Methodological guidelines for educators

About the guidelines

01 Already tested in practice

These methodological guidelines are a part of the Erasmus+ project Young Creators Discover 3D. They present the learning materials developed within the project as well as the experience of testing them in 3 countries. More than 300 youngsters have already tried out our activities where they could learn, create, innovate, communicate and collaborate with their peers.

02 Who can benefit from the guidelines

Project material is intended for people working with younsters who want to enrich their everyday activities with 3D printing. We have designed our materials for youth workers and educators that are active in non-formal learning environments, such as youth centers and youth organizations, community and open-learning centers, libraries, etc. However, the contents can easily be adapted to school environment, too.

03 Discover the 3D technology

In the project, we focused on bringing the innovative 3D technology to the Youth field. Since the world of 3D is very wide, we will present a few ways of using 3D printing in youth work. We will also offer a clear map of stepping into the 3D world by providing a scenario for a 3D modelling and silicone moulding workshop for 13-19 year olds. Our best practices, tips and tricks are here to help YOU discover the world of 3D!

04 No previous experience needed

The possibilities that 3D technology offers may reach very high levels of complexity. At the same time, very practical and tangible objects can be designed and printed with very simple and intuitive software. The workshops that we have created are suitable for everyone and do not require previous experience, neither for youngsters, nor for facilitators!

Contents

About the project

Exciting opportunities for young people

The project Young Creators Discover 3D was an opportunity for many youngsters and youth workers to get acquainted with 3D. Learn more about the project's goals, activities and results!

Why Young Creators Discover 3D?

The demands of the digital era

In the near future, the skills that will be essential to have success in the professional world will differ a lot from what was demanded earlier. In order to find a fulfilling occupation, it is crucial for young people to skill up for a technology-driven future.

One of the emerging technologies, 3D printing, represents the digital era as it enables individuals all over the world to design their own custom products. 3D projects are a promising approach for preparing for the digital age.

However, an existing offer of technological education is of limited availability for young people, especially those with fewer opportunities due to economic, social or geographical obstacles.

Our approach

In the project **Young Creators Discover 3D**, we have offered young people 3D workshops where they could learn, create, innovate, communicate and collaborate with their peers.

Workshops took place in non-formal learning environments, such as youth centers, libraries, STEAM centers. Youngsters learned about 3D through hands-on approach and had an opportunity to create their own unique design.

A pack of methodological material was developed for this project, then tested in 3 countries and now available for everyone who would like to start with 3D from scratch.

Some facts
about the project

FUNDING

The project was financed under Erasmus+ strategic partnerships programme in the Youth field.

COUNTRIES

The project was carried out in Lithuania, Latvia and Estonia

TIMELINE

The project started on 01.02.2021 and finished on 31.07.2022.

PARTNERS

3 project partners and a bunch of associated organizations were involved in activities

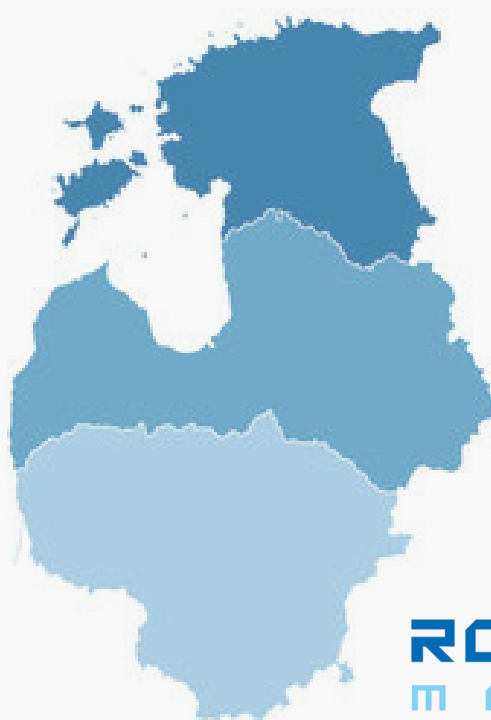## PROJECT'S WEBSITE

youngcreators.gaminu.eu

GRANT AGREEEMENT NO.

2020-3-LT02-KA205-007214

LEARNING MATERIAL

Explore play.gaminu.eu for English, Lithuanian, Latvian and Estonian versions!

Partnership

3 COUNTRIES	LITHUANIA LATVIA ESTONIA	3 PARTNERS

School of Robotics

Robotikos mokykla provides non-formal education in the field of STEAM in Lithuania since 2009. Our goal is to raise innovators by giving our learners new knowledge and skills as well as an opportunity to think, feel and act as inventors.

The school offers a variety of technological activities, depending on the learners' age group and previous experience. The main fields of expertise are: robotics and electronics, rapid prototyping, including 3D printing, programming, and artificial intelligence. The school is well equipped with modern learning equipment and resources.
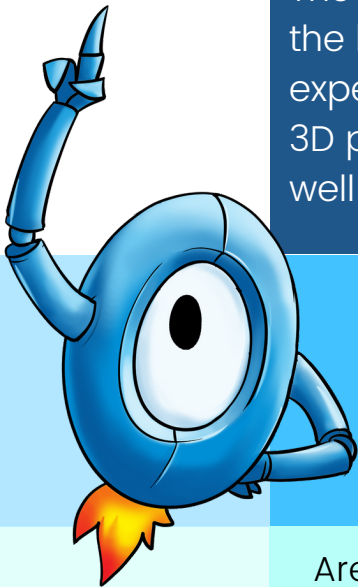
ROBOTIKOS
MOKYKLA

Areas of activities:
- teaching robotics to children, youngsters and adults
- summer camps
- local and international projects
- teacher training
- development of methodological materials
- designing new devices

@Robotikos. mokykla

robotikosmokykla

@robotikos. mokykla

robotikosmokykla.lt

Baltic Regional Fund

Baltijas Reģionālais fonds(Latvia) is a non-governmental organization created with the aim to develop, encourage and support creative ideas to enhance friendly and peaceful world by promoting intercultural dialogue and equality and respecting individuality. The organization is located in Riga but the foundation organizes regular activities in the whole of Latvia as well as collaborating on a European level, implementing educational projects. Seminars, trainings and projects open the door to new experiences, competences and opportunities by promoting non-formal education and lifelong learning.

Baltic Regional Fund

Areas of activities:
- Project work at the local and European level
- Youth studio "BaMbuss"
- Work with volunteers
- Trainings, Seminars & Consultations

For more info:

We also have a Youth studio in Riga:

@BaltijasRegionalaisfonds

www.brfonds.lv

@jsbambuss
@jsbambuss

Tartu Youth Work Center

Tartu Noorsootöö Keskus is a subdivision of the Culture department of the Tartu City Government, which opened in 2018 in Tartu, Estonia.

The aim of the center is to create an inspiring and innovative youth work environment for the youth of Tartu for them to grow to be active, creative and happy people.

Tartu Youth Work Center has three youth centers - Anne Youth Center, Lille Youth Center and Ilmatsalu Youth Center.

Areas of activities:
- Open youth work
- Hobbies
- Youth initiative
- Primary counseling
- City-wide events
- Inclusion
- Street based youth work
- Youth trainings
- Projects
- Social media

TARTU NOORSOOTÖÖ KESKUS

SOCIAL MEDIA

@tartuntk
@lillenoortekeskus
@annenoortekeskus
@ilmatsalunoortekeskus

Tartu Noorsootöö Keskus

Tartu Noorsootöö Keskus

@tartuntk
@lillenoortekeskus
@annenoortekeskus
@ilmatsalunoortekeskus

Podcast Noorteaken

Website: tntk.tartu.ee

Project activities

Development of the methodology

In the beginning of the project, we created methodological materials for a 3D/silicone moulding workshop. The materials are aimed at a beginner level. They comprise slide presentations that can be used during workshops, teachers' books for better preparation, a list of needed materials and equipment, and other relevant information. The materials were delivered by School of Robotics in English and translated by partners to Lithuanian, Latvian and Estonian.

Apart from that, partner Tartu Youth Work center prepared a set of non-formal games and activities. They focus on getting to know each other, teambuilding, boosting creativity, and evaluation.

Different workshop evaluation methods were presented by Baltic Regional Fund. Facilitators can select one or more of them depending on the group and own choice.

International training for youth workers

30 youth workers and educators gathered to learn about 3D in a 5-day training in Lithuania in August 2021. They got theoretical and practical knowledge about how to run a 3D/silicone moulding workshop for youngsters.

The training was the first encounter with the 3D for most of the participants, and they were very enthusiastic about the possibilities of sharing it with the youngsters.

Testing in partner countries

The methodology created for the project was tested in all three partner countries in the period between October 2021 and May 2022. Workshop facilitators also participated in the survey.
In the next pages, you will learn more about who was involved in testing and what feedback was received.

Updating the methodology

Based on the feedback received from workshop facilitators, updates were made in the learning materials. Survey data was processed and analyzed not only to evaluate the quality of the methodology, but also to estimate the impact of the project activities on the participants' skill development.

Dissemination

Multiplier events gathering more than 70 representatives of the youth sector and various educational institutions took place in all 3 countries from May to July 2022. Dissemination of the project and its results was done throughout the project's time and will continue afterwards.

Testing experiences

Learn from good practices

In this part of the guidelines, you will learn about the facilitators' survey results and some good experiences from local workshops that took place in Lithuania, Latvia and Estonia. These tips will help anyone working in the youth field to tackle possible challenges and make the 3D workshops run efficiently.

Workshops in Lithuania

In Lithuania, local workshops were offered to youngsters at 5 different locations.

Involvement of associated partners in delivering local workshops has helped the project to reach youngsters in different parts of the country.

The activities took place in smaller towns, where there is usually less non-formal learning possibilities than in major cities.

Robotikos mokykla provided the local partners with 3D printers for the testing period. Other necessary materials, such as plastic for printing, silicone and other items, were also supplied.
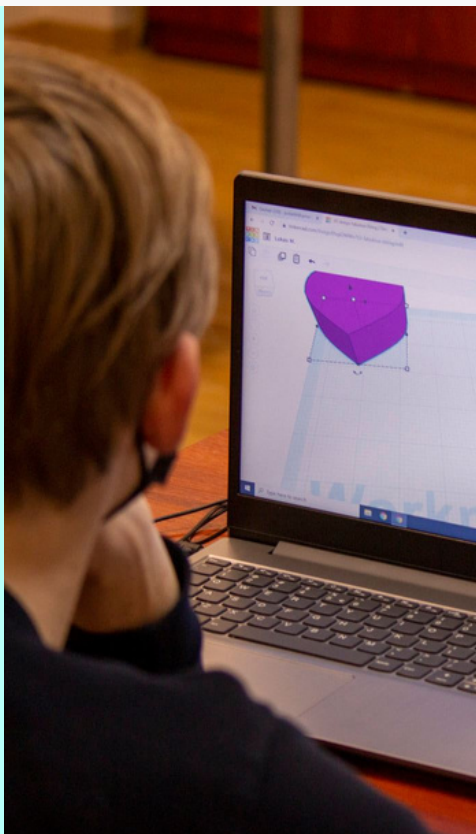
Local partners

☑ **Ramygala Open Youth Center**
Ramygalos atviras jaunimo centras

☑ **Druskininkai Youth Activity Center**
Druskininkų jaunimo užimtumo centras

☑ **Visaginas education center**
Visagino edukacijų centras

☑ **Panevėžys STEAM center**
Panevėžio atviros prieigos STEAM centras

☑ **Kaunas County Public Library**
Kauno apskrities viešoji biblioteka

In Lithuania,

129 youngsters

participated in workshops and discovered the world of 3D!

Participant profile

Most of them were 13-18 years old. The groups included some young people with fewer possibilities due to one or more of these exclusion factors: geographic obstacles, economic and/or social obstacles.

Prior experience

3D printing and silicone moulding techniques were new to all the youngsters who participated in the workshops. They found the process easy and fun.

Young people were very interested in 3D printing possibilities and how accessible it actually is.

Most of them tried modelling with TinkerCAD software for the first time and had no trouble navigating through it.

Exploring 3D

In one youth center youngsters printed out Dungeons and Dragons game figurines; they started to meet regularly at the youth center to play the game.

Youngsters also searched online databases for 3D designs made by others. Printed puzzles, food forms and parts of the game have a lasting value and will be used many times.

In another youth center youngsters designed and printed their unique keychains and necklaces with pendants.

Feedback

Self-evaluation of 3D-related skills done before and after the workshops demonstrate that participants have improved their abilities significantly.

3D workshops also helped to improve the youngsters' social skills in communicating with others.

Personal success stories included young girls who managed to overcome the attitude that IT is not for them.

They learned new things eagerly, created 3D designs themselves and monitored the 3D printing process.
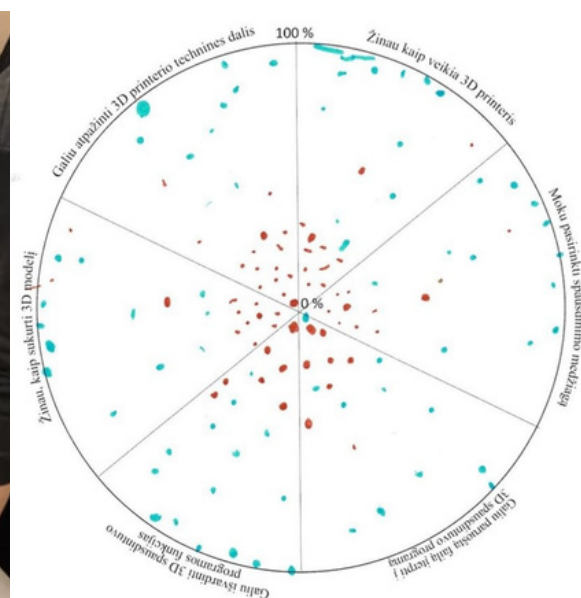
Facilitators

> The 3D modelling and printing software that is used in the workshops is very intuitive, user-friendly and good for total beginners. Don't be afraid of making some mistakes in the process - it can also be fun!
>
> *Justinas, Youth Worker*

PROFILE

- youth workers
- youth educators
- librarians
- volunteers

PRIOR EXPERIENCE

- The majority of the facilitators had no prior knowledge of 3D modelling and printing before this project.

FEEDBACK

- According to the facilitators, workshops were rather easy to facilitate thanks to the concise learning materials and training.

SKILL DEVELOPMENT

- In the survey carried out after the local workshops, all facilitators have indicated to have reached a high level of the ability to support young people in their working process.

WORKSHOPS IN
LATVIA

4
Schools

1
Co-creation workshop

2
Youth centers

101 Participant

Valmiera
Liepa

Rīga

Altogether seven workshops were held. Three of them were held in a rural area.

Daugavpils

~40

participants with fewer possibilities

Participant profile. Participants were 13-19 years old. It is known that most participant groups included youth with fewer possibilities due to Economic barriers that usually went together with Geographic obstacles, in some cases educational difficulties or social obstacles like living with a single parent.

It was a good experience.
Youth and the workshop facilitators have developed many skills while participating in this project.

Facilitators

> By facilitating in the workshops I found out more and more about 3D printers and the possibilities that they can provide. From math to art class, from small customized gifts to technical solutions. I learned as much as the youth did!
>
> */Elīna - facilitator in the workshops/*

PROFILE

- youth workers
- teachers
- instructional designer

PRIOR EXPERIENCE

- Half of the facilitators had prior knowledge of 3D modelling and printing before this project.

BACKGROUND

- All facilitators had prior working experience in youth field so it helped with planning non-formal activities.

FEEDBACK

- The facilitators stated that workshops brought them new ideas how to use 3D printers and together with the youth started developing new projects;

- They found new possibilities to talk about technologies that are used globally.
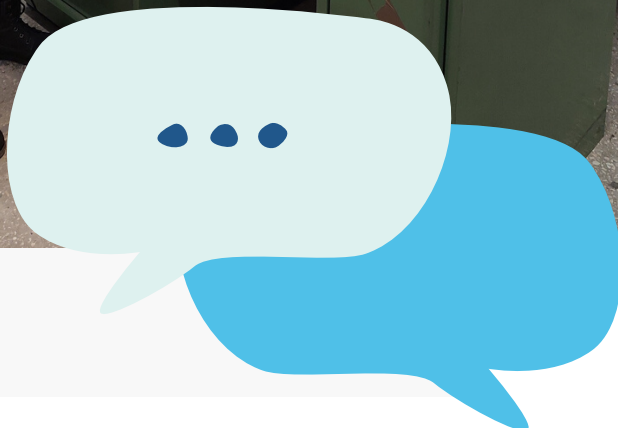
Developed their skills?

After self-evaluation in the beginning and end of the 3D workshops, the biggest impact in participant views of their development can be observed by the rise in technical thinking and creative thinking skills level.
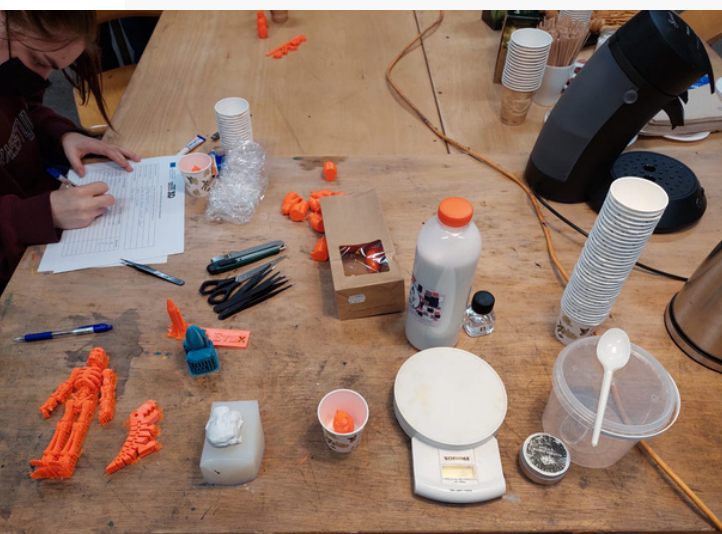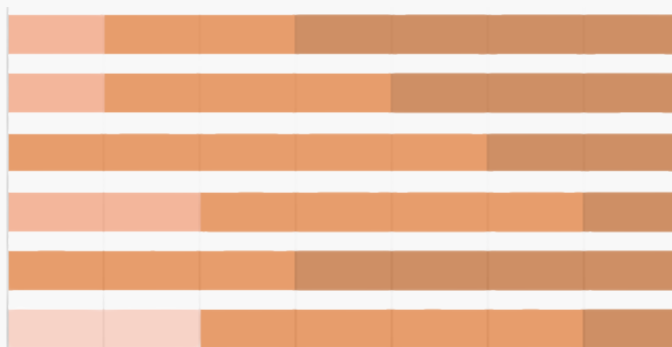

Technical thinking skills
Innovative thinking skills
Analytic thinking skills
Design thinking skills
Creative thinking skills
Critical thinking skills

Latvian facilitators' advice in organizing 3D and silicone moulding workshops:

1. Youth that had never used a 3D programme before had difficulties understanding 3D environment and thinking in 3 dimensions. Provide them with the necessary time to experiment!
2. Youths' first models were not suitable for silicone moulding. A solution was to provide them with model that are suitable for silicone mould or make another workshop.
3. Take in notice that facilities usually provide only one printer, that means that it will be a slow printing process.
4. The curriculum of 3D printing is quite theory-based. Use of non-formal activities will make the process smoother.

Workshops in Estonia

In Estonia, local workshops were offered to youngsters at 2 different locations.

Involvement of associated partners in delivering local workshops has helped the project to reach youngsters in different parts of Tartu.

The activities took place in youth center and in one school. The three workshops that took place in school were integrated into arts and IT lessons.

Tartu Noorsootöö Keskus provided the local partner with 3D printer for the testing period. Other necessary materials, such as plastic for printing, silicone and other items, were also supplied.
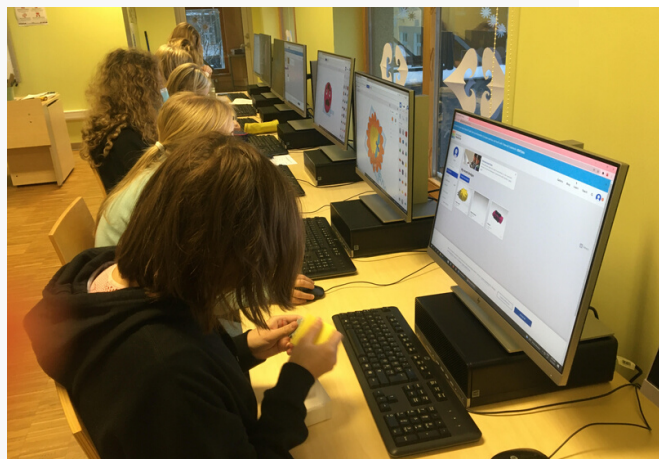
Locations

☑ **Tartu Youth Work Center, Anne Youth Center**
Tartu Noorsootöö Keskuse Anne noortekeskuses

☑ **Tartu Kesklinna School**
Tartu Kesklinna Kool

Participant profile

All of the participants were 13-16 years old and studying in three different schools in Tartu. One group consisted of young people from a non-Estonian speaking school.

106 youngsters

took part in 3D workshops and experienced the endless possibilities of 3D printing!

Modelling in TinkerCad

Modelling in TinkerCad was interesting for most of the participants and some of them wanted to explore the program even after the time was up.

Silicone moulds

Making paper boxes and doing silicone moulds was a fun and crafty way to make something for everyday use.

Prior experience

Most of the young people had no experience with modelling and 3D printing, but in each group there was at least one participant, who had some.

Feedback

Facilitators used "pizza method" to get feedback and reflect on the workshops. Most of the dots showed the improved skills and knowledge that participants got from two workshops.
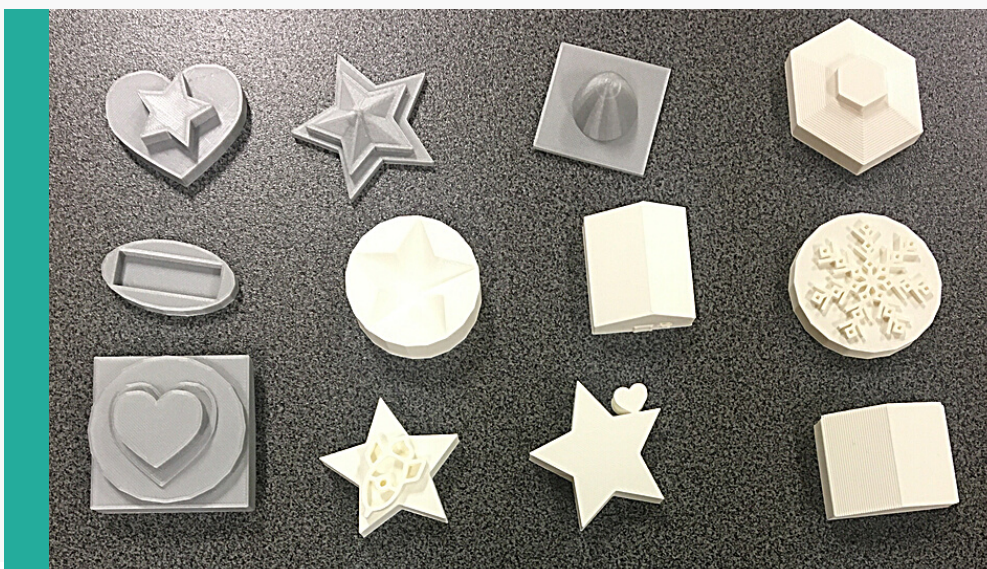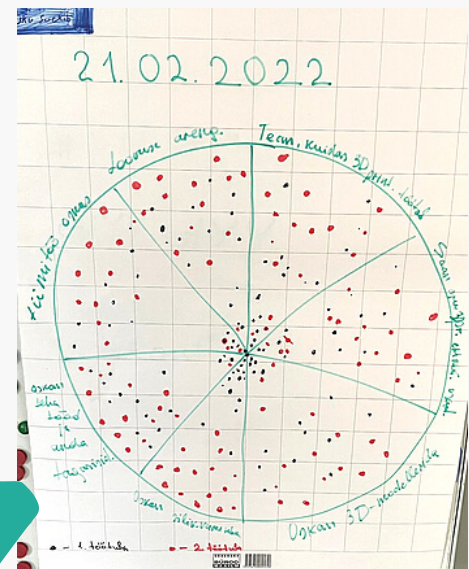
Facilitators

PROFILE

- youth workers
- teachers

PRIOR EXPERIENCE

- Half of the facilitators had a prior knowledge of 3D modelling and printing before this project.

BACKGROUND

- The facilitators had prior working experience in youth field so it helped with planning non-formal activities.

FEEDBACK

- The facilitators stated that workshops were fun and participants were excited to learn more about 3D printer and modelling.

BALTIC 3D Facilitators' Evaluation summary

Location: Where the workshops were held

School: 4   Youth centers: 6   Open access/creation/other centers: 3   Library: 1

Number of participants: **336**

People with fewer possibilities: **102**

Average facilitators' evaluation on how successful the workshop was overall: 8,31

Facilitator's general comments and observations during the workshops:

The facilitators noticed that youth that had never used a 3D programme before had difficulties in understanding 3D environment and thinking in 3 dimensions. However, receiving more time, they could build their printable models.

First created models were not suitable for silicone moulding. A good solution was to prepare some sample models in advance that could be used for silicone mould.

It's okey if there is just one computer for a pair.

Only one printer for the whole group makes it slow...

If there is larger group of youngsters, there should be also more tutors to run the workshop effectively.

Time management is important in preparing, printing, and for the youngsters to understanding 3D modelling and printing process. Plan more time in getting computers ready and silicon materials as well.

Between two parts of the workshop there should be enough time planned, keeping in mind a number of prints to be made and their printing time.
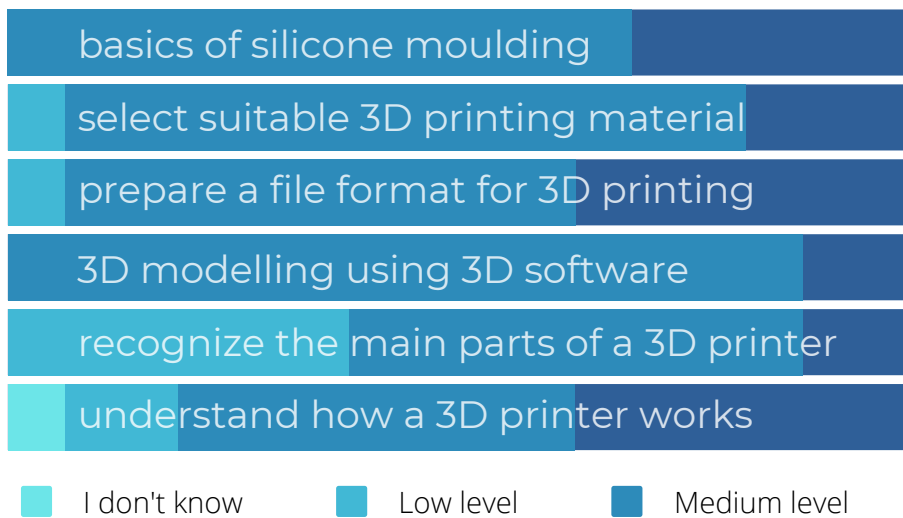
To what extent participants developed their skills?

- basics of silicone moulding
- select suitable 3D printing material
- prepare a file format for 3D printing
- 3D modelling using 3D software
- recognize the main parts of a 3D printer
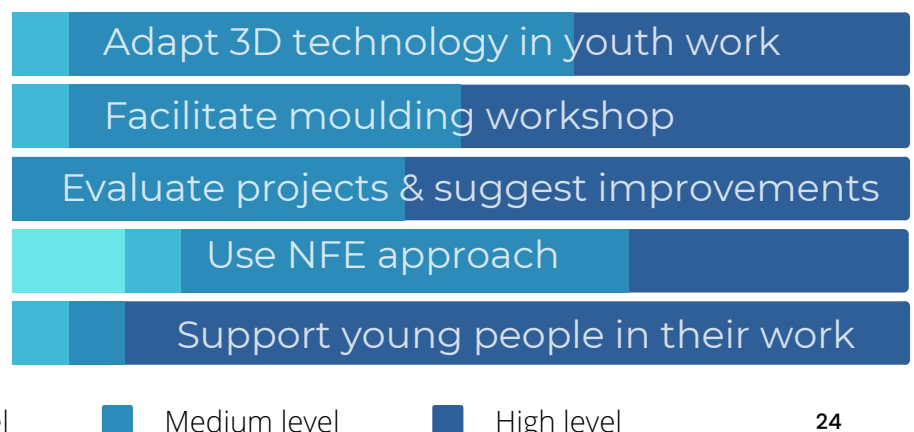- understand how a 3D printer works

The biggest impact is in understanding how a 3D printer works. One facilitator's comment suggests that in order to maintain these skills it would be good to consider repeating a class with 3D printers with the same group after a week or two.

Legend: I don't know | Low level | Medium level | High level

- Critical thinking skills
- Creative thinking skills
- Design thinking skills
- Analytic thinking skills
- Innovative thinking skills
- Technical thinking skills

Legend: I don't know | Low level | Medium level | High level
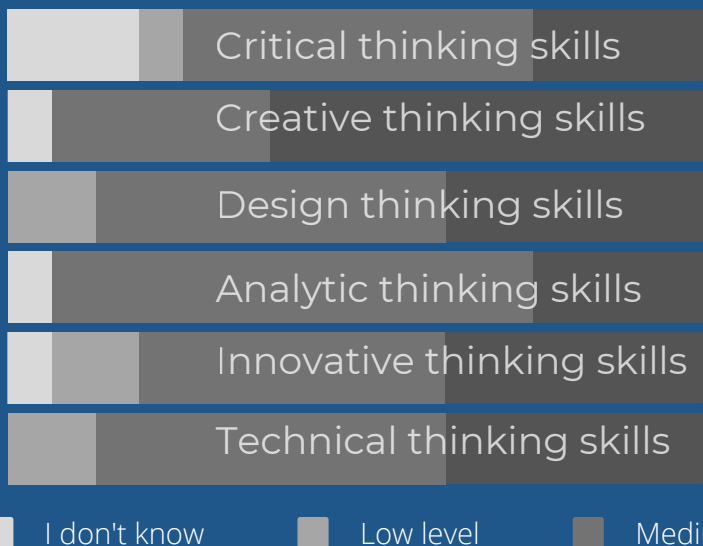
The biggest changes in skill development was in creative thinking skills that was observed on a high level in 10 workshops. Next best developed skills are design thinking skills and technical thinking skills.

Facilitators have also developed some skills...

The facilitators have evaluated that their own skills in supporting young people in their work has had the most impact. On average the most undeveloped skill by the facilitators is the use of non-formal education methods in the field of 3D printing.

- Adapt 3D technology in youth work
- Facilitate moulding workshop
- Evaluate projects & suggest improvements
- Use NFE approach
- Support young people in their work

Legend: I don't know | Low level | Medium level | High level

Best practices

Best practices that the facilitators mentioned were self-directed, hands on learning and trial and error method. The youth usually are not allowed to use the technologies themselves, so being given the responsibility to find out facts themselves and testing their hypothesis was a good experience.

Another suggestion was to use paper cups for the mould in the silicone workshop if the 3D figure has a suitable size; it saves time and resources.

At the end of a workshop day, when the concentration level is down, but it is still necessary to receive reflection and to summarize, a facilitator suggested to use small snacks as rewards.

Facilitators used:

Information gathering

Letting the youth gather info about the 3D printer themselves enhances critical thinking and digital competences.

Creative ideas

We used game - Dixit. I think it helped them to prepare creatively for the workshop.

Pizza

We used the "pizza" method to map the youngsters skills. The "pizza" method is a good way to map and see the skills in a visual representation

Snacks?

Snacks for the right answers motivated to review the info that was delivered in the workshop.

Self-directed learning

I made the workshop as a self-directed learning class. Learning outcomes were given and the students had to experiment and find information on their own.

Pillow war

Pillow war for feedback: talked about what you liked or did not like, made a negative experience positive! The young people did the activity happily and relieved the tension.

Ninja

There's also a possibility to do energizers like ninja, if the youngsters seem tired or not in the mood.

Tour

We had an tour in the co-creation workshop place. They showed cool projects that other young people are making.

Keychain

Each participant made their own unique keychain. Easy way to start learning about 3D.

Ice breaking

We started with an energizer - it breaks the ice.

If there is no 3D printer at your youth center

During our project, we learned that youth centers usually do not have 3D printers. Here are some possible options where you could get one:

1) Many libraries have 3D printers. Ask at the library in your area and find out if they could print out the youngsters' 3D models or even have you come over to them with the group to learn more about the printer.
2) Most schools also have 3D printers. Try to look for contacts with school authorities or teachers for collaboration.
3) Public or private robotics/STEAM centers are usually equipped with 3D printers and might be interested to work together.
4) If your youth center is run by a local municipality or other public institution, ask them about potential support or funding opportunities.
5) Companies selling 3D printers may also be able to lend or rent a printer for the activities.

Collaborate with local schools

There was a 3D printer from the project to run 3D workshops at my youth center, but we did not have enough computers for the 3D modelling part. So I made contacts with the local school and suggested to work together in this.

They were interested, so I made the first part of the workshop, the 3D modelling, in the school's computer class. For the second part of the workshop, the youngsters already came to the youth center. They got to see the 3D printer and prepare silicone moulds.

Collaboration with the school was a win-win on both sides. The youth center was visited by many youngsters who have not been here before. It was a good opportunity for us to present our activities. And the school was asking me to come again and teach 3D modelling to other students as well.

Ernesta, Youth Worker (Lithuania)

3D use in Youth Work

Here are our ideas based on testing experiences on some of the ways that 3D printing could be used in youth work:

3D printing gives an opportunity to create something useful by yourself

For example, creating new game buttons to replace lost buttons in board games or replacing broken packages with cases made of durable material.

For the cooking club, you can design different shapes yourself, which can be used to make silicone moulds for baking, pouring chocolate or making unique ice cubes. Moulds can also be used for crafts (for example, for pouring candles or soaps). But it can still be said that fantasy is the only limit.

3D printing can be adapted to different age groups

For younger people, we recommend introducing the basics of printing and showing the printing process. From the printing program (Tinkercad), it is also possible to choose ready-made shapes that the younger ones can print themselves.

However, for 14-year-olds and older, in addition to introducing the printer, we recommend showing the Tinkercad program in more detail and letting them model something more complex themselves.

Value for young people

3D printing gives young people more than just new knowledge about technology. For example:

- Developing spatial, logical and technical thinking

- The skill of modeling

- Development of creativity

- The ability to work together

- Entrepreneurship - stimulates the brain, young people learn to see opportunities

- Wow effect - the experience of success and the feeling that you can physically see the thing from 3D software in your hands

- Development of planning skills

- Development of the skill of reflection

- Development of STEAM skills

Value for youth worker

- Developing your own skills

- Development of mutual cooperation between people working with youngsters

- Using future technology in your work

- Developing the ability to solve unexpected situations and problems

- Wow effect, same as for youngsters!

Value to the field of youth work

- Innovativeness

- Non-formal learning - 3D develops all kinds of skills - creativity, spatial thinking, technical thinking, cooperation skills, communication

- Recycling and saving nature

- Cooperation between youth centers and schools - schools are more aware of the possibilities of youth centers

3D workshop methodology

Learn to run a 3D workshop from scratch!

In this part, we will guide you through the workshop idea that we have developed and tested with more than 300 youngsters. You will learn how you can prepare for the workshop and what materials are needed. You will get a step-by-step plan with links to the ready-made presentations that you can use during the workshop.

Let's get started!

About 3D/silicone moulding workshop
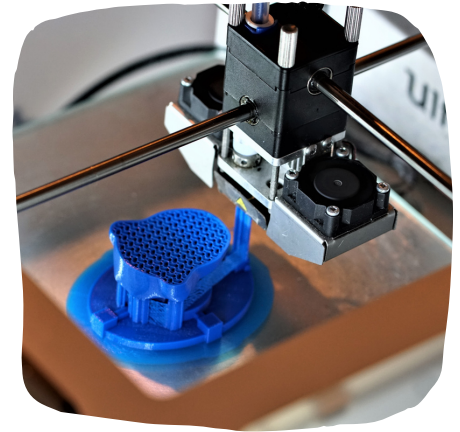
What you will learn in this workshop:

- **Design with 3D software**
- **Work with 3D slicing programme**
- **Prepare models and print them with a 3D printer**
- **Use silicone moulding techniques**
- **Use different learning methods to acquire new knowledge**

The main parts of the workshop

The workshop consists of two main parts that should be spread over time with at least 1 day gap between them.

On Day 1, youngsters get the basics of 3D modelling and create their own design using free online program TinkerCAD. The design is then processed with a 3D slicing program and printed with a 3D printer.

On Day 2, the printed 3D model is prepared for moulding and then poured with food-grade two-component silicone. The silicone hardens for up to 24 hours.

After that, the 3D form is removed and the silicone form is ready. It can be used for making jelly, chocolate, candles, cookies or other solidifying substances! This could be Day 3 of the workshop for everyone to make their own unique item!

Preparation of the facilitator
before the workshop

Here are some tips to get started with the activities:

The facilitator should read all the methodological materials to make sure that he or she knows well how to run the workshop. Also, it is recommended to practice before the event and try to design several different moulds and perform the casting process. In this way, you will understand what problems may be encountered during the workshop. If you run the workshop on your own, it's best to have a group of up to 10 youngsters at at time. If you work with a partner, the group can be larger. Plan approximately 6 hours for each day.

Needed equipment and materials

- Software: TinkerCAD (a free web app for 3D design)
- Equipment: 3D printer(s); PC/laptop per participant (but 2-3 participants can also share one computer if you don't have many of them); multimedia
- Materials: PLA/ABS (in well ventilated room only)/PETG plastics, food grade silicone, cups, wax, super glue
- Other tools/equipment to be used: follow this link for downloading a complete list

👉 play.gaminu.eu

Log into the website to get free access to all the methodological materials. In the section Available courses, choose Young Creators Discover 3D or follow this direct link.

Day 1

We recommend to start the first day with introducing the goals of the activity and the workshop plan. The first part is to teach about 3D modelling. Firstly, show the possibilities and examples of Tinkercad (or other selected software, such as Solidworks/xDesign/etc.)

Demonstrate simple tasks with a 3D program with youngsters doing it parallelly. Then tell learners about the specifics of silicone moulding: what to keep in mind and what mistakes not to make.

Afterwards, the participants start designing their own models. The facilitator helps them, if needed.
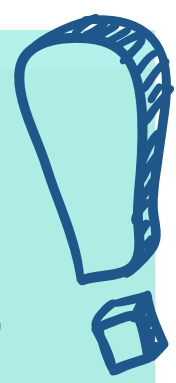
Introducing 3D to youngsters

It is important to show the possibilities/outcomes of the computer aided design (CAD). Otherwise participants might not be very interested if they do not understand what they can create with it. What to show exactly? It is best to show your own creations or your colleagues' creations, because you need to know the story of creation.

In this way, it will be much more interesting for participants to listen to. In the best case, already constructed work examples should be displayed, at the same time show a 3D model from your computer by using a projector and show "live mechanism" – compare them. Also, if you have, show 3D printed parts which are designed by you. If you do not have your own examples, just find some from the internet.

Read
TinkerCad
Teacher's Book

to be well prepared for Day 1!

Working with TinkerCAD

After showing the examples, you can start practicing TinkerCAD by using the presentation TinkerCad Basics. These are fully prepared slides so that participants could read all of it by themselves, but it is better to go through them together, step-by-step.

Then the facilitator should invite the participants to start creating their own and assist them if they are struggling. In the end of this part of the workshop, everyone should have an individual design complete. The final output should be .stl file – ready to be sliced and 3D printed after slicing.

Before ending the 1st day, make sure that you get .stl files from everyone to your email. If you do not get files, you will not be able to print them.
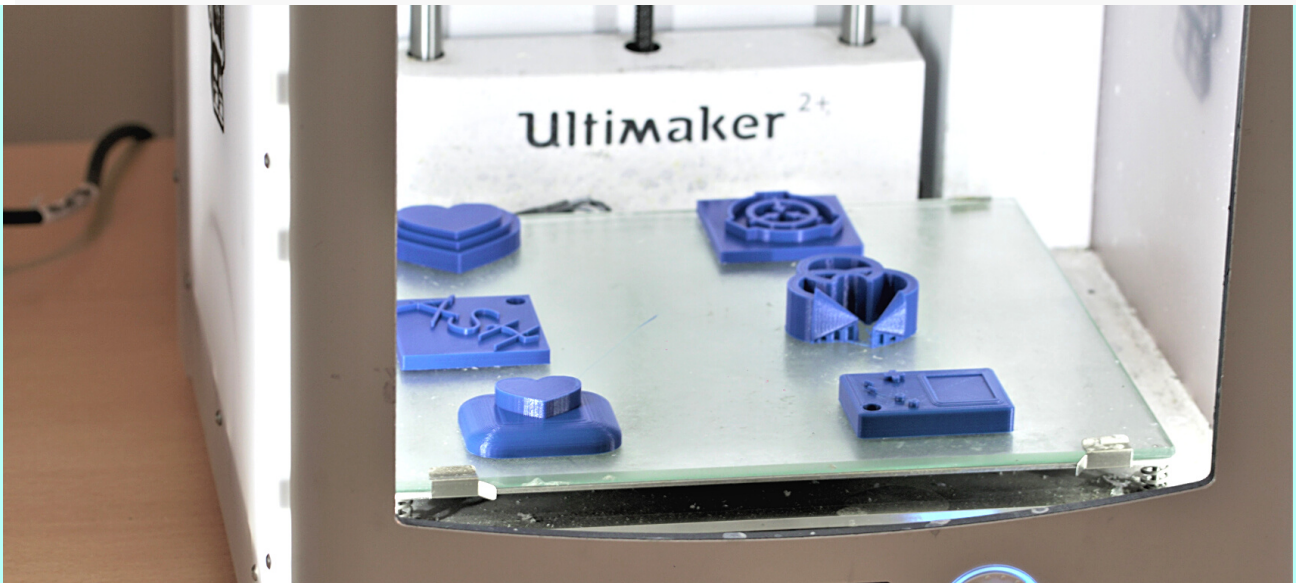
Tip:

Get acquainted with the materials about Moulding Primer before youngsters start designing so that you know what type of mistakes to avoid in 3D designing when the model is designed specifically for silicone moulding.

Printing: tips

What could go wrong with printing .stl files? During the printing, the models might be printed unsuccessfully (sometimes it just happens). To solve this, just print a faulty piece again.

It is important to plan printing time correctly. Printing one piece takes approximately 2 hours. If you have 20 .stl files and only one 3D printer, you will need at least 40 hours of printing. It might become 50 hours in case some pieces need to be reprinted.

If available, use more than one 3D printer. Always print over day and night (non-stop). Print pieces "one by one" instead of "all at once" (you can find this setting in a 3D slicing program). In this manner, a bigger percentage of 3D prints will be successful.

Try to optimize printing time by increasing time saving parameters in a slicing program such as: print speed, layer height, infill percentage, thickness of the walls. By saving time, try to keep balance not to lose quality too much.

Consider making a longer gap between Day 1 and Day 2.

You may also consider using more default print works and print just some of the participants' works. There are often a few participants who do not finish their models to be suitable for printing. So if you print several default models in advance, everyone will have a print to work with on Day 2.

Some examples of 3D prints

Here you can see models designed by youngsters during our workshops:
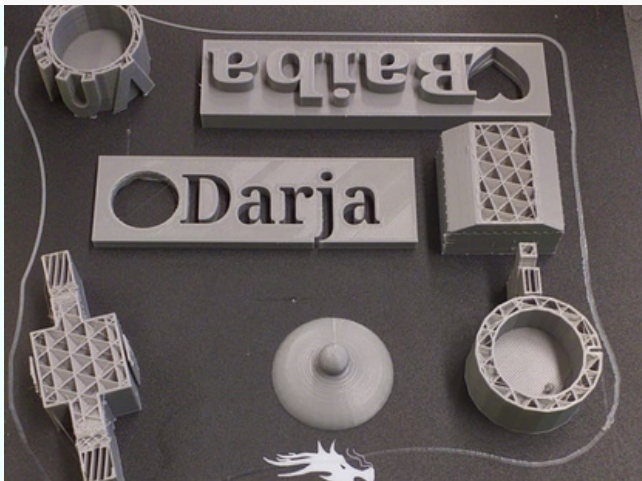
Tips and tricks

SAFETY FIRST

Keep in mind safety requirements and give safety instructions to workshop participants. Nozzle gets hot during printing and should not be touched. Print bed also gets hot when using PETG and ABS plastic. If your printer does not have side walls, you can put a box on top of it for safety. If you use ABS and PETG plastic, the room has to be well ventilated. Only PLA is safe to be used in any conditions.
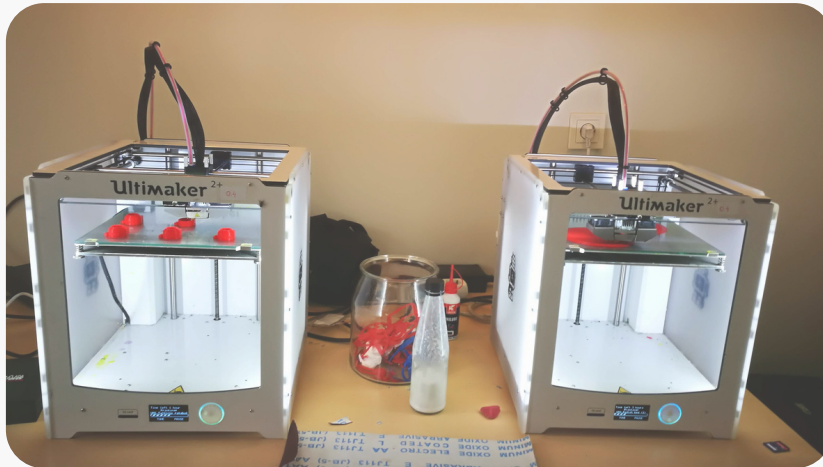
It is worth using videos to introduce printing. On the Internet you can find many videos in different languages.

In English

In Russian

Day 2

In this part of the workshop, you will show the participants **how to use** 3D **slicing programs,** such as Cura, for preparing a designed model for 3D printing. We also recommend talking about **how 3D printers function** and presenting the variety of 3D printing materials.

After that follows an **exciting hands-on activity**! First, let the youngsters prepare printed 3D forms for silicone moulding. Then put on your aprons and **start preparing silicone for moulding!** In the end of the activity, all printed forms will be covered with silicone and left to harden for 24 hours.

Show more of 3D printing

Our recommended slicing program is Ultimaker Cura. It is one of the most user-friendly 3D slicing programs and one of the most popular. It has an intuitive interface with super easy settings for beginners.

If needed, it can be used in a more advanced way. In addition, its database has a variety of suitable 3D printers.

Tip: choose at least one .stl that acquires support, and demonstrate that the same part can be printed in many different positions and that printing time depends on that. This way, learners will understand the optimal printing position and print optimization.

This part should not take very long, maximum up to one hour. Just show the most important parameters so that participants are able to slice a part by themselves.

Even if they do not manage to do it in the most optimal way, your goal is reached. For this, pick one or two .stl files (you can choose the one that participants made or any of your choice) and let the everyone perform your step-by-step actions of slicing in parallel.

Present the most common plastic used for 3D printing. It is PLA, ABS and PETG. The goal is not to compare particular technical numbers (like working temperature or strength),

but to explain in which situation it is better to use each of them. This should take maximum 15 minutes.

After that, move on to demonstrate 3D printer. You could present the main parts of the device, such as: nozzle, print head, feeder, stepper motor, motherboard, axles, belts, heat bed as well as the main working principles of 3D printers.

Tip: explain about 3D printing materials that you are familiar with. If you never used ABS or PETG, just talk about them less.

While explaining the working principles of a 3D printer, just follow the route of the plastic wire – where it goes and how particular parts that are touching the plastic wire are affecting it.

Hands-on activity

Some tips to get started:

The activity will require particular materials (check the list!) and suitable environment. Check the slide presentation **Moulding Primer** to understand the process yourself. You can also use these slides during the workshop for making an introduction to the practical part.

Make sure that everyone understands how to mix the silicone components together. If you mix components in the wrong ratio, it might not harden at all or will become hard too soon (in a few minutes).
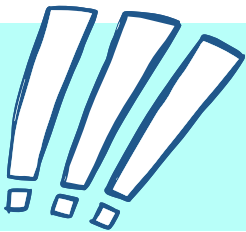
Make a silicone mould yourself at least one time before the workshop from the beginning until the end and pay attention to what could go wrong.

Silicone moulding: process

1

Preparation of printed 3D forms

removing the supports, sanding

2 Making a box

that will be used
to place the
model and pour
it over
with silicone

3 Preparing silicone

measuring the
amounts and mixing
the components

4 Pouring silicone into paper forms

covering the 3D
forms with silicone
mix and leaving it
stand for 24 hours

Extra day: making chocolate

Expand the workshop even more

Silicone forms can be used for baking cookies (you can put them in the oven), making chocolate, candles or soap. They are **heat-resistant and reusable.**

You could **organize Day 3** and make it a nice opportunity to gather again and have another hands-on experience. Turn this into **a gift-making workshop** before Christmas or Valentine's day, or a culinary activity for your youngsters!

Workshop participants can also take the final step - to pour the desired solidifying delicacy into the prepared mould - **at home.**

Main steps in this part are:

• Remove the 3D forms from silicone
• Clean the silicone forms by removing unnecessary parts
• Prepare chocolate, wax or other suitable materials for pouring into silicone forms
• Pour the material into the silicone form
• Wait until the substances harden enough for using them
• Remove them from the silicone forms and use as needed!
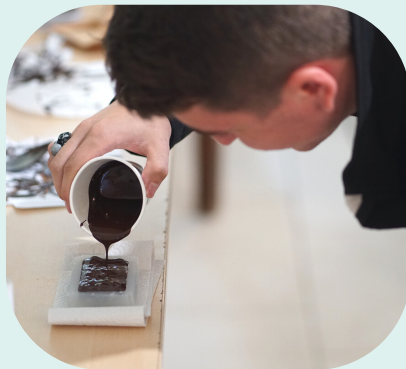
SELF-ASSESMENT 0 → 10

1. ABILITY TO UNDERSTAND HOW a 3D PRINTER WORKS
2. ABILITY TO RECOGNIZE THE MAIN PARTS OF A 3D PRINTER
3. ABILITY TO SELECT SUITABLE 3D PRINTING MATERIAL
4. ABILITY TO MODELING USING 3D PROGRAM
5. ABILITY TO UNDERSTAND PRINCIPLES OF BASIC SILICON MOLDING
6. ABIL...
7. AB...
8. ABILITY TO EVALUATE ... PROJECTS
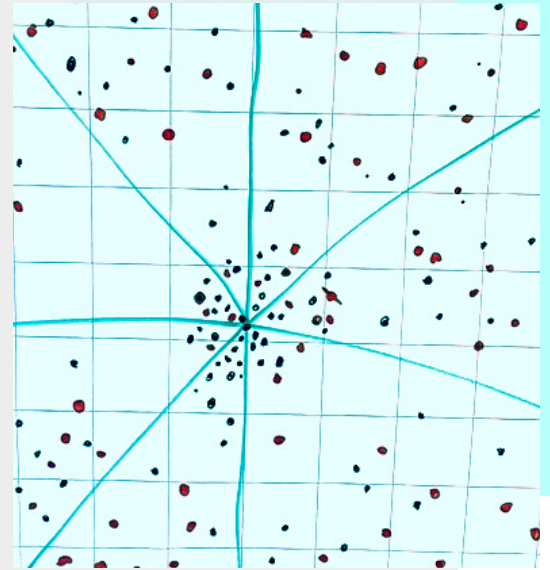9. A...
10. DEVELOPED SKILLS OF TEAMWORK
11. BOOSTED CREATIVITY

Evaluation methods

Reflection is important

In the next part, we provide a selection of evaluation and self-evaluation methods that can be used before, during and after the workshop. These tools were used during local workshops in the testing period.

EVALUATION METHODS FOR WORKSHOPS

What is evaluation?

Evaluation is a systematic and ongoing process of obtaining information and using it to come to conclusions. It is important to make evaluation in order to:

- Find out participants' opinions/emotions about the activity;
- Understand what was good;
- Clarify how and what can be improved;
- Clear up undefined conclusions.

A Pillow war can be an evaluation method!

A participant receives a pillow and says his/her assessment and throws it to the next one who has to give his/her assessment. Please note, that this works if the group is in a good relationship and has no intention to harm anyone.
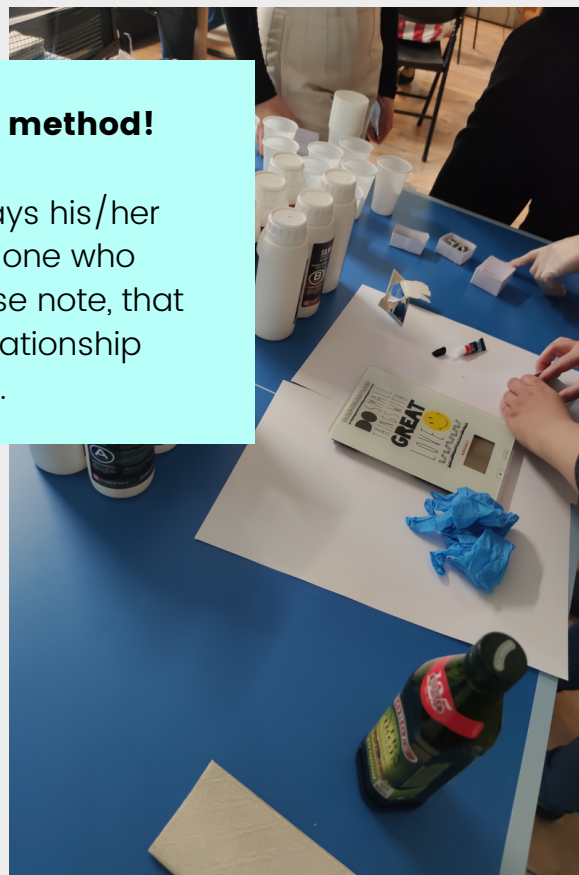
Evaluating participant abilities:

All participants were asked to evaluate their 3D-related abilities both in the beginning and at the end of the workshop:

- Ability to understand how a 3D printer works;
- Ability to recognize the main technical parts of a 3D printer;
- Ability to select suitable 3D printing material;
- Ability to prepare a file format suitable for 3D printing;
- Ability to model using a 3D program;
- Ability to understand the principles of basic silicone moulding.

The purpose of self-assessment is to find out how much progress individual has made, to help the individual know the extent of his abilities and to improve upon them without the need of a performance appraiser.
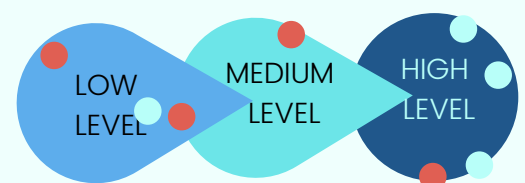
Evaluating soft skills

During self-evaluation, questions about soft skills can also be added.

Relevant skills:

- critical thinking skills
- design thinking skills
- technical thinking skills

- creative thinking skills
- analytic thinking skills
- innovative thinking skills

Participants evaluate their skills:

LOW LEVEL   MEDIUM LEVEL   HIGH LEVEL

Methods that can be used during workshop

1 Flipcharts with criteria

Before the workshop, provide participants with a flipchart with criteria and **one color** marker and ask them to assess their ability in each criteria. **After** the workshop provide **another color** and ask them to assess their ability again. Online this could be done in Google Forms indicating an exact number from a scale.

I understand how a 3D printer works

I can recognize the main technical parts of a 3D printer

…

2 A gamified version – "The Pizza"

The same principle works in a pie-chart with sectors that represent pizza slices. How close markers are to the center of each pizza slice (must be pre-defined if the center 0 or 10)indicates how satisfied or aware they are about their abilities before and after the workshop. The Pizza chart can be drawn on paper, or made online using Google Slides.

Methods that can be used
after workshop

1 Debriefing circle

After the activity all participants sit in a circle and facilitator asks questions. Participants share their opinions, and the group continues with a discussion. An option is to divide participants in smaller groups (or even pairs) if it's important to get more detailed answers or give each participant more time to share their conclusions.

Questions can be provided also before the debriefing circle. Participants individually fill out the questionnaire and join the circle.

Question examples

2 Visual evaluation with debriefing

First create 4 flipcharts with questions, then put them in different corners of the room. Each participant take around 15 min to walk around the room, write their reflections and conclusions about the activity. In the end the facilitator (or any of the participants) read conclusions about each question and the group has a discussion in a circle.

Experience
What did you observe during the activity (objective facts)?
What happened?
Reflection
1. What do you think about the activity?
2. What did you like?/ What was good?
How do you score the activity (from 1 to 10, where 1 is the lowest score and is the 10 highest)?
How did you feel?
Did you find the activity easy or difficult?
What was the most challenging?
3. What could be improved if the activity would be run again? / How could we improve the activity?

Conceptualize
What can we learn from it?
What did you learn during this activity?
What do you think is the most important when it comes to ……?
4. Are there any unclear questions? Anything else you would like to mention?

*Applying*
How can we transfer it to our lives? …….?

3

Representation through objects

Ask the participants to bring an object representing the activity and ask them to explain why exactly that object is the one they chose, ask them to share their opinions/thoughts/ etc.
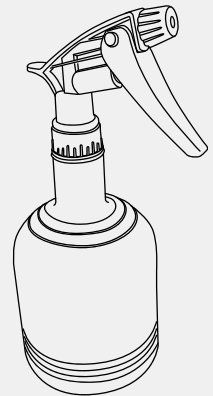
I brought a ruler because after printing I discovered that I did not calculate the length of my prototype right.
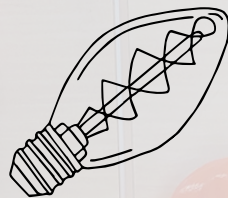
Light bulb - because I have so many ideas what I want to make with a 3D printer.

I tried to make a flowerpot for my mom's small cactus and I used this flowerpot for inspiration.

This is made out of PLA as was the 3D printing material we used. I did not know it is made out of corn.

4

Associative cards

Provide the participants with associative cards/cards with pictures like Dixit, Lilluu, Points of you, etc.

a) Randomly deal each participant 3-4 cards, them let them associate their experience

b) Lay the cards on a table and let the participants choose one that can help describe their thoughts about the workshop.

∗ In any method, open questions for self-evaluation can be included:

- *I feel good about...*
- *I am proud of ...*
- *A strategy that really helped me learn better is...*
- *If I could do something again differently, I would...*
- *One thing I will remember to do in the future is...*
- *One thing I really want to learn more is...*

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Non-formal activities

Enhance the workshop experience

Project partners have selected and tried out a range of activities to be used during the workshop. They aim at getting to know each other, teambuilding, boosting creativity, and evaluation. Facilitators can include them at different parts of the workshop in order to enrich the non-formal learning experience.

Non-formal activities

When choosing games, we recommend the following advice:
- Time - since the time of the workshops is usually already limited, it is worth choosing shorter games.
- As for the content of the workshop, if the modeling part is at hand, it is worth making games that stimulate creativity.
- When the energy of the group goes down, it is worth doing energy games.
- If there is a group that knows each other, then there is no need to put emphasis on familiarization games, but at the beginning of the workshop you could get to know the workshop facilitators. However, if there is a group of strangers, it would be good to play 1-2 familiarization games to create a group.

1.Getting to know each other

Dixit cards
Time: 10-15 minutes
Tools needed: Dixit cards

At the beginning of the workshop, Dixit cards can be used. They allow the participants to open up a little.

Take Dixit cards and lay them picture side up on the table. Everyone takes one card and explains to everyone why they chose this card or how it characterizes them. The topic of discussion can be chosen depending on the mood or the topic of the workshop.

Bingo
Time: 10-15 minutes
Tools needed: Bingo card with different kind of questions, pen or pencil

One of the best ways for people to get to know each other is to play a game of People Bingo! It's easy to play, just give each person a Bingo card (filled with different kind of questions) and make sure everyone has a pencil or a pen.

The Bingo players move around the area trying to be the first to get their Bingo card filled up with different names. It is great ice breaker to help people get to know one another or to practice asking and answering questions about likes/dislikes, future activities, school subjects, holidays hobbies, etc.

It is always fun to get a prize or a treat for a job well done, whether you are the first to finish or the last. Everyone can be a winner playing People Bingo!

Three Truths and a Lie
Time: 10- 15 minutes
Tools needed: paper and pen to anyone

All you require is 3 or more members sitting in a circle, with each person taking turns to state four facts about self, out of which 3 are true and the remaining 1 is a lie. The instruction is to frame the lie realistically rather than making it look hard to believe and easy to guess. Once the facts are stated, the other team members take turns to identify the lie from the 4 statements. Once all are done with guessing, the right answer is revealed at the end. The game works wonder for new or geographically scattered teams who can benefit by knowing more about their teammates. It challenges preconceived judgments and helps introverts to open up in a group set-up.

Group order
Time: 15 Minutes

Goal: Have the team correctly line up in order of a specific criteria.
Ask the group to line themselves in order based on certain criteria. Make it more challenging by setting a rule that members can't speak to each other. You can do this as a get-to-know-you-better activity. Some examples are by: birthday, height, shoe size, hair color, eye color
As members move around the room to organize themselves in order, you'll notice how they communicate to complete the task and who takes on the role of organizers or leaders.

2. Team building

Human Knot
Time: 15 - 20 minutes

Have everyone stand in a circle facing each other, shoulder to shoulder. Instruct everyone to put their right hand out and grab a random hand of someone across from them. Then, tell them to put their left hand out and grab another random hand from a different person across the circle. Within a set time limit, the group needs to untangle the knot of arms without releasing their hands. If the group is too large, make multiple smaller circles and have the separate groups compete.

Objective: This game for team building relies heavily on good communication and teamwork.

Flip the blanket
Time: 15 minutes
Tools needed: One or more blankets (or tarps) just large enough for the entire group to stand on

This activity usually works best with groups of 8-15 people. As with any group activity requiring close physical contact, remind participants that if they become uncomfortable at any time, they may excuse themselves from the game. Also, if you have a particularly large group, you may want to create two or more teams and have them compete against one another. First, lay a blanket (or a tarp) flat on the ground. The entire group will start out standing on the blanket with the object of flipping the blanket entirely over. They may not step off of the blanket at any time and they may not use their hands. If someone violates one of these rules, the group will have to start over.

Scavenger Hunt
Time: 30 min-1 hour
Tools Needed: Pen and Paper

Rules: Break the group into teams of two or more. Make a list of goofy tasks for each team to do as a group. Tasks can include taking a selfie with a stranger, taking a picture of a building or object around the office, etc. Give the list to each team, along with a deadline by which they must complete all tasks. Whoever completes the most tasks the quickest, wins! (You can even create your own point system according to task difficulty if you want!)

3. Boosting creativity

Game of Possibilities
Time: 10-15 Minutes
<u>Tools needed:</u> Various random objects, one per each participant

Goal: Come up with alternative uses for everyday objects and have team members guess said uses.

Each participant is given an object and must demonstrate an alternative use for it. You can use anything from a basketball or plastic bag to a hula hoop or stapler.

Give the participant one-minute to silently act out their alternative use for the object; for example, a stapler could be used as a fork or a trumpet. While they're acting, others in the group try to guess what they're mimicking. Every person who correctly guesses the alternative use gets a point. Once the minute is over, the next person will do the same and so on.

The Game of Possibilities is a great way to bring out your team's creativity and quick thinking as well as a fun way to boost team creativity and innovation.

Follow Up Questions: What was the most creative use someone came up with? Did you struggle to come up with alternative uses? Did it get easier over time?

Blind artist
Time: 10 minutes
<u>Tools needed:</u> paper, pencils

Have participants form pairs. They can't see each other. One participant gets a drawing you have prepared earlier. Ideally, the drawing should be something relevant to what you are teaching.
The participant holding the drawing needs to give good instructions to the other. The other needs to draw it without being able to see the original picture. If you want to spice up the game, you can put a variety of conditions to it. For example: no asking questions, must draw with your non writing hand etc. Aren't you curious about the results?

When you use this energizer as a revision activity, you let the pair explain to the rest of the class what the drawing is about.

Don't answer
Time: 10 minutes

Ask the participants to stand in a circle. One of them starts by going up to someone else. The participant asks the other a question. For example: "What is your most annoying habit?" However, that person may not answer the question, but the person on his left must answer. The answer doesn't have to be right. Participants can make their answers as imaginative as possible. Fun guaranteed!

4. Evaluation

Give a compliment
Time: 15 minutes
Tools needed: Papers, pencils

No one's too old for compliments! This energizer lets people feel better about themselves by sharing compliments. Each person gets a paper on their back. Every person has to write down a compliment on the paper on the backs of every other person. They cannot miss a single one. Afterwards the participants can read their paper and all the compliments they have been given.

Negative to positive
Time: 15 minutes

The principle of negative to positive exercise is to notice things and lessons from situations that we would otherwise perceive negatively. To carry out the exercise, participants should pair with other team members with whom they have shared work-related experiences, such as joint projects, tasks or activities. One of the couples should mention some negative aspects of their shared experience and partner should highlight its positive aspects. After that the paired roles should exchange and repeat the same thing. This task is best used with a large team that has shared many different experiences together, as it helps team members get to know each other better, while encouraging positive thinking about failures. For an even better experience, ask to change partners after each exercise.

Useful links
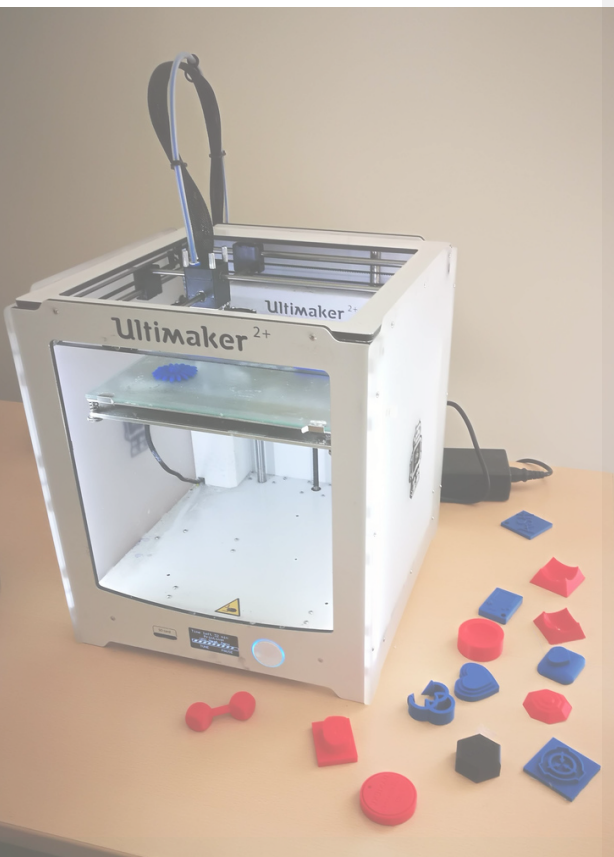
Here are most important links

that will help you easily find the project's resources, which are all free and accessible to any interested person. Click on the underlined text to follow a hyperlink to your preferred resource.

Methodological materials for 3D workshops:

English version
Lithuanian version
Latvian version
Estonian version

As you will see, these materials are on website play.gaminu.eu. You need to register to get access to the website. Alternatively, you can use your Google account to login.

If you want to learn more about the project, check this out:

Project's website (English)
 youngcreators.gaminu.eu

Project news feed in Lithuanian

News about the project in Estonian

The information in Latvian
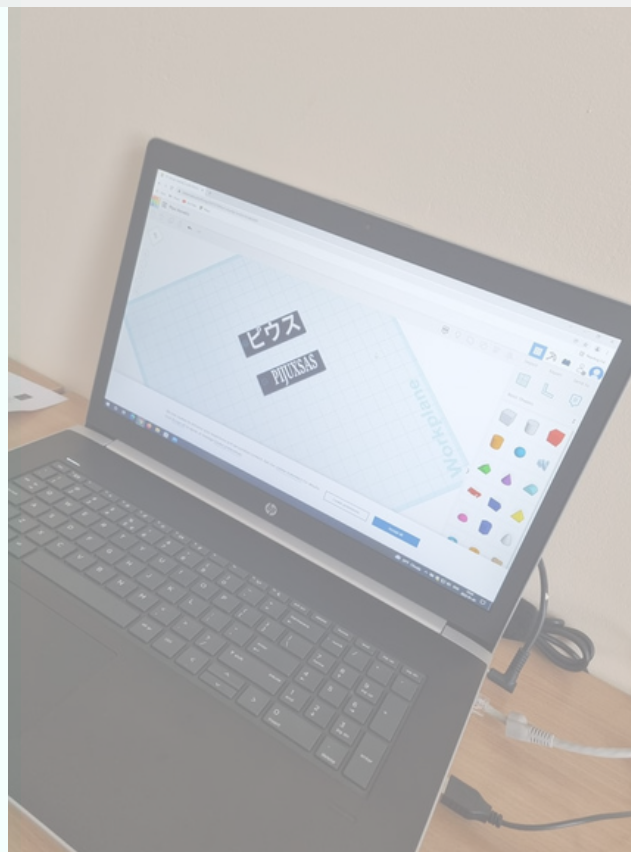
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