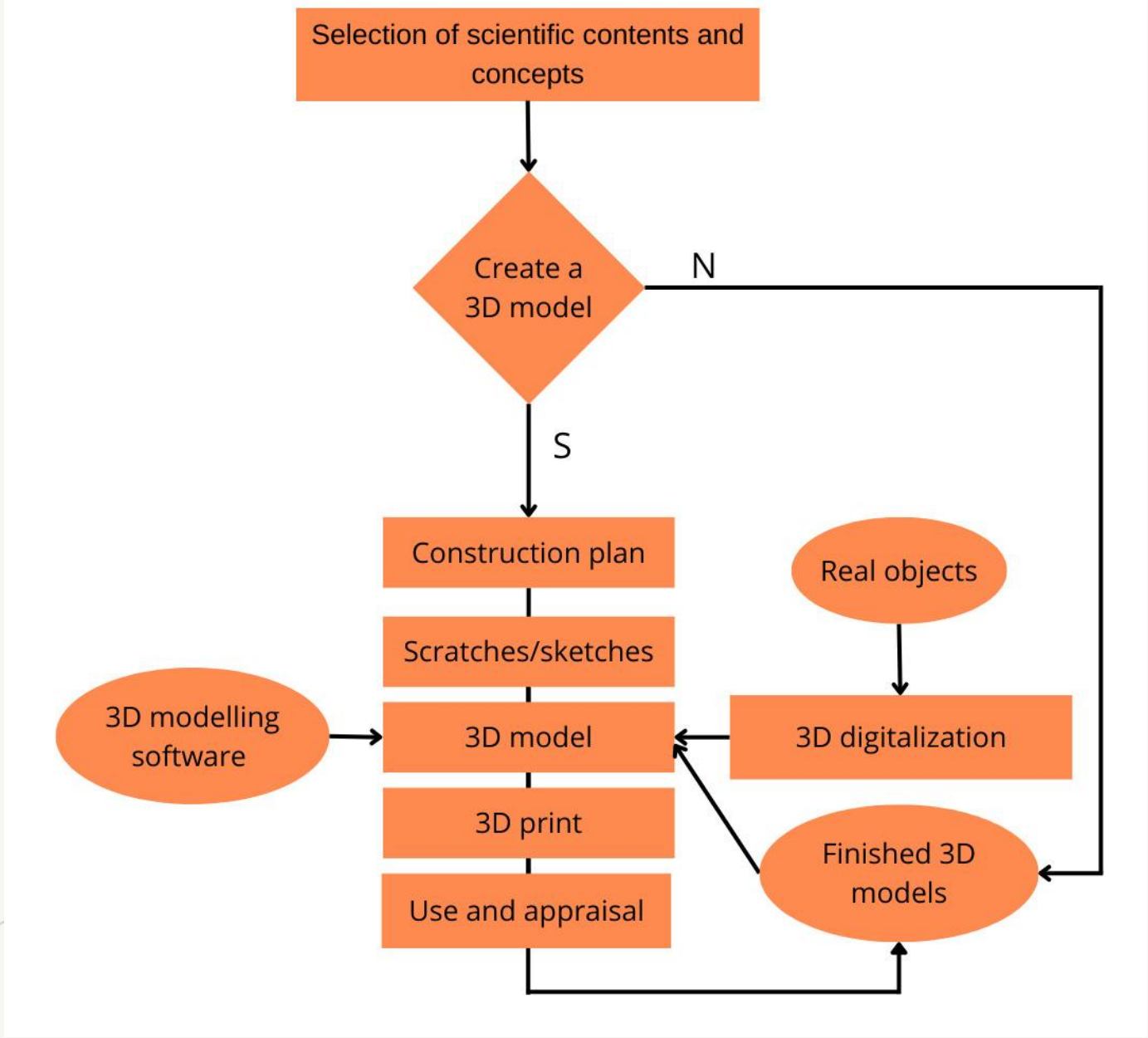
3D PRINTING OVERVIEW

CREATING OR GETTING THE 3D MODEL

PREPARING THE 3D MODEL

RUNNING THE MACHINE





Process of using 3D printing to build didactic devices for science teaching (Adapted from Aguiar, 2016)

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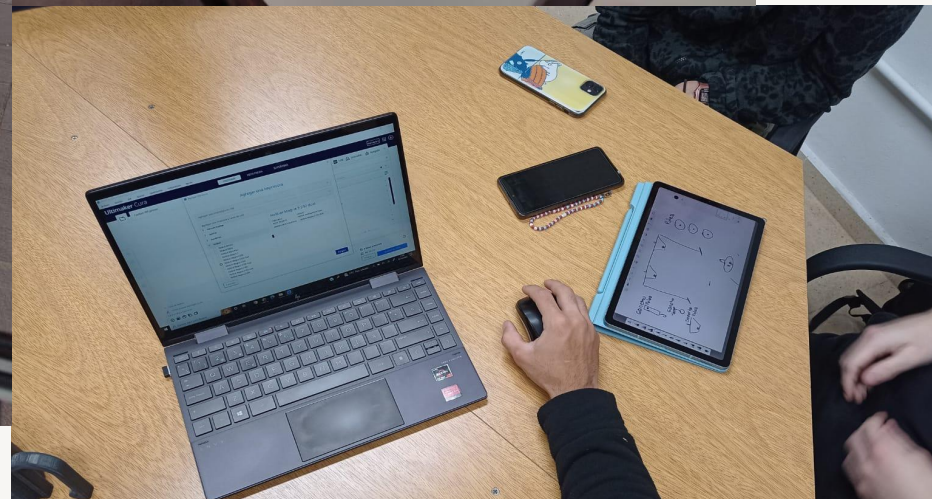
LOCAL EXPERIENCE

3D printing Innovation Lab



MEET THE TEAM

230 students volunteers involved
6 students in tutor role
Director of the project (Industrial Designer)
General Director

DEVELOPMENT OF 3D PRINTED EDUCATIONAL DEVICES

Primary / Secondary / Higher Education

Subjects / Content

1) Mathematics: fraction cake, ruler with angles, cones and sections, pieces with numerical operations, Pythagoras theorem

2) Geography: monument puzzles, timelines, province puzzles, Maps of Argentina with relief

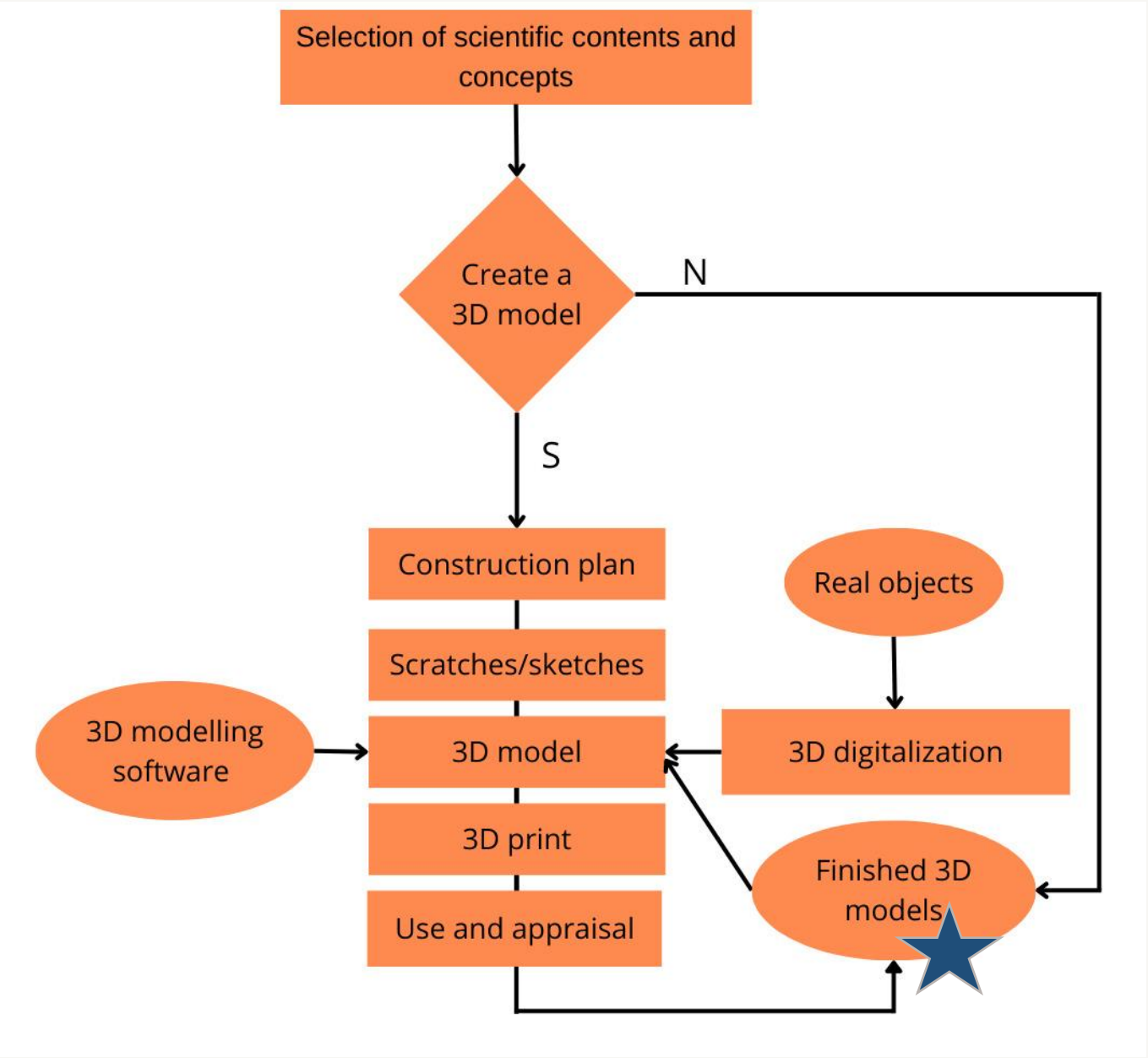
3) Physics: axis system, pulley system, Pythagorean vessel.

4) Biology: prokaryotic and eukaryotic cells, bone models

5) Language: Didactic roulette, character from stories, openwork letters.

6) Astronomy: moon phases, solar system, sundial.

7) Chemistry: periodic chart, chemical bonds, atomic models.



ACTIVITY 1

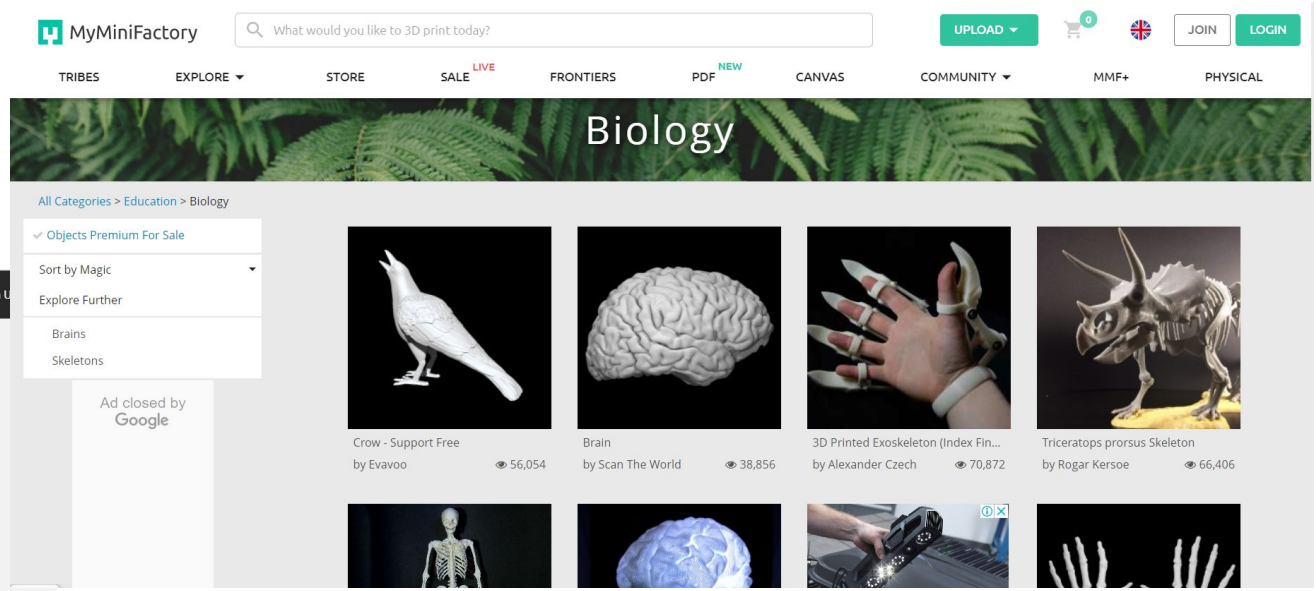
(10 MIN)

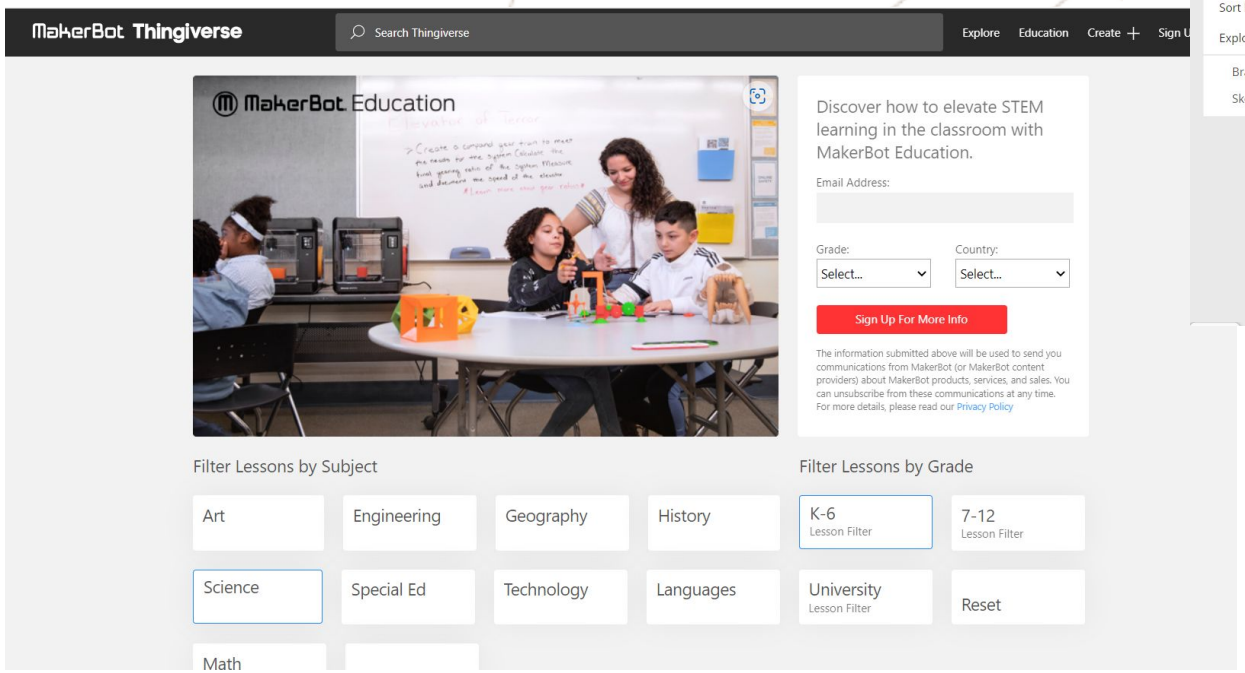
A) Explore the open source repository websites.

B) Think about how some of the finished 3d models displayed there could be used to teach content from your subject syllabus.

C)Share your ideas in the link below (Copy the link or paste an image to illustrate it and write a short paragraph about how to incorporate it in a lesson plan).

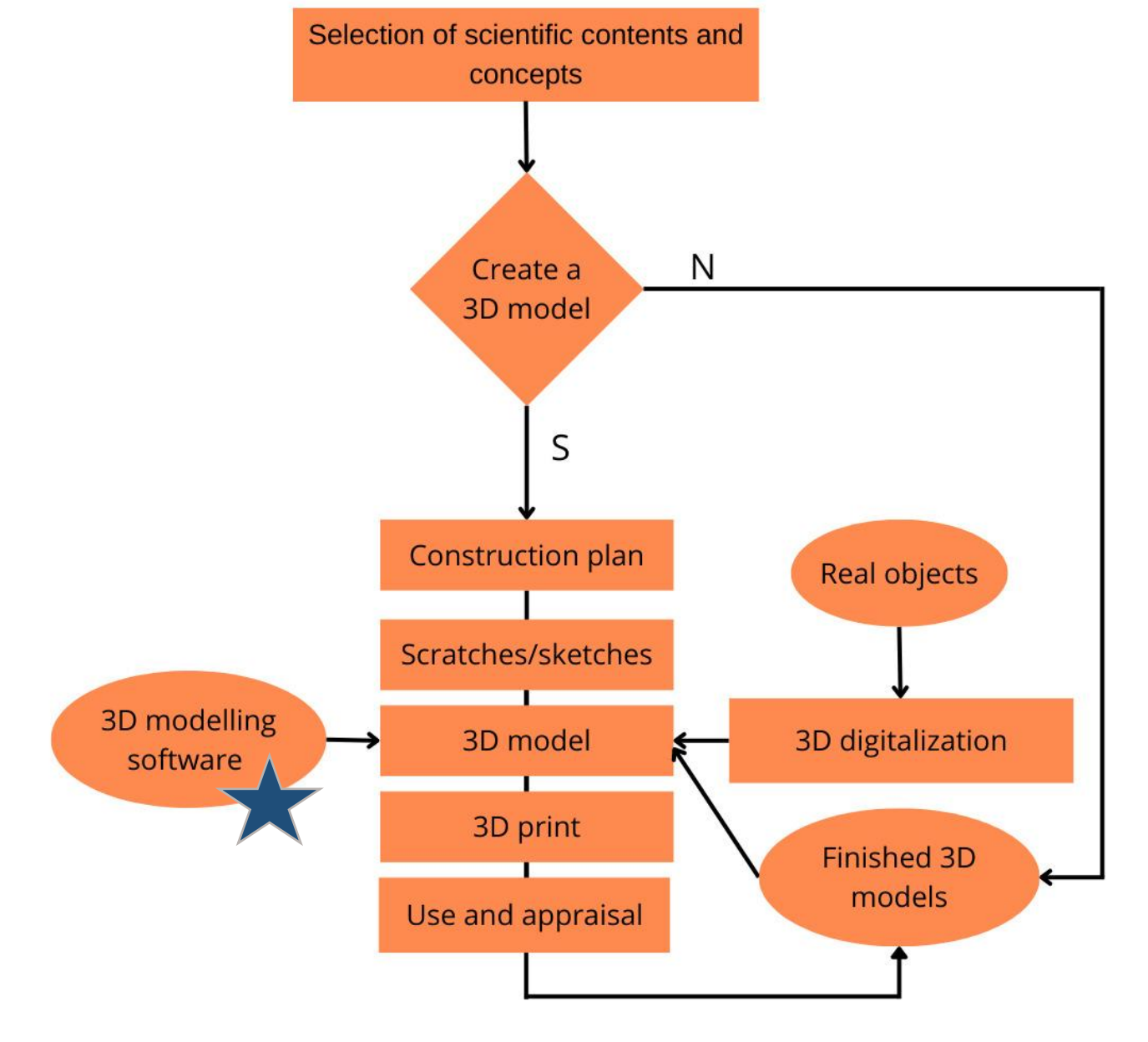
MAKER COMMUNITY





[Discover STL files for 3D printing ideas and high-quality 3D printer models. | MyMiniFactory]

[Thingiverse - Digital Designs for Physical Objects]



ACTIVITY 2

A) Log in Tinkercad

B) Pay attention to the explanation of the main features and tools.

C) Design a desk organizer

DESIGN SOFTWARES

Tinkercad

3D modeling program available to anyone to use.

It is free and is completely available online.

Design is simple and easy to use, compared to the complex designs of the competitors

Affordability is the main draw for our consumers to our product

MORE OPTIONS

SolidWorks

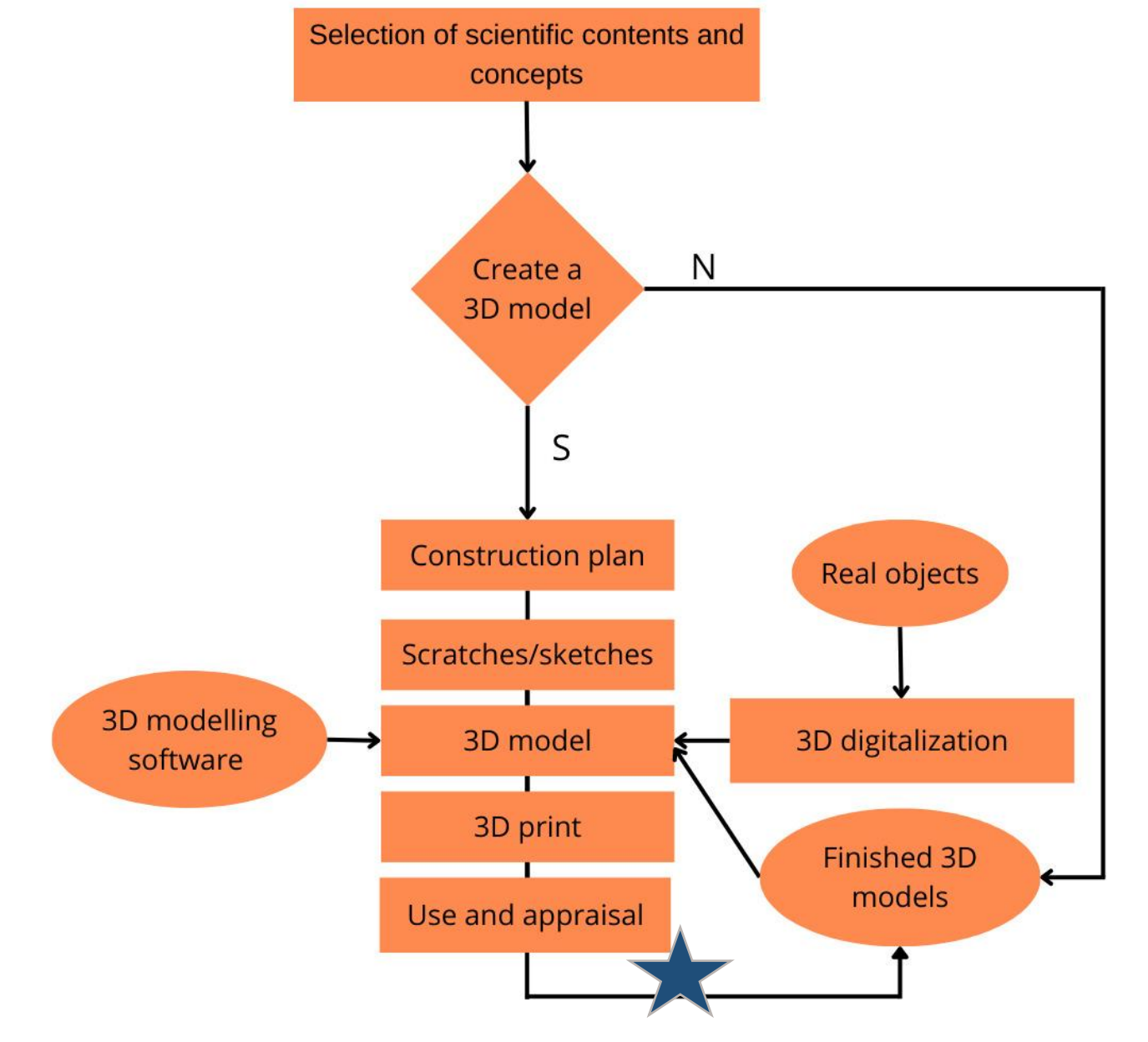
SolidEdge

SketchApp

SculptGL

3D Slash

Fusion 360



ACTIVITY 3

A) Give stars to your classmates production´s (you can only have 3 to share)
B) Add a post it with a comment explaining why did you choose that

Criteria	Excellent (3)	Satisfactory (2)	Developing (1)
 Effectivene wss 6 points	□ It aims at responding to a highly reasonable and valid need that is based on a certain context □ It can respond to the need in a highly effective manner and greatly serves to its purpose	□ It aims at responding to a need that can considered reasonable that is based on a certain context □ It can respond to the need in a partially effective manner and generally serves to its purpose	□ It is not based on a certain context and does not focus on a valid need □ It is ineffective at responding to the need and does not serve its purpose because an unexpected result is obtained
 Innovati veness 6 points	□ Compared to its counterparts, its available features/projected use include comprehensive and significant improvements	□ Compared to its counterparts, its available features/projected use are effective but only include limited improvements	□ Compared to its counterparts, its available features/projected use do not include any improvements
 Quality 6 points	□ Compared to its counterparts, it seems highly useful for the user preferences □ Its available features/method of use display total compatibility with the preference(s) of the user	□ Compared to its counterparts, it seems neither useful nor non-useful according to the user preferences □ Its available features/method of use only display compatibility with the primary preference(s) of the user	□ Compared to its counterparts, it seems non-useful according to the user preferences □ Its available features/method of us e do not display compatibility with the preference(s) of the user
 Dimension 9 points	□ It offers a perfect understanding of dimensional transformation operation of simple building blocks □ The proportions of the dependent and independent components, which consists of the product, are totally consistent with one another □ They are perceived as totally consistent with the dimensions of the products in the same context	□ It offers a satisfactory understanding of dimensional transformation operation of simple building blocks □ The proportions of the dependent and independent components, which consists of the product, are partly consistent with one another □ They are perceived as consistent at a certain level with the dimensions of the products in the same context	□ It offers an inaccurate understanding of dimensional transformation operation of simple building blocks □ The proportions of the dependent and independent components, which consists of the product, are not consistent with one another, at all □ They are not perceived as consistent with the dimensions of the products in the same context

RUBRIC

Tinkering learning in classroom: an instructional rubric for evaluating 3D printed prototype performance Ahmet Çelik1 · Selçuk Özdemir (2019)

 Visual 9 points	□ It offers a complete understanding of the operation of placing simple building blocks according to their relationships with one another □ It offers a perfect understanding of alignment/ rotation operation of simple building blocks □ All of its displays on 3D platform create an acceptable visual order	□ It offers an incomplete understanding of the operation of placing simple building blocks according to their relationships with one another □ It offers a satisfactory understanding of alignment/rotation operation of simple building blocks □ Only some of its displays on 3D platform create an acceptable visual order	□ It offers an inaccurate understanding of the operation of placing simple building blocks according to their relationships with one another □ It offers an inaccurate understanding of alignment/rotation operation of simple building blocks □ None of its displays on 3D platform creates an acceptable visual order
 Detail 9 points	□ It offers a profound understanding of transformation operation of simple building blocks by adding/subtracting □ It is understood that an adequate number of simple building blocks in as much variety as possible has been used □ It looks quite detailed and extremely realistic	□ It offers an incomplete understanding of transformation operation of simple building blocks by adding/subtracting □ It is understood that an adequate number of simple building blocks in only a limited variety has been used □ It is generally detailed but does not look realistic	□ It offers an inaccurate understanding of transformation operation of simple building blocks by adding/subtracting □ It is understood both the variety and the number of the simple building blocks used is inadequate □ It lacks details and looks basic
 Fabrication 9 points	□ It takes the maximum build volume limitation of 3D printer into account from head to tail □ It reflects an advanced comprehension in integrating plastic with various materials □ It reflects the comprehension of using less resources in fabrication from start to finish	□ It does not take the maximum build volume limitation of 3D printer into account, but can be printed when minimized □ It reflects an incomplete comprehension in integrating plastic with various materials □ It generally does not reflect the comprehension of using less resources in fabrication	□ It does not take into account of the maximum build volume limitation, and cannot be printed even when minimized because of the errors □ It reflects an inaccurate comprehension in integrating plastic with various materials □ It does not reflect the comprehension of using less resources in fabrication

RUBRIC

Tinkering learning in classroom: an instructional rubric for evaluating 3D printed prototype performance Ahmet Çelik1 · Selçuk Özdemir (2019)

SURVEY

https://forms.gle/bf5LZXtRJotMiJAd6

TEACHER TRAINING IN VISUAL CONTENT - 3D PRINTING

We appreciate your interest in the workshop and the time you spend sharing your impressions to the team.
This survey will take you less than 3 minutes
Complete it just once.
Share this with other teachers of your Universities.

Thank you

3D Innovation Lab Team - Cordoba National University

Director email: mariazoe.maldonado@unc.edu.ar

mariazoe.maldonado@unc.edu.ar (no compartidos)
Cambiar de cuenta

*Obligatorio

Where are you teaching at the moment? (Country) *

Tu respuesta

Where are you teaching at the moment? (City) *

Tu respuesta

Thank you for your attention

Hope you enjoy it as much as we!

e-CLOSE

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

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