

FAST

Promote
Female
Start-ups
in STEM



 European
University Cyprus



IULM
UNIVERSITY



STEM LITERACY FOR YOUNG WOMEN



Erasmus+



YOUTH
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STEM LITERACY for Young Women is a product of "**Fast prototyping and entrepreneurial skills to promote female founded start-ups in STEM**" project. This project has been funded by European Commission.

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Partners: **IULM University** (Italy), **PontoPr** (Portugal), **RACIO** (North Macedonia)



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Fast prototyping and entrepreneurial skills to promote female founded start-ups in STEM

Instructions and tools to conduct STEM themed workshops, lessons, quick exercises: Inspired by daily activities or widely used items and practices, in particular showing how STEM can be applied in real life job and in non-scientific jobs (arts, fashion, food industry)
 Inventory of tools, examples, exercises, reading or experiments used during workshops: activities: lessons.

FAST Promote Female Start-ups in STEM



Young **WOMEN** - 18 to 30 years
 Socioeconomic barriers - migrants background, weak family support, early school leavers)



A **NEW** way to fostering Girls' interest in STEM and **INSPIRING** them in choosing a **CAREER** within **STEM** fields.



Increase **STEM** literacy, Increase *Entrepreneurial Skills* and **MOTIVATION** for personal improvement, Create a **BUSINESS** and connect experts and mentors



fasterasmus.com

Introduction

STEM LITERACY for Young Women is a product of “**Fast prototyping and entrepreneurial skills to promote female founded start-ups in STEM**” project. This project has been funded by **European Commission**, under the **ERASMUS + programme**.

This product is one of the four products that during the implementation of ‘**FA-ST**’ project has been developed. You can find more about the FA-ST project and its products in the main website: www.fasterasmus.com

What will you find inside this product?

In this product, so called “**Digital Catalogue**”, we offer an inventory of workshops and practical activities that can be organized outside the educational system, offering examples on concrete applications of STEM in real life use and purpose for STEM, encompassing also subjects where STEM is less evident but still largely used (like arts, fashion, food industry...), also activities to rise **STEM Awareness** and **Literacy** among girls and young women.

In the beginning of the product, you will be informed about the general project “**Fast prototyping and entrepreneurial skills to promote female founded start-ups in STEM**”; Explanation about **STEM, STEM literacy** and recognition of STEM literacy; Data related to the Women Unemployment as well as Data to **Women in STEM**; Main part of the product, different **Training, Workshops and Activities** and **Real-life stories** related to **STEM in fashion industry**. Also, in the end of the product you will find a **multi-dimensional Generic Assessment** which we are offering to this product.

Who is the main target group?

The main target group are Young women (18 to 30 years of age) coming from disadvantaged backgrounds, such as early school leavers, of immigrant background, facing social and economic exclusion, not in education/employment for a long time (at least 6 months) as well as from low- or no-income households and/or disadvantaged urban/rural areas.

How to use this product?

This product can be used by Educators, Trainers, Teachers who conduct activities in STEM field as well as in different fields, because some of the

activities are based on non-formal education and they can easily be adapted to the needs of the person in charge to conduct the activity.

Those who want to deliver these activities need to have background knowledge on STEM as well as knowledge on non-formal education. Some activities require higher knowledge on programming as well. The level of the activities is shown at the '**Content page of activities**'. *The green line is for the easy activities, yellow stands for the medium and red is for hard activities for which you will need knowledge on STEM, Programming and Computing.*

For the target group there is a basic knowledge on Computer, as majority of activities are conducted in Computer. **At section 4.1** we have provided an extra activities related to general digital skills which will help those participants in need. *Because of this we strongly suggest Trainers to know the knowledge limit of their target group before conducting any activity!*

You can start by explaining the term STEM and STEM Literacy, aim and general objectives of the STEM to your participants, after that you start with section 4.1 which is there as a help you and help the participants to be prepared before starting any activity/workshop. After that, based on the knowledge that the participants have you can start with the workshops.

Non-formal education methods

Mainly activities can be used for other purposes with some adaptations as they are based on non-formal education. In 21st century there is a need for new teaching methods which are based on non-formal education. Non-formal education refers to education that occurs outside the formal school system. Non-formal education is often used interchangeably with terms such as community education, adult education, lifelong education and second-chance education. It refers to a wide range of educational initiatives in the community, ranging from home-based learning to government schemes and community initiatives. It includes accredited courses run by well-established institutions as well as locally based operations with little funding.

Pedagogy of the twentieth century differs from the pedagogy of **the twenty-first century**. Since the beginning of the twenty-first century, there have been many changes in the development of national and world education. In the twenty-first century, significant changes are occurring related to new scientific discoveries, informatization, globalization, the development of astronautics, robotics, and artificial intelligence. This century is called the *age of digital technologies and knowledge*.

A number of different teaching techniques have emerged due to this change in education. Many of these **teaching techniques** are not actually new! The **use of technology in the classroom** has simply given education a new lease of life allowing us to approach old ideas in new ways.

Some innovative approaches that educators/teachers/trainers can implement during any activity, for example *Math teaching strategies*: **Math games, Mental math, Solve math problems faster, Multiplication games, How to divide fractions, Math websites, Common core math, Hot to teach multiplication, Multiplying fractions, Math puzzle...** are some of the strategies that you could use during your activities.

Example: Common core Math


For some students, math is complicated enough. Even when it consisted of counting on fingers and grouping blocks in an effort to grasp the concept of multiplication, it sometimes still proved challenging. **Common Core math** is a new framework that seeks to improve students' conceptual understanding of math by encouraging problem-solving, critical thinking, and discussion skills.

Since it's so new, instructors have struggled to prepare materials that align with the standards. If that's you, here are some techniques to get you started:

- **Use modular tools:** Younger students can model their problems using number blocks, and older student can use everyday objects to “act out” the concepts they’re learning.
- **Encourage peer discussion:** Common Core standards place a large focus on critical thinking and problem solving — two things that students can learn by talking through problems with their peers.
- **Math journals:** Writing out the steps they took to solve a problem helps students to understand where they got stuck. Plus, it’s a great tool for teachers looking to keep track of student comprehension.

COMMON CORE MATH View the arithmetic problems below to see the difference between traditional (pink) and Common Core (green) math.
Source: Business Insider

SUBTRACTION

$234 - 86 =$ $\begin{array}{r} 1\ 12\ 1 \\ 234 \\ -86 \\ \hline 148 \end{array}$	$86 + 4 + 10 + 100 + 34 = 148$ 
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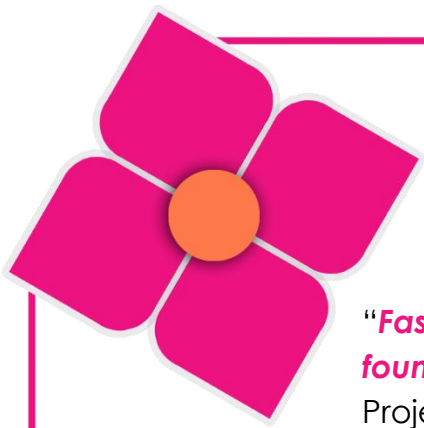
ADDITION **MULTIPLICATION**

$\begin{array}{r} 23 \\ +15 \\ \hline 38 \end{array}$	$23 + 15 =$ $\begin{array}{r} 23 \\ +7 \\ \hline 30 \\ \downarrow \\ 30 + 8 = 38 \end{array}$ SINCE $3 + 7 = 10$, USE 7 THINK: $15 = 7 + 8$ ADD $23 + 7 = 30$ ADD $30 + 8 = 38$ SO, $23 + 15 = 38$	$\begin{array}{r} 1 \\ 42 \\ \times 8 \\ \hline 336 \end{array}$	$40 \times 8 = 320$ $2 \times 8 = 16$ $320 + 16 = 336$
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FO:ST

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Start-ups
in STEM





What is FA-ST?

“**Fast prototyping and entrepreneurial skills to promote female founded start-ups in STEM**” also known as “**FA-ST**” is a European Project funded by **European Commission**¹ through **ERASMUS+ programme**².

The project consortium consists of 4 partners: **European University Cyprus (Cyprus)**, **International University of Languages and Media IULM (Italy)**, **Center for Educational and Cultural Development “RACIO” (North Macedonia)** and **PontoPR (Portugal)**.

FA-ST provides opportunities of empowerment and development to **young women (18 to 30 years of age)** affected by socioeconomic barriers (migrants background, weak family support, early school leavers), and inspire them to start a business in the STEM (Science, Technology, Engineering and Math education) sector.

The high-quality practical resources produced by the 4 partners in the FA-ST consortium are used to increase a wide set of competences, necessary to compete in the actual labour market (**STEM literacy, soft and entrepreneur skills**) while offering a substantial and comprehensive support to those willing to start a business in the STEM sector (fast prototyping, business planning).

FA-ST will offer a new way to fostering girls' interest in STEM and inspiring them in choosing a career within STEM fields.

Considering the increasing importance of **STEM in the global market**, and the employment opportunities connected to it, increasing STEM literacy and entrepreneurial mind-sets widespread opportunities in the EU28, thus the root-based initiative like this one will offer a good starting point for a positive change in STEM situation.

The project can be used as a **baseline practice for STEM literacy** and **STEM skills development** for other similar initiatives, expanding as an example to youth work and civil society initiative as a mean to validate non-formal or informal skills. The practice can be easily transferred to other institutions or countries as the skills for sustainability and responsible behaviours are relevant and applicable in all the EU (and beyond) Nations. For this reason, a version of the contents will be created in English to facilitate a wider diffusion

¹ Read more about European Commission: <https://ec.europa.eu/>

² Read more about Erasmus +: https://ec.europa.eu/programmes/erasmus-plus/node_en

The project has 3 strategic objectives:

To promote a more engaging and more equal environment where all students, girls and young women in particular, can increase their STEM literacy levels

To foster equal access to better careers and job opportunities in the STEM sector for young women

To enhance the employability, and entrepreneurial skills of young women with a business idea in the STEM sector

The '**STEM LITERACY for Young Women**' it is also translated in **Greek, Italian, Portuguese** and **Albanian language**. For more details related to the project and its products as well as for other translated documents you can check the website: fasterasmus.com

You can also find and follow the project in our social media channels:



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STEM



2



What is STEM?

STEM is a curriculum based on the idea of educating students in four specific disciplines — **science, technology, engineering and mathematics** — in an interdisciplinary and applied approach. Rather than teach the four disciplines as separate and discrete subjects, STEM integrates them into a cohesive learning paradigm based on real-world applications.

STEM stands for science, technology, engineering, and mathematics. STEM is important because it pervades every part of our lives. Science is everywhere in the world around us. Technology is continuously expanding into every aspect of our lives. Engineering is the basic designs of roads and bridges, but also tackles the challenges of changing global weather and environmentally-friendly changes to our home. Mathematics is in every occupation, every activity we do in our lives.

By exposing students to STEM and giving them opportunities to explore STEM-related concepts, they will develop a passion for it and hopefully pursue a job in a STEM field. *A curriculum that is STEM-based has real-life situations to help the student learn.* Programs like Engineering for students integrates multiple classes to provide opportunities to see how concepts relate to life in order to hopefully spark a passion for a future career in a STEM field. STEM activities provide hands-on and minds-on lessons for the student. Making math and science both fun and interesting helps the student to do much more than just learn.

In an increasingly technology-oriented world, growth in areas related to science, technology, engineering, or mathematics (STEM) outpace all others. To remain competitive in the global economy, our nation's students need to be prepared for the careers of tomorrow.

Approximately 20 percent of careers require STEM skills, with STEM-intensive careers (5% that are science, engineering, mathematics) and STEM-infused (another 15% that rely heavily on content from one or more of the STEM disciplines). "Based on these workforce analyses, it is not unreasonable to say that about 20% of U.S. workers will be utilizing their STEM-expertise on a regular basis" (Meeder, 2014). And on top of these STEM careers, there is a level of STEM literacy necessary to be an informed citizen.

Within public policy, for instance, citizens need to understand topics such as the science of vaccination requirements just to be an informed voter (Meeder,

2014). And with the world becoming increasingly digital, citizens need to have the problem-solving skills to troubleshoot technology issues.

STEM literacy is fast becoming a requirement for life in the nation's future, so a "STEM literacy for all" (Sanders, p. 23) approach is better here; broad strokes will better serve our students.³

What is STEM literacy?

STEM literacy relates to a student's ability to understand and apply concepts from science, technology, engineering and mathematics in order to solve complex problems. But STEM-literate students are not only an innovator and critical thinker, but is able to make meaningful connections between school, community, work and global issues:

- **Scientific literacy is the ability to use knowledge in the sciences to understand the natural world**
- **Technological literacy is the ability to use new technologies to express ideas, understand how technologies are developed and analyze how they affect us**
- **Engineering literacy is the ability to put scientific and mathematical principles to practical use**
- **Mathematical literacy is the ability to analyze and communicate ideas effectively by posing, formulating, solving and interpreting solutions to mathematical problems**

Recognizing STEM literacy

The National Research Council (NRC) defines STEM literacy as

"the knowledge and understanding of scientific and mathematical concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity" (2011, p. 5). In STEM Lesson Essentials, to be STEM literate means having the skills "to function and thrive in our highly technological world" (Vasquez, Sneider, & Corner; p. 9). Ultimately, STEM literacy is less about discrete content and instead more about developing a set of cognitive skills (Lederman, 1998; P21, 2009; Zollman, 2012).

Literacy is about communicative competency, the ability to do and share. To that end...

³ Check more: https://www.researchgate.net/publication/329464731_Exploring_STEM_literacy

STEM-literate student:

Demonstrates problem-framing and problem-solving skills, applying them across disciplines

Articulates that technology is used to expand knowledge and ability

Draws connections to the opportunities specific technologies create for individuals

Persists through productive struggle to attain success, especially as it relates to technology and engineering design.

Makes informed decisions using sound reasoning that can be appropriately expressed

Articulates reasoning based in mathematical and scientific concepts and processes

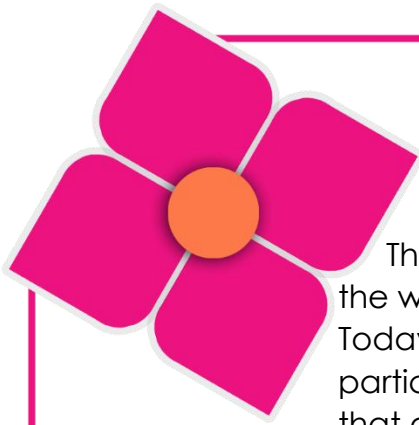
Evaluates information for relevancy and accuracy

A student who is accomplishing these tasks is actively demonstrating the 6Cs (creativity, critical thinking, collaboration, communication, citizenship/culture and connectivity) when engaged in work. The 6Cs are the 21st Century skills that UNESCO in 2017 has promoted and identified as integral to building the successful workforce of tomorrow.



3





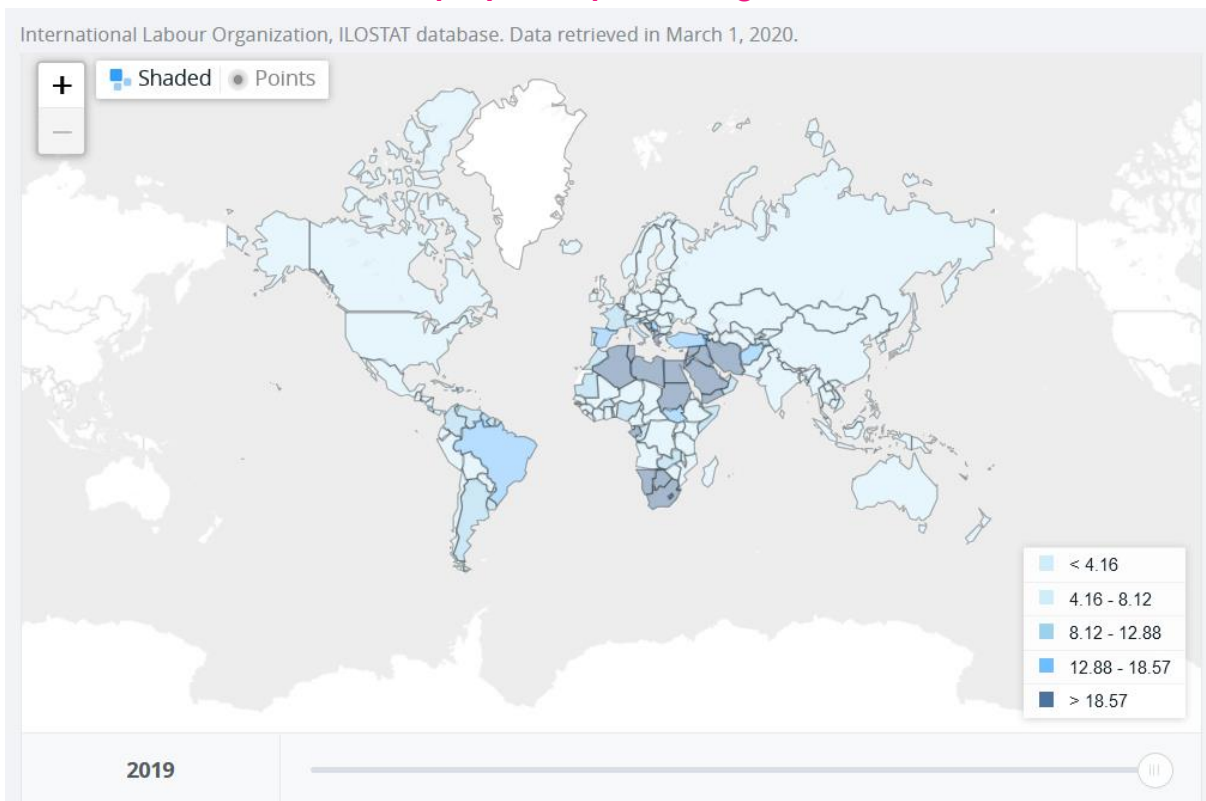
Unemployment Rate

The past **20 years** have witnessed some progress for **women** in the world of work and in terms of gender equality in society. Today, more women than ever before are both educated and participating in the labour market, and there is greater awareness that gender equality is of paramount importance in efforts to reduce poverty and boost economic development.

Women are more likely than men to be unemployed in large parts of the world!

Not only are women less likely than men to participate in the labour force, but those who do are also less likely to find employment. As of 2018, the global unemployment rate of women, at **6 per cent**, is approximately 0.8 percentage points higher than that of men. This translates into a ratio of female-to-male unemployment rates of **1.2 in 2018**. By 2021, this ratio is projected to remain stable in developed countries and to increase in both developing and emerging countries, mirroring the deterioration in the relative position of women in terms of global unemployment observed over the past decade.

World data related to unemployment percentage of women.⁴



⁴ Check more:

<https://data.worldbank.org/indicator/SL.UEM.TOTL.FE.ZS?end=2019&start=2019&view=map>

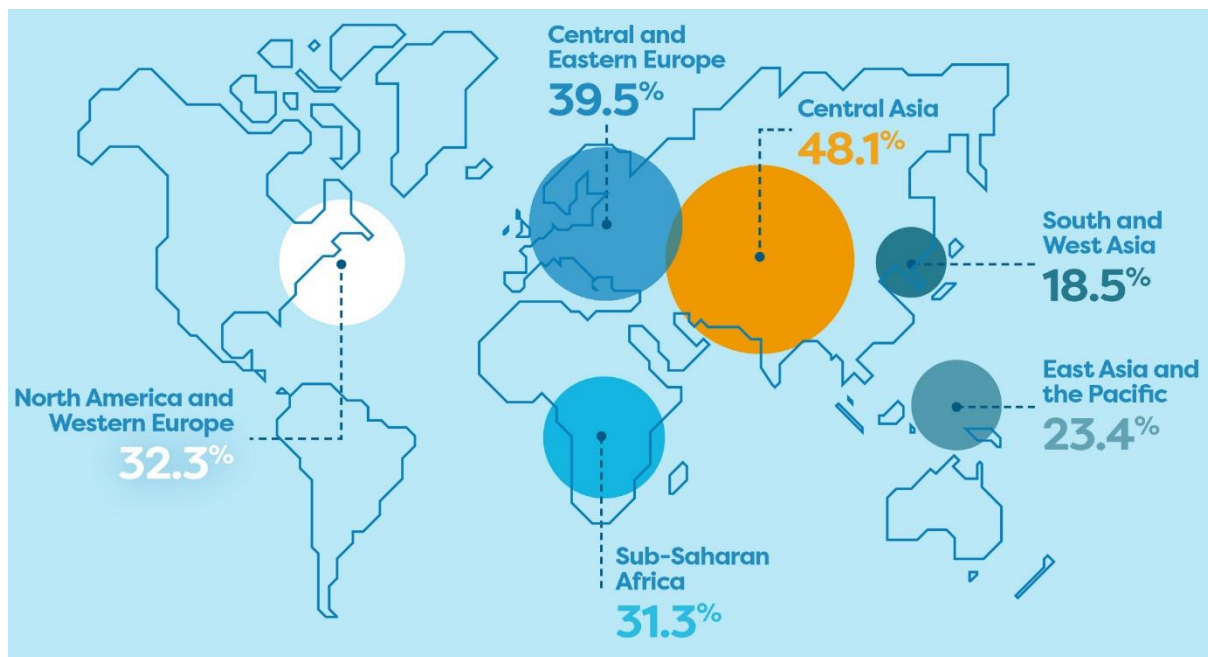
Women unemployment rate:

Portugal	6.9 % (2019)
Cyprus	8.1 % (2019)
Italy	10.8 % (2019)
North Macedonia	17.0 % (2019)

In 2018, **16,848** Girls and **26,202** Boys received a Bachelor's degree in STEM disciplines, while **11,456** Women and **17,623** Men received a Master's degree. In total, then in 2018, **28,304** Girls and **43,825** Boys graduated in STEM disciplines.

Women in STEM – A Global Perspective

Of all scientist's employment within research and development (R&D) worldwide, only 28.8% are female (as of 2015). A breakdown of the regional averages is shown below⁵:



The gender gap is particularly pronounced in engineering and computer science, where nearly **four out of every five** doctoral graduates in 2014 were men.

Still, millions of women pursue degrees in STEM fields. STEM department chairs across the countries are recruiting women into their fields, actively cultivating an open and inclusive environment for students from all backgrounds.

⁵ <http://uis.unesco.org/sites/default/files/documents/fs51-women-in-science-2018-en.pdf>

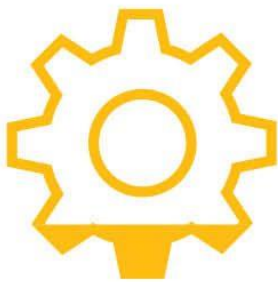
"An investment in knowledge pays the best interests."

Benjamin Franklin

Women in STEM

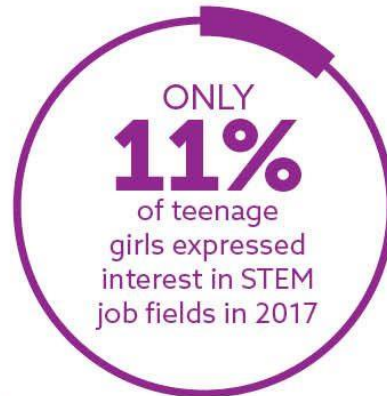
There are more jobs in STEM available than the number of people qualified to fill them. Women are needed to help fill these jobs and to provide different perspectives and skill sets.

EDUCATION



15%

of engineering faculty in universities and four-year colleges are women

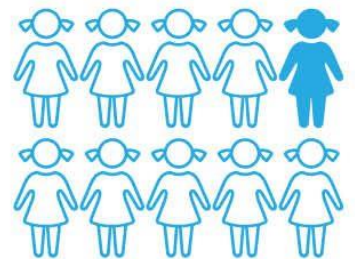
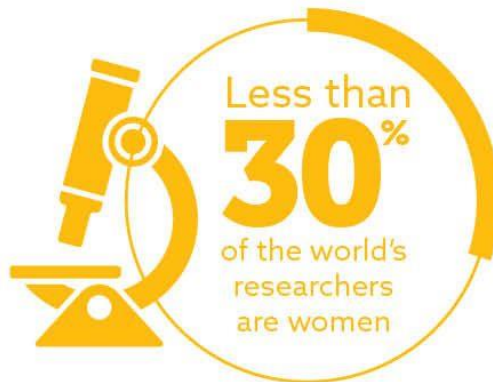


EMPLOYMENT



1 IN 4

computer and mathematical workers are women

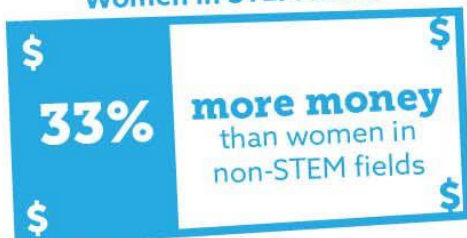


1 IN 10

scientists or engineers is a minority woman

SALARY

Women in STEM make



Women-led tech companies are





4

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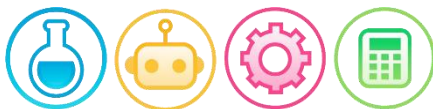
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Intro to Startups and STEM

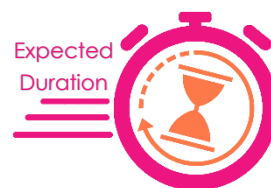


Girls and Young Woman age 18 – 29, It can be adapted for uneducated young woman, high school students

Relationship of the Activity with STEM



This activity is closely related to an entrepreneurial skill that a person needs to develop, irrespective of the area of interest and the professional career choice: the skill of teamwork. This is considered a life (transversal) skill and it is vital to be developed by all young people, irrespective of their specific interest in STEM or entrepreneurship topics.



2h 30minutes



Content / Description of the Activity:

Start by brainstorming of word “**Start Ups and STEM**”. Ask participants what they first think when they hear it, what does it mean to them.^{10'}

Introduce the “**Where do you stand**” exercise and use the following statements, where participants have to choose if they:

*Agree and stand on one side of the room;
Disagree and go on the other side or
they are undecided and stand in the middle.*^{5'}

Read each statement out loud, allow the group to take a position and give them the space and the word to express their opinion.^{30'}

Statements prepared from trainers:

Everyone can be an entrepreneur

Start Ups do not need a lot of money to be started/run

One needs to have the proper education to be able to start a business

Everyone can start a business based on STEM

It is easy to start up a social enterprise

Profit is very important for social enterprise

The private sector has the resources and entrepreneurial skills to create big social change

Big private companies in the development sphere can make. changes at far larger scale than much smaller NGO-s combined

Blending profit and non-profit organisation might lead to abuse or potential conflict of interests

Man can be a better entrepreneur then woman

Man can easier start up a business based on STEM rather than woman.

A businessman/businesswoman and an entrepreneur are the same people?

Make a summary of the exercise and give theoretical input on definitions on social entrepreneurship, startup, STEM and entrepreneurship. **10'**



Workshop: Importance of teamwork in overcoming business challenges

Working method: Discussion and brainstorming, group exercise, presentation

All participants are first asked to view these videos in advance:

- **Bullock Properties:**
<https://www.youtube.com/watch?v=dpM6WH3PV6k>
- **50 entrepreneurs share priceless advice:**
<https://www.youtube.com/watch?v=QoqohmccTSc>
- **Advice For Aspiring Female Entrepreneurs | Forbes**
https://www.youtube.com/watch?v=zAPc2ZGQ_Xo
- **The top 50 rules for Women Entrepreneurs**
<https://www.youtube.com/watch?v=DUsiTjOcb8>

Following the viewing of these videos, students should write down important entrepreneurial challenges and bring these notes in class/workshop, in small slip papers.

- 1) Before class, students choose usual entrepreneurial challenges and write them on slips of paper. Examples could include: time management, finding trustworthy team members, managing the team, locating mentors, knowing where to turn for help, etc. The facilitator can give one or two examples just to help them understand the concept and then allow the students to start sharing their ideas freely. This could be done before class or during the start of class. **10' maximum**
- 2) Place the slips of paper into 4 balloons, one in each and inflate these and another 20 balloons. **5'**
- 3) Place students into groups of 3 or 4. Give each group 5 or 6 balloons and ask them to choose a leader. The facilitator of this exercise can actively appoint a leader to each group up front, so that the participants who are not naturally taking the leadership role could use this opportunity to explore the role as well. One balloon should contain a slip of paper with a challenge. The leader will be responsible for rallying the team and reporting out at the end of the activity. If the facilitator feels the whole activity will get too messy and noisy, he/she can ask students to sit on the floor and throw their balloons to each other while seating.
- 4) Explain to students that as a team they will be required to keep all balloons in the air for **45"** by continuously batting them. If a balloon

touches the ground, students may pick them back up and continue. Let students know when the time is up. Ask them to hold their balloons.^{5'}

- 5) Empty balloons can be collected, but ask the group to keep balloons containing challenges. Have each group read the challenge inside the balloon and brainstorm ways to overcome it. After students are finished brainstorming, ask each group leader to share their challenge and the ways they would overcome it. After all groups have shared their input, collect the remaining balloons and have students return to their seats for the discussion.^{25'}
- 6) Facilitate a discussion about asking for help, being a trusted part of a team, and finding ways to push through other difficult situations. In the video, Tighe talks about how a lot of these things affected his life and business. Ask students to share their thoughts about why these points are particularly important when you are in business for yourself.^{20'}

Other discussion points to consider from the activity:

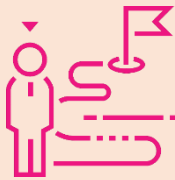
- ❖ The balloons represent the many aspects of life that must be juggled at any given time (schoolwork, family, social life, business operations, etc.)
- ❖ Sometimes, these aspects of life have hidden challenges that may not be apparent upon first glance (the slip of paper within the balloons)
- ❖ There will be times when not everything goes the way you plan, like in the activity when balloons are dropped on the floor. Most of the time, you can find a way to fix these situations, but they generally will require more creativity than simply picking the balloon back up like in the activity
- ❖ Teamwork: an important part of running a successful business, having the ability to maintain balance
- ❖ Help the participants become more aware of gender related issues and biases as individuals in relation to this exercise, e.g. how many of the examples viewed in the videos of successful role models included men, the role of leader always assumed by boys, how work-life balance is usually related to women as an issue they need to handle (more than men do)
- ❖ Time constraints, like the 45" activity timeframe, often change how we perform tasks. For example, students may have been moving very quickly in the game because they knew there wasn't much time. Discuss how this can affect the quality of work being done.
- ❖ Solutions are often easier to come by when you discuss them with multiple people – like brainstorming solutions at the end of the activity. It is often easier to build off of other people's thoughts than to rely solely on your own.

- ❖ People generally want to be part of a team with a positive leader. Have students think about ways they could create a positive atmosphere as an entrepreneur leading a team.

** Use these discussion points and any of your own to tie the activity back to the challenges and successes that successful entrepreneurs mention in the videos.*

** Each group creates a posterboard to represent an idea, e.g. "Life doesn't always go as planned, but there's always a solution" or "Teamwork is an essential part of life and running a successful business."*

Training Goals



- Clarify confusing vocabulary terms related to different forms of entrepreneurship, STEM, Start-Ups.
- Participant developed debating and critical thinking skills
- Participants are given the opportunity to ask questions in order to clarify their own understanding of the subject matter.
- Participants get information of what is youth entrepreneurship, start-up, social entrepreneurship and other related concepts.

Learning Objectives/ Learning skills



- Strengthen participants' knowledge of entrepreneurship and its associated concepts,
- Identify and clarify other related issues and dilemmas linked to the entrepreneurship.
- Recognize entrepreneurial challenges and brainstorm ways to overcome them.
- Appreciate the value of teamwork and collaboration for finding solutions.
- Develop problem-solving and team-building skills

Pre-requisite knowledge and skills

If participants know basic knowledge on entrepreneurship, start-ups, STEM it will ease the work of Trainers but it's not Mandatory

Tips for Trainers



If you don't know about the activity called **“Where do you stand”** – here you can read more about the activity and how it is done:

<https://greenteacher.com/activity-where-do-you-stand/>

The facilitator arranges the classroom in such a way as to have enough room for the balloons and the posterboards and the class is divided in small stations for small teams of 3-4 people to be developed.

If you want to show videos to those who didn't see, make sure you have them in your laptop or at least there is a WIFI

You can also make a power point presentation if it is more suitable for delivering the training for you.⁶

Tools and Resources (including hardware, software, ppts, handouts, videos, hands-on material)



A4 paper, hand out with statements, computer and projector for the YouTube video, Balloons, Scrap paper, Colored pencils, Crayons, Markets, Posterboard and other craft materials.

Instructional Setting (class/group/group room, online, blended)

Classroom, conference room or gym, depends on the situation that you are and the possibilities that you have

Pedagogical Approach



Co-operative Learning - Group and cooperative learning strategies are a priority, students work in groups;
Inquiry Learning - Learning is directed by questions, problems, or challenges that students work to address.

⁶ Training module on entrepreneurship

<https://www.stemitup.eu/Activity/Entrepreneurial-Challenges-and-Balloons>

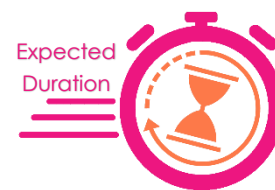
SWOT analyses



Girls and Young Woman age 18 – 29, It can be adapted for uneducated young woman, high school students



This activity requires teams to use skills central to entrepreneurship and STEM, including creativity, ingenuity, experimentation and communication. This activity offers participants the opportunity to work in a variety of ways that facilitates inclusiveness and necessarily requires good teamwork, communication and creativity without a single "correct" solution. The activity can be used to demonstrate the power of failure, resilience and persistence.



120 minutes



Content / Description of the Activity:

You start the activity with a small workshop.

Workshop: Build a tower as tall as possible using only the materials provided

This is an entertaining task and should be conducted in a lighthearted manner to foster teamwork and communication. *Failure resulting from experimentation should be celebrated.*

Introduce challenge. Students must build their towers with the only materials you provide to them. You may wish to initially provide a target height (e.g. 0.5 m). ^{5'}

Students can build (and rebuild) their towers. They should be encouraged to be experimental and not fear failure. ^{15'}

Measure final towers and assess construction strategies. ^{5'}

At this stage you continue with **SWOT analyses** itself. Later on, you come back to the workshop and ask students to make SWOT analyses on their towers that they have built.

When we have a business, we often take it for granted. '**We have always done it this way**'. But is it the best way? We need to look at our business often as if it belongs to someone else.

Be critical. What could we do that would raise our profit?

What do we do well? Where do we need to improve? What could we do to attract more customers? Do people like to do business with us? Do we run it in a business- like way?

We need to do a *SWOT analysis every three or four months*, to see if we can improve our profits.

S = Strengths

W = Weaknesses

O = Opportunities

T = Threats

A SWOT analysis lets you look at your business on a regular basis and work to improve your weaknesses and make the most of your opportunities.

Strengths and weaknesses are in your control. You can do something about them. Opportunities and threats are outside of your control. You can still respond to them.

Pretend you run a printing shop and print cards and menus for restaurants and entertainment facilities. You have decided you need to look at how you run the business, to see if it's as good as you can make it. You start by making a list and you write down everything you can think of about your business.

<i>You sell daily menus to your friends at half price</i>
<i>A new hotel is being built near the town center</i>
<i>You record your sales in the cashbook every day</i>
<i>Some of your inks are poor quality</i>
<i>You're always friendly with your customers</i>
<i>Three new print shops are opening in town</i>
<i>The shop nearest to you is opening an hour early</i>
<i>You have not paid your business license this quarter</i>
<i>You visited three hotels in town and have some new orders</i>
<i>The Council is talking about closing your street to commercial business</i>
<i>Look at the list and decide which things listed are Strengths</i>

What are the Strengths?

- I.** Keeping daily records is very good.
- II.** Being friendly with your customers is good. (*People would much rather buy from someone who is pleasant and greeted them by name than from a bad-tempered person*)
- III.** Visiting the three hotels to get some orders was a good thing to do. You went out and looked for business.

What are the weaknesses?

- I.** Selling menus to your friends at half price reduces your profit, so that is bad - **a weakness**
- II.** Also, why would anyone buy cards printed with poor ink? In business, you want a reputation for selling a quality product for a fair price. Bad quality is **a weakness**.
- III.** There is no excuse for not paying your business license.

Now let's look at the Opportunities!

- I. The new hotel being built near the town center presents us with an Opportunity. They will be buying business cards and menus for their restaurant and maybe, we can persuade them to buy from us.

Lastly, let us look at the Threats.

- I. The new shops are **a threat**... they are competition. However, if they pay their business license you cannot stop them coming.
- II. But what could you do about the shop, which is opening earlier than you do? You might also arrive early.
- III. If you hear rumors that the Council is considering closing your street to commercial business, you may not be able to do anything to stop them, but you can be looking for another favorable location.

In our story, think about:

1. What can you do about weaknesses?
2. How can you build on your strengths?
3. How can you take advantage of your opportunities?
4. How can you protect your business against the threats?

Now look at your **business (tower)** or your business idea. What are the strengths, weaknesses, opportunities, threats? Be objective and comprehensive.

Discussion whereby students should be encouraged to reflect on the role they played within their team (leader, follower, arbiter, builder, ideas-generator, critique, encourager) and how the team functioned (democratic, unilateral/directive, consultative, consensual).

Were there any gender stereotypes?

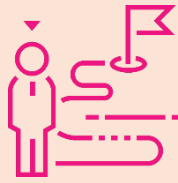
What would they do differently next time?

Which team had the best approach? ^{10'}

Then begin to think about what you have identified about the situation in your business and in the environment. What can you do with this information? How can you best use your strengths? What do you do about the weaknesses? How do you respond to opportunities and threats? This thinking will be the start of your planning.

Do this individually and then share the SWOT analyses in small groups. ^{10'}

Training Goals



- This session introduces an analysis framework. It allows the entrepreneur to look objectively at the business, to honestly assess strengths, weaknesses, opportunities, and threats, and to plan to maximize success and minimize risks.
- The SWOT will be repeated over the life of the ongoing business operation to adjust the business plan and maintain a successful operation.

Learning Objectives/ Learning skills



- Know what S, W, O, and T mean for a business
- Describe a business by its strengths, weaknesses, opportunities and threats
- Solve problems and apply ingenuity
- Communicate and work as a team
- Embrace failure, resilience and persistence

Pre-requisite knowledge and skills

No needed, if participants know basic knowledge of SWOT analyses it will ease trainers work

Tips for Trainers



- If possible, invite a local business woman to share the story of her start up and her SWOT analyses
- Make sure each team has the same materials and none of the groups have more or less
- Observe their work so you can have already questions on your mind to ask the groups later on

Tools and Resources (including hardware, software, ppts, handouts, videos, hands-on material)

Flip chart and Pens/Markers,

Visual: SWOT Analyses

Materials for building the tower (e.g. straws, spaghetti, marshmallow, tapes, papers, hooks, rulers, scissors)



Instructional Setting (class/group/group room, online, blended)

Classroom, conference room, gym, open space

Pedagogical Approach

Differentiated Instruction - Activities address a range of student learning styles, abilities and readiness, includes a variety of instructional approaches.



Experiential Learning - Authentic learning experiences are provided, learning is made concrete. 'Working with real objects, using real sources of information.

Case Studies - Relevant case studies are included. Case studies are thorough descriptions of real events from real situations that students use to explore concepts in an authentic context.



Supporting Document

Strength	Weaknesses
Keeps daily records	<i>Sells daily menus at half price to friends</i>
Friendly to customers	<i>Has poor quality ink</i>
Visits three hotels and gets orders	<i>Owes business license</i>

Opportunities	Threats
New hotel being built	<i>Three new print shops</i>
	<i>Nearby shop opening early</i>
	<i>Council thinking of closing street to commercial business</i>

SWOT Analysis

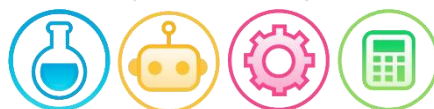


How to Finance Startups



Girls and Young Woman age 18 – 29, It can be adapted for uneducated young woman, high school students

Relationship of the Activity with STEM



The activity is fully aligned with the entrepreneurship concept, introducing basic terms like value proposition, product-market fit, understanding the market needs, niche markets as well as STEM concept



2h 30minutes



Content / Description of the Activity:

Workshop: Amazing Restaurants

The trainer explains to participants that they will design, draw and present their unique restaurant. The participants are divided into groups of 4 people. As in the previous team exercises, random roles can be assigned to team members to make sure people assume a role that they are usually not at ease in taking (e.g. *the presenter, the idea creator, the note taker, the person drawing, etc.*).

The trainer can write down all these roles in pieces of paper and the students pick randomly their own role. Once the teams are created, the trainer first presents unique and **amazing restaurants from all over the world**, to inspire and create enthusiasm among the students and to give them nice ideas for the development of their own unique and amazing restaurant. The presentation is implemented using the **ready-made PowerPoint** developed.

The trainer can also add more amazing restaurants, including those that exist at local/national context. Once the restaurants are presented, the trainer asks the teams to come up with their own amazing restaurant, using their most crazy and innovative ideas. It is important to explain to the students that they need to pay attention and think hard about the clients they want to attract (target audience), someone who will be willing to visit their restaurant repeatedly, based on their personality and other characteristics (education, socio-economic status, area of residence, tourist's vs locals, hobbies).

This is a very important part of the exercise and emphasis should be given, as it introduces basic entrepreneurial concepts like the **product-market fit** and **value proposition**. In the presentation that the students will be giving later on they should explain clearly the target group they want to attract as clients and why did they choose this specific group.

They first need to discuss these ideas, write them down, decide which ones are their favourite ones as a group and then draw this new restaurant in the

flipchart given to them. The discussion process should last about **10-15'** and then the drawing/construction phase another **25'-30'**. Then 1-2 team members present their restaurant idea in front of the class within **3'** and the other students and the facilitator can ask questions or clarifications.

Now, **how they can finance their ideas? How they can start a business out of it?**

The safest way to start a business is to start small with one's own resources. However, when savings are inadequate for starting capital, funds need to be wisely sought and carefully used.

We said that a business needs resources at the start. Many wise business owners have started small. As they learned more about running the business and made some money, they grew their business, using their profits.

For some business ideas, one's own resources are insufficient at the start. Funds are needed for equipment purchases and operating expenses. We have seen how the business plan helps to determine how much start-up cash is needed. When the decision is made to seek additional funds, the entrepreneur should be prepared with her business plan and knowledgeable about the alternative sources.

Steps to looking for funds:

1. What is your business plan?

You need to know and your lender needs to know your plan.

2. What funds do you need for your Startups?

A detailed budget is most important. It convinces potential lenders that you have done your homework. It confirms that this is a good business idea.

3. What resources do you have?

4. Go back to step one.

Are you convinced that your business plan is realistic?

5. List the sources of funding available to you.

Consider family, banks, credit unions, village lending programs, cooperatives, money lenders.

6. Prepare the loan application

7. If you get the loan, put the money in a safe place and begin working according to your plan. Do not divert funds to other needs. You have to build a successful business and repay the loan.

8. If you do not get the loan, ask the lender why not?

What can you learn from that? What can you change for the next application?

Loans may come from a variety of sources. Consider the differences among different sources. Note that a business plan will be useful and even required for some loans.

A loan is not a gift. It is money that must be paid back by a certain date with extra money for interest. Usually we go to a bank to get a loan. We must remember that a bank is a business. It has to make a profit (just as you do), and one of the ways it makes money is to charge the borrower interest, for using the bank's money.

Before the bank will loan you money, they are going to want the answers to a lot of questions.

- ❖ **What are you going to use the money for?**
- ❖ **Does it make sense?**
- ❖ **How are you going to pay it back? From profits? Savings?**
- ❖ **Can you be trusted to repay it, as you agree to?**
- ❖ **If you don't pay it back, what do you own, that the bank could take and sell to get their money back?**

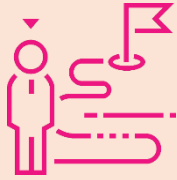
Sometimes we can access micro-credit. The arrangements vary by the agency, but usually provide small loans for short periods, up to 4 months for example. When the loan is repaid, a second loan may be offered to the entrepreneur.

Success most often comes to small entrepreneurs who have a skill or know where to obtain and sell a product. The risk of failure is increased if the entrepreneur does not know how to manage money, if money is not kept in a secure place and if the husband and wife do not have a good understanding about the business. It is important that family members realize that the woman's business is small and she needs the money to support the business, the family, and to save.

Family members must also share the responsibility for repayment of the loan, to keep their good name and have access to an additional loan. It may be tempting to take the easy cash for a drink or a treat, but that will not help the business succeed.

You should only get a loan if you are sure it will produce enough income to pay back the loan and interest within the time allowed. *If you should get you a loan, **be SURE you spend it on what you got it for.***

Training Goals



- Understand the importance of developing a unique business idea that will not be easily imitated and will attract specific target groups, with their own characteristics and will make companies and
- Other funders to fund the project/idea/business

Learning Objectives/ Learning skills



- Know the steps to looking for funds
- Understand the differences in lenders
- Work in teams and develop a basic understanding of entrepreneurial concepts, including issues like the product-market fit, value proposition and the identification of the target audience (target groups/clients for this new business)
- Develop their creativity and their innovation skills along with an entrepreneurial mindset

Pre-requisite knowledge and skills

Basic Knowledge on Entrepreneurship and willingness to be an entrepreneur

Tips for Trainers



- Prepare a list of local resources where women could seek financing.
- Invite local women business owners who have financed their business. Ask them to share their experience. Include women who have experience with different types of lenders.
- Alternatively, distribute the case studies attached, one study per small group. The group should read the example and be prepared to summarize the entrepreneur's experience getting funding. What funding was obtained? How did it help the business? What is the most important lesson of the story?
- In order to make this more related to STEM concepts, you can ask participants to think about a zero-emission restaurant, an energy efficient restaurant, a restaurant using renewable sources of energy, has zero waste policy, uses the latest technology, has modern engineering works in it, etc.
- The example of the restaurant can be used for any other product/service, e.g. design a unique chair, by first thinking about your target market (audience) and what are their specific needs/wants. Again, other innovative and unique chairs can be shown to inspire students and they the teacher can ask them to design and draw their own unique chair. Mechanics and technology easily fit into this example of the unique chair,

having both an entrepreneurial and STEM element in this activity.

- You can find the supporting document 'power point' of amazing restaurants in this link: <https://www.stemitup.eu/Activity/Amazing-Restaurants>
- Additionally, you can use these videos as an example of Entrepreneurs related to STEM
<https://www.facebook.com/nasdaily/videos/1423650011130454/>
<https://www.facebook.com/ecuapecologico/videos/239394140670532/>
<https://www.facebook.com/nasdaily/videos/2592942260929148/>

Tools and Resources (including hardware, software, ppts, handouts, videos, hands-on material)

PowerPoint presentation, showing examples of other amazing restaurants from the world and providing the instructions for the group exercise; Large flipchart paper where the teams will draw their unique restaurant; Colored pencils, crayons, colored markers.



Visual: General Funding Sources

Instructional Setting (class/group/group room, online, blended)

Classroom or conference room with projector

Pedagogical Approach



Case Studies - Relevant case studies are included. Case studies are thorough descriptions of real events from real situations that students use to explore concepts in an authentic context.

Supporting Document

General Funding Sources



Savings	Entrepreneur may have cash saving to get started	No interest on saving used	Personal savings have the least risk but a failed business depletes family savings
Micro-finance	Small amounts available to small entrepreneurs	Interest rate high, may include training	May be more sensitive to needs of woman and small entrepreneurs and the supportive environment may provide discipline for repayment
Bank Loans	Larger loans available, usually to larger business with experience	High rate of interest to small business without credit history	Consequences exist if loan not repaid
Family Loans	Funds may be limited	May or not feel obligated to pay more than borrowed	Moral obligation to family
Money Lender	Funds often made available	Very high interest	Consequences if loan not repaid are high

Example of some amazing restaurants



Dinner in the air!
Restaurant in
London

Restaurant in
Belgium



Dinner surrounded by
snow and ice
Snow castle in Finland



Lunch in the water!
Restaurant in Bora Bora

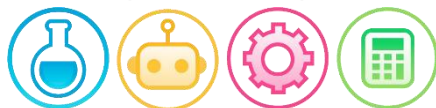
Food for Thought: Defining a Problem to Find a Solution



Girls and Young Women.

Note: Adequate but not exclusive to target individuals with formal education background from 6th to 12th grade (or similar educational background).

Relationship of the Activity with STEM



Asking Questions, Earth & Space Science, Engineering & Technology, Flipside Science: Food, water, energy - we need solutions to the environmental issues of our day



60 minutes



Content / Description of the Activity:

DESCRIPTION: The purpose of this activity is to give our target group, good practice in putting a design problem into perspective. Learners will gain insight into the challenges associated with meeting various design requirements and the importance of collecting information through interviewing others.

CONTENT:

PART 1: Understanding your constraints 30'

NOTE: In this activity, learners will NOT actually be coming up with complete plans for the party food, but will concentrate instead on how one goes about collecting the information needed for a design plan and how to work around certain restrictions or conditions.

1.1 Welcome, designers! Set the stage for this design thinking unit, noting today's focus is on generating questions we can ask that help us better understand the problem for which we are designing a workable solution.

1.2 Introduce the design challenge: Imagine we are planning a class/group party at location and that the class/group is responsible for purchasing the food for the party. Doing this, however, won't necessarily be as simple as going to the grocery store and buying a bag of potato chips and a cake. There will be certain conditions that must be met:

- **Everyone in the class/group must like the food AND be able to eat all of the food.**
- **No food can go to waste.**

- **The food must come from within a 1-mile radius of the venue.** (Note: Depending on the location of your venue, you might need to expand this radius. Try to make sure there is access to at least one convenience store or market.)
- **There is a limited budget for the food.** (Don't actually give learners a number—let them ask this question in step 4 below!)

1.3 What steps should be taken to design a plan for the party food that meets all of these conditions? An important first step in design thinking is to better understand the people who will be impacted by your design plan, as well as the constraints or restrictions you must design within. How do we gain this better understanding? By asking questions!

1.4 Generating questions: Ask learners to take 5 minutes to write down questions they might ask to either their fellow class/group mates or their location administrators (one question per sticky note) to help them design a party food plan. Ask for an example or two before you let them brainstorm individually:

Examples:

- *(To a class/group mate) Do you have any food allergies?*
- *(To a location administrator) What is the budget?*

1.5 After 5 minutes of question writing, divide learners into groups of 4. Give them about 5 minutes to share their questions within their groups.

1.6 Come back together as a class/group and ask for a few volunteers to share their questions. After eliciting a few responses, ask each group to elect two people to bring all their sticky notes (minus duplicate questions) up to the board and stick them underneath the constraint that they most relate to. Here are some questions that your learners might come up with and the party food parameters they would go under:

Everyone in the class/group must like the food AND be able to eat all of the food:

- *Are you (fellow learner) allergic to any foods?*
- *Are you a vegetarian?*
- *Are there any foods you can't or won't eat?*
- *What are your favorite/least favorite foods?*
- *Is there a particular type of cultural cuisine that you prefer?*

No food can go to waste:

- *Can we store any leftovers in the location refrigerator and pantry?*
- *Would you (another learner) be willing to take any leftover food home?*
- *Could we donate any leftover food to a food bank?*

The food has to come from within a 1 (or more)-mile radius of the location.

- *Can we get food from a fast-food restaurant?*
- *Can we use the vending machines at location?*

There is a limited budget for the food.

- *What is our budget?*
- *Is the budget flexible?*

- 1.7** Hand out one Interview Worksheet to each learner. Give learners about 10 minutes to get up and look at all of the sticky note questions on the board. Ask them to write down 5 questions on their worksheet from the sticky notes that they think are most important for developing their design plan.

PART 2: Asking questions 20'

Note: The purpose of Part II of this activity is to give learners experience interviewing others and getting insight into the complexities of design problems. This exercise will be done as a full class/group, so it might get a bit noisy!

2.1 Give learners about 15 minutes to walk around the class/group **to interview 3 different people** using their 5 chosen questions, being careful to record responses on their worksheets. You will represent the 'location administrator' overseeing the party, and are also available for questions. (You can answer administrative questions however you want; just make sure to be consistent with your answers.)

2.2 After they have interviewed 3 different people, learners should return to their seats and reflect on the activity (quietly and individually) by answering the Reflection questions on the back of their Interview Worksheet.

PART 3: Wrapping Up 10'

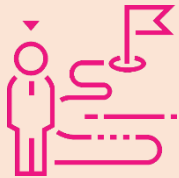
3.1 Ask volunteers to share some of their thoughts from their reflections. Before you conclude this exercise, make sure learners are on board with the importance of interviewing and asking questions in the design thinking process. Interviewing helps you to better understand the person or situation you are designing for and what the constraints or conditions of your design are.

3.2 Do you think any of the restrictions you were given in this exercise are issues that people face in their everyday food choices? Why or why not?

(Agree: People have budgets and financial constraints, some people live closer to grocery stores than others, some people don't have a car or a way

to get to easily get to a store, some people can't eat certain food due to religious practices or medical reasons. **Disagree:** Most people can travel more than a mile, you don't get to each your favorite food every day, etc.)

Training Goals



- In this activity, learners are challenged to design a food menu for a class/group party that will be held at their location. The food plan must meet several conditions. For example, everyone in the class/group must be able to eat the food, and there is a budget for the meal. The design constraints that learners must consider in this exercise correlate with many issues that people face in the food choices they make in their everyday lives, such as dietary restrictions, financial constraints, and food availability.

Learning Objectives/ Learning skills



- Practice developing questions and interviewing others to gain a sense of why these are important first steps in the design thinking process.
- Consider how a variety of constraints or criteria influence a design plan within the context of planning the menu for a class/group party that meets several different conditions.

Pre-requisite knowledge and skills

Basic knowledge about food and cooking ingredients. Basic knowledge about currency, prices, cost of materials.

Tips for Trainers



- Leave room for a 15-minute preparation period prior to execution.
 - 1) Attach 10 sticky notes to each learner's desk.
 - 2) Prepare the board with the Design Challenge ("Plan a Class/group/group Meal!") and the constraints: "Everyone Likes/Can Eat," "No Wasted Food," "Within Location Radius," and "Limited Budget." Learners will place their questions on post-it's underneath these headings during Part I.
 - 3) Print out learner worksheets and the map around your area/location.
- You can search for 'food,' 'grocery stores,' and 'convenience stores' in Google Maps for these locations.

**Tools and Resources
(including
hardware, software,
ppts, handouts,
videos, hands-on
material)**



Sticky notepads (enough for at least 10 sticky notes per learner)
Interview Worksheets (1 per learner)
(Optional) Printed map (with scale bar) of surrounding area showing the locations of restaurants, grocery stores, convenience stores/markets, etc.

**Instructional Setting
(class/group/group
room, online,
blended)**

Class/group room / groups

**Pedagogical
Approach**



Practice developing questions and interviewing others to gain a sense of why these are important first steps in the design thinking process.

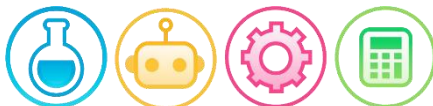
Consider how a variety of constraints or criteria influence a design plan within the context of planning the menu for a class/group party that meets several different conditions.

Rapid Brainstorming: How to help conserve water resources?



Girls and Young Women.

Relationship of the Activity with STEM



Expected Duration



Note: Adequate but not exclusive to target individuals with formal education background from 6th to 12th grade (or similar educational background).

Asking Questions, Earth & Space Science, Engineering & Technology

60 minutes



Content / Description of the Activity:

DESCRIPTION:

The purpose of rapid ideation is to produce an abundance of ideas in a short amount of time unconstrained by judgments or perceived limitations. Rapid ideation promotes out-of-the-box thinking and creativity and can lead to highly innovative and perhaps unanticipated solutions to complex problems. In this activity, learners will not proceed beyond the rapid ideation stage to the actual implementation of a solution, as the goal of this lesson is not to lead learners through a full design process. However, in the final activity of this unit, your learners can participate in a design thinking challenge to develop solutions for a water conservation issue at home or school.

CONTENT:

Part 1: Ideation warm-up 10'

1.1 Divide learners up into pairs. You (the teacher) will challenge learners with a question to which the learners will be asked to brainstorm solutions. Their goal is to brainstorm (individually) as many solutions as they can in two minutes. Challenge them to try to come up with 10-15 solutions. They should write these solutions down in their notebooks or on a piece of paper. **Challenge question options (or make up your own!):**

- *How could you find a needle in a haystack?*
- *How could you heat up a bowl of soup without a stove or microwave?*
- *How could you open a jar without touching it directly with your hands?*
- *How could you move water up a hill?*

1.2 Remind learners that the goal is to try to think of **as many solutions as they can** without worrying about how 'good' the solutions might be.

1.3 After the two minutes are up, the learners will stop writing and compare lists with their partners.

1.4 Briefly discuss the exercise.

Did you find it easy or difficult to brainstorm solutions?

- *Did you think any of your ideas were silly or wacky? Would you have included those ideas in the list if you were asked to only write down ideas that you thought were 'good'?*
- *Do you think there is an advantage to brainstorming as many ideas as you can and not worrying about how good, bad, silly, or strange they might seem?*

Part 2: Practicing rapid brainstorming of water conservation solutions ^{35'-45'}

2.1 Hand out to learners or write on the board a list of questions for them to think about while they watch the Flipside Science: How Do We Meet the Growing Need for Water video (see below).

2.2 Show learners the selected video.

2.3 Ask learners to jot down some of their thoughts about the questions that they were asked to consider while watching the video. Give them about 10 minutes to do this. You might want to play the video another time through for learners. Briefly discuss these questions as a class/group after learners have had a chance to reflect individually.

- *What kinds of water issues were raised in the video?*
- *Where can we find freshwater on Earth? What are freshwater reservoirs? Where else is water stored?*
- *Why is a growing population a concern for our water resources?*
- *Who/what uses water? Who/what is the largest user of water?*
- *In what ways is water wasted?*

2.4 Ask learners to choose one of the water issues introduced in the video to focus on (groundwater overuse, water waste, high water demand of agriculture, and access to clean freshwater sources) and to find a partner who chose the same issue. Note: To expedite this process or if you would like to ensure that all water issues are represented, you can also have learners pick water issues out of a hat and pair up that way too.

2.5 Hand out one Learner Worksheet to each learner. Instruct learners to work with their partners to figure out a way to express the water issue they chose **in the form of a question**, and to write their question on their worksheet. Give learners about 5-10 minutes to work on this, helping to facilitate the process where needed. Here are some examples of questions learners might consider:

- *How can we keep underground aquifers from drying up?*
- *How could we decrease the amount of water wasted in our homes or on farms?*
- *How can we grow more food with less water?*
- *How can we provide easier access to clean, fresh water for people who don't have it?*

2.6 Hand out one stopwatch or timer to each pair, and briefly show learners how to use them if needed. At this point, learners will guide themselves through the next few steps of the activity, which include working through the process of facilitating their own rapid brainstorming sessions with their partners and comparing their ideas. Give learners about 20 minutes for this part of the activity, reminding them when they have 10 minutes and 5 minutes left.

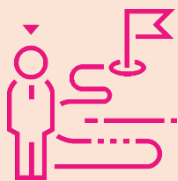
Part 3 - Wrapping Up 10'

3.1 Come back together as a class/group and ask for volunteers to share some of their questions and brainstorms.

3.2 Ask learners to reflect on their experience.

- *Why do you think we tried to brainstorm as many ideas as we could instead of just trying to think of one or two 'good' ideas?*
- *Are there easy solutions to the water issues you learned about in the video? Is there only one solution to each issue?*
- *When thinking about which of your solutions might be the 'best,' what was your criteria? For example, did you think about the potential environmental impacts of the solution, or how expensive the solution would be to carry out?*

Training Goals



- In this lesson, learners will practice rapid ideation - an important step in design thinking - by brainstorming solutions to issues surrounding global water use and conservation.

**Learning Objectives/
Learning skills**



- Discover some of the water use and conservation issues people are currently dealing with around the world.
- Practice rapid and creative ideation in the context of designing solutions for global water issues.

Pre-requisite knowledge and skills

Basic knowledge about the importance of water in the planet's lifecycle

Tips for Trainers



- Leave room for a 10-minute preparation set. Ideally this unit's goals would be reached easily with a visualization of related videos on the subjects: *Water footprint and/or the growing need for water.*

Tools and Resources (including hardware, software, ppts, handouts, videos, hands-on material)



1. Computer with Internet access
2. Projector
3. A documentary or any video on the subject: Water Footprint and/or The Growing Need for Water?
4. Learner Worksheets (1 per learner)
5. Stopwatches or timers (1 per group of 2 learners)

Instructional Setting (class/group/group room, online, blended)

Class/group room

Pedagogical Approach



What are some of the water use and conservation issues we are facing in the world today, and how might we design solutions for them?
What are some advantages of rapid brainstorming?
Why is brainstorming an important step in designing solutions?

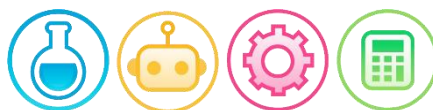
Bright Ideas: an activity on illumination



Girls and Young Women.

Note: Adequate but not exclusive to target individuals with formal education background from 6th to 12th grade (or similar educational background).

Relationship of the Activity with STEM



Engineering & Technology,
Planning and Carrying Out Investigations
Designing Solutions



Expected
Duration

~ 60 minutes to
75 minutes



Content / Description of the Activity:

DESCRIPTION:

With this unit/lesson/workshop the learner is motivated to acknowledge, investigate, plan, develop and deliver a solution for a lighting challenge.

CONTENT:

Part 1: Introduction and Warm-Up 10'-15'

Display Warm-Up Slide #1 for learners to see and give them about 2-3 minutes to write an answer to the question in their notebooks. Repeat with Warm-Up Slide #2. For the questions on slide #2, create two tables on the board to fill in as a class--see examples (Document: Example Table).

Warm-Up Slide #1:

Did you know that as of 2012, 17% of all the electricity consumed in commercial buildings—places like office buildings, warehouses, and stores—was just for lighting? That's a large chunk of energy, but just over a decade ago, this number was 40%!

- *What do you think happened over the last 10-15 years to account for this reduction in electricity use from lighting?*

Warm-Up Slide #2:

Having enough light in places like offices or class/group rooms is important for people to be able to do their work without straining their eyes. But sometimes there can be too much artificial light. Have you ever been in a room that felt uncomfortably bright, or left the lights on in an empty room? These are

examples of 'over-illumination.' Over-illumination happens when there is an unnecessary amount of artificial light in a space, which wastes energy.

- *Can you think of other examples of over-illumination?*
- *What might cause a space to be 'under-illuminated'?*

Part 2: Activity ~60'

2.1 In groups, ask learners to brainstorm ways to fix the types of over-illumination listed in the table on the board (from the warm-up). Have learners write one solution per sticky note and stick it in the table in the appropriate place. For example, you could fix leaving the lights on in an empty room by turning the lights off when you leave the room.

2.2 Repeat the same process as above to brainstorm solutions for the problem of under-illumination.

2.3 Hand out the Recommended Light Levels handout and give learners a few minutes to look over it. Ask them to describe what they notice about the information on the handout and ask any questions they have.

2.4 Pass out Learner Worksheets and introduce the Challenge:

Today you are going to visit different places around this facility to:

- 1. Measure the illumination in each place and compare it to the Recommended Light Levels handout to determine if it is too high or too low.*
- 2. Design a solution to fix one space's over-illumination if it is too bright, or to increase illumination in an energy-efficient manner if it is too low.*

2.5 Pass out the smart phones and run through a quick tutorial on how to use the Science Journal app and Ambient Light sensor (optional).

2.6 Assign each group of learners 1-2 places in the school to investigate. Give learners about 10 minutes to take measurements and record their data in each place, then have them come back to the class/group room to analyze their data.

2.7 Once you are back in the class/group room, inspire your learners with examples of well-designed and energy-efficient spaces, (**investigate prior to access one good practices example**) building or other natural/artificial lighting ideas (you'll find many Pinterest boards!).

2.8 Give each group a piece of poster board. Each group should choose one of the locations they investigated and design a solution for it, whether it was over-illuminated or under-illuminated. If the space they analyzed was properly illuminated, have learners brainstorm a more energy-efficient way of lighting

that space. Learners will have about 15 minutes to draw up their designs on their poster board.

2.9 Share out: Groups can share their designs with their classmates through presentations or a class gallery walk.

Possible activity Extensions:

If you'd like to make this a more in-depth challenge for your learners, provide them with information about the various kinds of light bulbs and lighting options available and let learners incorporate this information into their designs.

Training Goals



- With a few guidelines and some innovative thinking, we can design spaces to have sufficient light and be energy-efficient.

Learning Objectives/ Learning skills



- Analyze the illumination in a space using a digital light sensor.
- Design energy-efficient solutions to improper illumination.

Pre-requisite knowledge and skills

Basic notions about lighting and the need for different power outputs depending on the scenario and specific needs.

Tips for Trainers



- Familiarize yourself with the Science Journal smartphone app (how to collect and record data, and how to use the ambient light sensor).
- Print out one Learner Worksheet per learner and one Recommended Light Levels handout per group of 2-3 learners.
- Leave room for a 15-minute preparation period

Tools and Resources (including hardware, software, ppts, handouts, videos, hands-on material)



1. Smartphone with Science Journal app by the Making & Science team at Google (1 per group)
2. (Optional) Computers with access to Google Drive (1 per group)
3. Recommended Light Levels handout (1 per group)
4. Learner Worksheets (1 per learner)
5. Warm-up slides
6. Sticky notes
7. Poster board (1 per group)
8. Markers

**Instructional Setting
(class/group/group
room, online,
blended)**

Class/group room

**Pedagogical
Approach**



Planning and Carrying Out Investigations

Designing Solutions

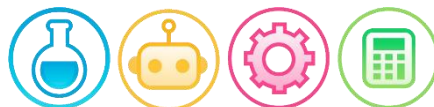
Selling Toys on Amazon over Christmas



Girls and Young Women

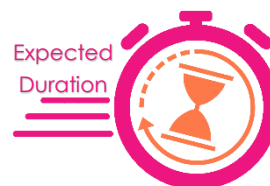
May be adapted for high school, and college-level instruction (appropriate for use in an introductory level statistics course)

Relationship of the Activity with STEM



Math modeling,
Mathematics, Statistics,
Technology

Expected
Duration



Lasts 75-90 minutes. If learners do not have background in Tinkerplots2, they will need to spend additional time (either at home or in workshops organized by the instructor prior to the conduct of this activity) to familiarize themselves with the software and its modeling functionalities (Tinkerplots Tutorials (<http://www.tinkerplots.com/tutorials>), or in the additional Workshops which you will find in fasterasmus.com).



Content / Description of the Activity:

DESCRIPTION:

The focus of this activity is on modelling and simulation — along with informal statistical inference — and is being facilitated by having learners use the dynamical statistical software package **TinkerPlots2** for all modelling and analysis. This software has been selected because it is designed explicitly to support integration of exploratory data analysis approaches and probabilistic models, and to allow for generation of data (e.g., drawing samples from a model) and experimentation (e.g., improving models, conducting simulations). In the activity, learners use **TinkerPlots2** to work on the following carefully-designed *open-ended Model-Eliciting Activity (MEA)*, which involves a complex, real world statistical problem:

Amazon places regular restrictions on sellers of Toys and Games in the run up to Christmas. The reason they give is “To maintain a great customer experience”. Basically (without being too blunt) Amazon don’t want a novice seller either being flooded with orders and shipping late, or overselling and having disappointed children and parents on Christmas day.

This year Amazon’s selling guidelines will apply from the 17th of November 2020 through January 5, 2021. To become eligible for selling Toys and Games on Amazon during the Christmas season (17/11/2020-5/1/2021), novice sellers need to have achieved the following target: They must have processed and successfully shipped (i.e. without delay) at least 25 orders from the 1st of September through 31st October 2021. The orders do not need to be specific to the Toys store.

If a novice seller accomplishes this prerequisite, he or she can then become a Christmas Amazon Toys Seller.

We know the following:

1. On average, **4%** of orders processed by Amazon representatives arrive late to customers due to external factors that are out of their control (Constraint 1)
2. On average, **1.75%** of Amazon's customers cancel their initial orders before they get processed (i.e. pre-fulfilment cancellation rate is 1.75%). (Constraint 2)

Learners use TinkerPlots2 to create and test a statistical model of this MEA and provide answers to the following research questions:

RQ1. Taking into account the fact that, on average, 4% of the orders processed by Amazon sales representatives arrive late to customers due to external factors (Constraint 1), at least how many orders should a novice seller seek to process between 1st of September though 31st October 2020, in order to ensure a very small probability (below 5%) of not achieving the target required for becoming a Christmas Toys Amazon seller?

RQ2. Taking into account the fact that, on average, 1.75% of Amazon's customers cancel the initial orders before they are processed (Constraint 2), at least how many initial orders should a novice seller seek to achieve between 1st of September though 31st October 2020 in order to ensure a very small probability (below 5%) of not achieving the target required for becoming a Christmas Toys Amazon seller?

CONTENT:

Part 1: Initial Considerations^{10'}

1.1 Ask learners to read the description of the Selling Toys on Amazon over Christmas MEA included in the activity handout given to them, to become familiar with the context of the problem.

1.2 Ask learners to consider and individually answer the following readiness questions about the MEA scenario so as to become even more familiar with the context and begin thinking about the problem:

- What might be some reasons why customers cancel their initial order in Amazon before it gets processed?
- What can be external factors (i.e., factors outside the control of sales representatives) that may cause a delay in the delivery of Amazon orders?

- Knowing that on average, 4% of orders processed by Amazon sales representatives of Amazon are delivered late to customers due to external factors, at least how many orders should a novice seller seek to process in order to achieve the target required for becoming a Christmas Toys Amazon seller?

1.3 After learner's finish writing down their answers in the provided activity handout, they discuss them with the person(s) sitting next to them.

Part 2: Modeling The Scenario Using Tinkerplots to Respond to RQ1 and RQ2 **45'-60'**

2.1. Separate learners in teams of 3-4, and ask them to set up Tinkerplots2 simulations to model the scenario in order to provide answers to RQ1 and RQ2. It is estimated that learners will need 45-60 min to work on this. The needed time range will vary depending on learners' familiarity with Tinkerplots, and with statistical modeling.

2.1.1 Ask teams to consider the following list of guiding questions included in the activity handout in order to construct a simulated model of the scenario and to use it to provide an answer to RQ1, taking into consideration Constraint 1:

- a) Which assumptions do you need to make regarding the distribution you will use to model the scenario? How likely is it for these assumptions to actually be true?
- b) Construct the model in Tinkerplots2 (i.e. model the number of orders processed by the novice seller), and execute (RUN) the simulation.
- c) Repeat the simulation. Please explain how and why the results you get are different from those of the previous simulation.
- d) Repeat the simulation a large number of times.
- e) Construct a suitable graphical representation of the distribution of the number/percentage of orders being processed by the novice seller. Describe the distribution.
- f) Is there something about the distribution that resulted from the simulation that has surprised you?
- g) If you deem it appropriate, make changes to your model (e.g., specify a different value for the number of sales) and repeat the simulation
- h) Indicate at least how many orders a novice seller should seek to process so as to minimize (to below 5%) the probability of not achieving the required target for becoming a Christmas Toys Amazon seller. Justify your answer with arguments that are based on data.

2.1.2 Ask teams to consider the following list of guiding questions included in the activity handout in order to construct a simulated model of the scenario

and to use it to provide an answer to RQ2, taking into consideration Constraint 2:

- a) Which assumptions do you need to make regarding the distribution you will use to model the scenario? How likely is it for these assumptions to actually be true?
- b) Construct the model in Tinkerplots2 (i.e. model the number of initial orders made to the novice seller), and execute (RUN) the simulation.
- c) Repeat the simulation. Please explain how and why the results you get are different from those of the previous simulation.
- d) Repeat the simulation a large number of times.
- e) Construct a suitable graphical representation of the distribution of the number/percentage of initial orders being made to the novice seller. Describe the distribution.
- f) Is there something about the distribution that resulted from the simulation that has surprised you?
- g) If you deem it appropriate, make changes to your model (e.g., specify a different value for the number of initial orders) and repeat the simulation
- h) Indicate at least how many initial orders a novice seller should seek to achieve so as to minimize (to below 5%) the probability of not achieving the required target for becoming a Christmas Toys Amazon seller. Justify your answer with arguments that are based on data.

2.1.3 (*optional; to be used only if participants have an adequate background in introductory statistics*) Ask teams to use Tinkerplots2 to build a model that will provide an answer to the following question:

- **RQ3.** Taking into account both Constraint 1 and Constraint 2, how many initial orders should a novice seller seek to have so as to minimize (to below 5%) the probability of not achieving the required target for becoming a Christmas Toys Amazon seller.

Participants should justify their answer with arguments that are based on data.

2.2 Ask each team to write a report describing the models they built and the answers to the research questions they reached.

Part 3 - Wrapping Up²⁰

3.1 Ask each team to present their solution to the class. Integrate whole class discussion with these presentations to discuss the different models/solutions, the mathematical and statistical concepts involved, and the effectiveness of the different models in providing answers to the research questions.

3.2 Ask learners to reflect on their experience through questions such as the following:

- To what extent did the use of the Tinkerplots2 software help you (or not) to answer the research questions?
- What is the practical application of your answers? In what ways (if any) do you think your models can help the novice seller accomplish the prerequisite set by Amazon, so as to become a Christmas Amazon Toys Seller?

Training Goals



The activity was carefully designed to exploit the model building affordances provided by the technological learning environment Tinkerplots2, in order to scaffold and extend participants' informal reasoning about key ideas related to inferential statistics through their involvement in a real-world statistical problem.

Learning Objectives/ Learning skills



The activity has the following objectives:

1. Expose learners to a real-world problem that can be solved using statistics
2. Expose learners to ideas of statistical modeling
3. Provide learners with informal understanding of key ideas of statistical inference
4. Engage learners in statistical thinking and working as a team
5. Familiarize learners with TinkerPlots2, a powerful data visualization and modeling tool

Pre-requisite knowledge and skills

Basic knowledge of descriptive statistics

Tips for Trainers



- Depending on learners' background and/or your instructional purposes, you may want to use a more teacher-directed or a more learner-directed format for going through the MEA activities.
- □ As learners work in teams, your role should be one of a facilitator and observer. You should encourage learner groups to come up with their own solutions, and should avoid questions or comments that lead them towards a particular direction.
- □ If more follow-up is desired after presentations and discussion,

- allow learners to resume their groups and modify their models

Tools and Resources
(including hardware, software, ppts, handouts, videos, hands-on material)



1. Computers with Internet access, and the Tinkerplots2 software installed
2. Selling Toys on Amazon over Christmas Activity Handout

Instructional Setting
(class/group/group room, online, blended)

Computer Lab

Pedagogical Approach



Informal Data-based Statistical Inference
Use of Model Eliciting Activities (MEAs)⁷
Exploitation of the model building affordances provided by a technological learning environment like Tinkerplots2

⁷ MEA was built based on the following post:

Dawson, C. (2015). *Selling Toys on Amazon over Christmas 2015*. Tamebay. Retrieved on May 5, 2020.

Financial Manager of Free-Spending Celebrities



High School, College & young adult



Main target group for which the game app was designed are “low-to moderate-income females aged 18 to 32”. However, the game can be played by both genders, as well by younger learners (ages 15 and up).

Math: numeracy, financial literacy
21st century skills: problem-solving, critical thinking, communication and collaboration

65-75 minutes



Content / Description of the Activity:

DESCRIPTION:

In this activity, participants study some of key ideas related to management of finances by playing the interactive game Celebrity Calamity. Celebrity Calamity is an award-winning financial literacy game app that puts the player in the shoes of financial consultants of Hollywood celebrities that like to spend beyond their means:

Exercise your money management skills to keep your star or starlet from spiraling into a celebrity Calamity!

Hollywood actors and actresses have expensive tastes – even if they’re still on the B-list. Shape the careers of three persnickety celebrities through more than 40 action-packed levels! In 3 mini games you decide which gigs to book and which to pass on, take care of their shopping, and help them pick up their jaws off the floor after they get the bills.

Participants will play each mini game, stepping into the role of financial manager of a spendthrift, out-of-control actor or actress. Their goal will be to manage the celebrity’s budget in ways that keep her or him happy, so as to avoid being fired. Players will need to make wise and responsible use of the celebrity’s bank account, debit card, and credit card to satisfy the client’s wish list while at the same time avoiding bankruptcy. They will need to keep the credit balance in check, minimize finance (interest) charges, avoid late fees and make good spending choices.

CONTENT:

Part 1: Initial Considerations^{15'}

1.1 Divide participants into teams of 3-4. Ask each team to visit the online Credit Card Minimum Payment Calculator, and to read and discuss the definitions of the following terms listed on the website: credit card balance, credit card rate, minimum payment, monthly payment, balance payoff, total payments. Then let participants manipulate the calculator figures, changing balance, Annual Percentage Rate (APR) and minimum payment parameters and seeing how this affects the total payoff time.

Part 2: Playing the game^{25'-30'}

2.1. Introduce the Celebrity Calamity game scenario. Explain that in this game, they will become the financial manager for three up-and-coming celebrities— Alice Albudget, Ryan “Buster” Buyin, and Missy Moolah— whose spending tendencies are out of control:



Meet Alice Albudget, Ryan “Buster” Buyin, and Missy Moolah- these fabulous up and coming celebrities have got the talent to become superstars...if only they could watch how much they spend as closely as they watch the Oscars. It's your turn to shine: play Financial Manager by balancing bank accounts, debit cards, and credit cards successfully! Looks like YOU'RE the next up and coming Celebrity Manager!

2.2. Distribute the handout [Celebrity Calamity Game Directions](#) with instructions on how to install and play the game. In their teams, let participants play Celebrity Calamity. Ask them to complete 20 rounds of the game, and to track their progress while playing by completing the charts of the Celebrity Calamity Round Game Tracker Handout (adapted from Endlich, 2018).

Part 3: Wrapping Up^{25'-30'}

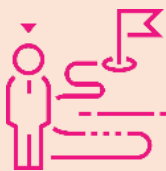
3.1 At the conclusion of the game, ask each team to reflect on their experience through responding to the following reflection questions (taken from Endlich, 2018):

- (i) It would be nice if money really fell from the sky! The challenge was to avoid extra purchases along the way – what do these items represent in real life?

- (ii) As your income increased, what did you notice about the credit limit? What did you notice about the types of things you had to buy? Do you think this is realistic? Why or why not?
- (iii) What happened to your credit card APR as the game progressed? Does this happen in real life? Explain.
- (iv) Were you able to pay off your credit balance every month (round)? Explain why or why not.
- (v) Summarize the lesson that you feel this game is trying to teach about finances.

3.2 Ask each team to present an overview of their experience and reflections to the rest of the class. Integrate whole class discussion with these presentations to consolidate key concepts and ideas introduced through the game.

Training Goals



The activity aims at promoting participants' budgeting skills by providing valuable financial information they can use in their daily lives. By trying to keep their boss on a budget while also keeping him or her satisfied, players learn the importance (and challenge) of adhering to a budget, as well as the consequences of overspending. They improve their credit management skills since, to be successful in the game and not get fired, they must effectively use a bank account, debit card, and credit card.

Learning Objectives/ Learning skills



The activity has the following learning objectives:

1. Improve understanding of basic concepts related to banking, interest and credit, and of the advantages and disadvantages of using debit and credit cards (financial literacy).
2. Improve personal financial capability by comprehending key principles of banking and using credit cards:
 - paying more than the minimum credit card payment
 - minimizing credit card finance charges
 - avoiding fees, including bank overdraft fees, and credit card late payment and over-limit fees
 - making good annual percentage rate (APR) choices.
3. Improve understanding of how to calculate and evaluate

percentages, and perform arithmetic operations such as division in order to determine minimum credit payments, card balance and purchasing.

4. Promote important 21st century skills (e.g. self-confidence, initiative, communication and collaboration, critical thinking, problem-solving).

Pre-requisite knowledge and skills

In order to benefit from the activity, participants should be able to:

- (i) Comprehend basic financial terms related to credit and debit cards (e.g. minimum payment, balance, APR)
- (ii) Perform basic financial calculations (e.g. to find pay able interest, credit balance, etc.)
- (iii) Understand basic game instructions written in English.

Tips for Trainers



- As some of the financial concepts and ideas introduced during the activity might be new to the participants, avoid overloading them with unnecessary terminology. Also, keep a list of the terms causing difficulty and go over them again at the end of the activity.
- Although Celebrity Calamity is a user-friendly and fairly self-explanatory game, while the teams play go around to provide help whenever needed, explaining rules and celebrities' messages

Tools and Resources (including hardware, software, ppts, handouts, videos, hands-on material)



1. Computers with Internet access
2. Online Credit Card Minimum Payment Calculator
3. *Celebrity Calamity*⁸ online game (also available on mobile – iOS)
4. *Celebrity Calamity Game Directions Handout*
5. *Celebrity Calamity Round Game Tracker Handout*

Instructional Setting (class/group/group room, online, blended)

Computer Lab or classroom (if using mobile devices)

⁸ <https://financialentertainment.org/celebritycalamity>

Pedagogical Approach



Celebrity Calamity is the first in a suite of financial literacy games created by the nonprofit **Commonwealth**⁹ (former D2D Fund), engages users in free financial education through fun and innovative casual games. In addition to *Celebrity Calamity*, their titles include:

- ***Farm Blitz***: Manage farm resources to build savings and survive financial emergencies;
- ***Bite Club***: Save for retirement while running a vampire nightclub;
- ***Groove Nation***: Dance and budget on the Road to LA;
- ***Refund Rush***: Help clients split tax refunds and save during tax time.

The aim behind the creation of this library of casual games is to teach simple lessons (credit cards, personal budgeting, saving, loans, etc.) that can help consumers better manage their finances. Through engagement rather than coercion, these games help people, especially lower income and less-educated ones, cultivate healthy financial habits. Players build financial responsibility by doing real life activities with fake money, learning from their mistakes in a safe environment without facing real-life consequences for their actions.

A main target group of this initiative are young women, since statistics show that women aged 18–35 years old play more of these casual games than men do. *Celebrity Calamity* is especially appealing to this target group since players learn about handling of personal finances while living a celebrity lifestyle.

Celebrity Calamity was the 2009 *Horizon Award Winner*.¹⁰

⁹ <https://buildcommonwealth.org/>

¹⁰ This activity was built by utilizing the following sources:

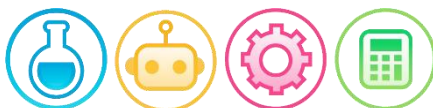
1. [Year 6 Lesson Topic: How Banks Work](#) (lesson plan created by Maria Garder)
2. [Tech Tool Review: Celebrity Calamity](#) (blog post by Jessica Endlich)

Playing Farm Blitz



Target Group

Relationship of the Activity with STEM



Expected Duration



High School, College & young adult

Main target group for which the game app was designed are “low-to moderate-income” adults. However, the game can be played by both genders, as well by younger learners (ages 15 & up).

Math: numeracy, financial literacy
Interdisciplinary: social studies, the economy (STEAM education)
21st century skills: initiative, decision-making, problem-solving, communication and collaboration

65-75 minutes



Content / Description of the Activity:

DESCRIPTION:

In this activity, participants study some of key ideas related to management of finances by playing the interactive **game Farm Blitz**. In *Farm Blitz*, players are farmers who have to borrow money during the growing season and invest in savings once they are paid for their crops.

Watching your crops grow is fun, but watch out for the hungry bunnies ready to munch if your debt gets out of control! Quickly match the same kind of veggies in a row to cash them in, and save to plan for emergencies like time warps and other “natural” disasters.

The game begins with a narrative walkthrough from Kyra, a friendly coach. Kyra explains that the player has inherited a farm (along with its preexisting debt) and is challenged to manage both its crops and its finances, building a net worth that wins "Farm God" status (everyone starts out as an "Agricultural Novice"). Players must manage cash, savings, and debt to reach "Farm God" status and own the farm free and clear of its creditors. Throughout the game, Kyra pops in primarily to provide tutorials.

CONTENT:

Part 1: Initial Considerations 15'

1.1 Divide participants into teams of 3. Ask each team to visit the online [Debt Payoff Calculator¹¹](https://www.bankrate.com/calculators/credit-cards/balance-debt-payoff-calculator.aspx), and [Compound Interest Calculator – Savings Account Interest Calculator¹²](https://www.bankrate.com/calculators/savings/compound-savings-calculator-tool.aspx), and to read and discuss the definitions of the following terms listed on the websites: loan balance, loan payment, loan interest rate, Annual Percentage Rate (APR), new loan terms, rate of return, interest compounding. Then let participants manipulate the calculator figures, and see how this affects their debts or earnings.

Part 2: Playing the game 25'-30'

2.1. Introduce and explain the *Farm Blitz* game scenario:



Harvest vegetables to pay off loans before your debt multiplies like rabbits! Tornadoes, droughts, or even a temporal vortex might try to destroy your harvest. But with savings and quick reaction skills you can reach Farm God status!

- Harvest crops by matching 3 or more in a row!
- Avoid bunnies who want to attack your farm!
- Match more plants at the same time and get bonus points!
- Plant money trees and watch your savings grow!

Learn why building and maintaining a small amount of emergency savings is so important while making sure compound interest works for you, not against you.

¹¹ <https://www.bankrate.com/calculators/credit-cards/balance-debt-payoff-calculator.aspx>

¹² <https://www.bankrate.com/calculators/savings/compound-savings-calculator-tool.aspx>

2.2 Ask each team to rotate through roles as they play the game. One will record terms and concepts, one will play, and another will research confusing aspects of the onscreen info ("What's APR?").

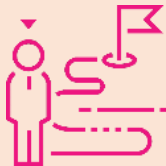
Part 3 - Wrapping Up ^{25'-30'}

3.1 At the conclusion of the game, ask each team to prepare a report providing an overview of their experiences and reflections on the game, and to present it to the rest of the class.

3.2 Integrate whole class discussion with these presentations to consolidate key concepts and ideas introduced through the game. Encourage discussion through questions such as the following:

- How does borrowing money pose a long-term threat to a person's finances? What is responsible borrowing and what is irresponsible?
- What is compound interest and how does it apply to both savings and debt?
- How do relevant concepts in the game relate to current societal or personal events?

Training Goals



The activity aims at promoting participants' financial literacy and at instilling good saving habits they can use in their daily lives. To reach "Farm God" status and own their farm free and clear of its creditors, players must successfully manage cash, savings, and debt. Thus, by experimenting with their agribusiness earnings, players practice essential financial management and fiscal responsibility skills.

Learning Objectives/ Learning skills



The activity has the following learning objectives:

1. Improve understanding of basic concepts related to banking, such as debt, savings, APR, net worth, compound interest (financial literacy).
2. Improve personal financial capability by comprehending key principles of banking:
 - minimizing high-interest, short-term debt
 - maximizing low-interest, long-term savings

- Promote important 21st century skills (e.g. initiative, decision-making, problem-solving, communication and collaboration).

Pre-requisite knowledge and skills

In order to benefit from the activity, participants should be able to:

- Comprehend basic financial terms related to banking (e.g. interest rate, short-term/long-term debt/savings)
- Perform basic financial calculations (e.g. to find payable interest, compound interest, etc.)
- Understand basic game instructions written in English.

Tips for Trainers



- As some of the financial concepts and ideas introduced during the activity might be new to the participants, avoid overloading them with unnecessary terminology. Also, keep a list of the terms causing difficulty and go over them again at the end of the activity
- Although *Farm Blitz* is a user-friendly and fairly self-explanatory game, important information occasionally moves by at a speed that is too fast to process. Thus, while the teams play go around to provide help whenever needed, explaining game rules and messages

Tools and Resources (including hardware, software, ppts, handouts, videos, hands-on material)



- Computers with Internet access
- Farm Blitz**¹³ online game (also available on mobile – iOS, Android)

Instructional Setting (class/group/group room, online, blended)

Computer Lab or classroom (if using mobile devices)

¹³ <https://financialentertainment.org/no-flash>

Pedagogical Approach



*Farm Blitz*¹⁴ is among the suite of financial literacy games created by the nonprofit **Commonwealth** (former D2D Fund). This suite, titled **Financial Entertainment**, engages users in free financial education through fun and innovative casual games. In addition to *Farm Blitz*, their titles include:

- ***Celebrity Calamity***: Manage celebrity credit cards and spending;
- ***Bite Club***: Save for retirement while running a vampire nightclub;
- ***Groove Nation***: Dance and budget on the Road to LA;
- ***Refund Rush***: Help clients split tax refunds and save during tax time.

The aim behind the creation of this library of casual games is to teach simple lessons (credit cards, personal budgeting, saving, loans, etc.) that can help youth and adults better manage their finances. Through engagement rather than coercion, these games help people, especially lower income and less-educated ones, cultivate healthy financial habits. Players build financial responsibility by doing real life activities with fake money, learning from their mistakes in a safe environment without facing real-life consequences for their actions.

A main target group of this initiative are young women, since statistics show that women aged 18–35 years old play more of these casual games than men do.

Farm Blitz was shortlisted at the Games for Change festival in 2011 in the **Direct Impact category**¹⁵.

¹⁴ <https://www.common sense.org/education/game/farm-blitz/field-notes>

¹⁵ <http://www.gamesforchange.org/festival2011/awards/>

This activity was built by utilizing the following source:

Farm Blitz Common Sense Education Review (review conducted by Marc Lesser)

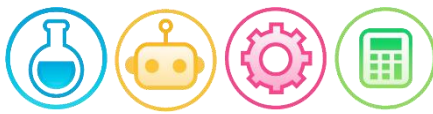
Aquation: Providing Freshwater to the World



Target Group

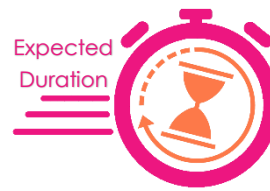
**Upper Primary,
Secondary, College &
young adult**

Relationship of the Activity with STEM



Science: ecosystems and the environment
21st century skills: decision-making, problem solving, strategy, thinking critically, communication and collaboration

Expected Duration



65-75 minutes



Content / Description of the Activity:

DESCRIPTION:

In this activity, participants study the science guiding the hydrosphere in relation to the global availability of freshwater by playing the digital-strategy game *Aquation: The Freshwater Access Game*. *Aquation* is a simulation game produced by the Smithsonian Science Education Center that challenges players to evenly distribute water resources around the world. The game uses water resource data and gross domestic product data to identify, on a color-coded map, areas of excess water and areas of water scarcity. It also incorporates world events like droughts, fires and heavy rain.

In order to achieve an even distribution of water resources, players ought to think globally and to develop a strategy that can help make all regions of the world more "green," i.e. with adequate fresh water resources for their populations. They need to try different actions that can help to spread scarce resources to areas most in need. For example, they can use a region's wealth to send humanitarian aid to regions in need, conduct research, run a desalination plant, or build a pipeline in order to transfer water from one region to another. Effective choices make regions change color from drought-stricken orange to green and blue. Players win the game when every region in the world has an adequate supply of water to meet its demand.

CONTENT:

Part 1: Initial Considerations 15'

1.1 Start the session by asking participants to dedicate a few minutes reading Matthew Williams' blog post [How Much Do You Know About Water?](#)¹⁶

1.2 Ask participants to estimate how much water they use at home daily by using the calculator provided in [United States Geological Society's webpage](#)¹⁷. Then prompt them to project how their daily habits would change if they were limited to 50 liters (13 gallons) or 25 liters (7 gallons) of water per day.

Part 2: Playing the game 25'-30'

2.1. Introduce and explain the *Aquation* game scenario:



Image: Smithsonian Science Education Center

Choice, strategy, balance, and . . . water equity? Parts of the planet are struggling to get enough water. Use each region's wealth to build pipes, desalinate water, and conduct research to bring water where it's needed most. Monsoons, dry spells, disease, and even cursed lawn sprinklers can help or hinder your progress. Manage your wealth and water carefully to solve the world's water crisis!

- Take actions to balance global water resources.
- React to global events.

¹⁶ <https://ssec.si.edu/stemvisions-blog/how-much-do-you-know-about-water>

¹⁷ <https://water.usgs.gov/edu/activity-percapita.html>

- *Make discoveries through research and recruit investors to share in the profits.*
- *Review and reflect on your strategy.*
- *Build, upgrade and use desalination plants to create fresh water.*

2.2 Divide the class into pairs. Ask each pair to rotate through roles as they play the game. One will record terms and concepts and one will play.

Part 3 - Wrapping Up 25'-30'

3.1 At the conclusion of the game, ask each pair to prepare and present to the whole class a report providing an overview of their experiences, and reflections on the game and on the strategy, they had used to meet global needs for water.

3.2 Integrate a whole class discussion with these presentations to consolidate key concepts and ideas introduced through the game. Encourage discussion through questions such as the following:

- How can we use what we have learned from playing the game in daily life? What choices can we make to conserve water and use it wisely?
- What kinds of real events might cause water shortages? How might people take action to avoid water shortages?
- How might the different choices that were popping-up during the game (e.g. build pipelines, run desalination plants, conduct research, etc.) have an impact in water management? Which choices might be good quick fixes? Which might make the biggest long-term difference?
- How (un)realistic were some of the choices in the game (e.g. build a water pipeline from Africa to South America)? What might people do instead in real life?

Training Goals



The activity aims to give participants a simplified look into the complex issue of water scarcity and uneven distribution of resources facing the world, and to encourage them to think globally in order to come with solutions to this huge humanitarian issue.

Learning Objectives/ Learning skills



Through participating in the activity, participants will be able to:

- Define the problem of water scarcity and unequal distribution of resources
- Specify a range of factors that can play a role in freshwater management

- Propose solutions to the global problem of water scarcity
- Use the simulated environment of the *Aquation* game to design and test solutions for moving, treating, and allocating water resources
- Recognize the need for global thinking and actions in tackling humanitarian issues like water scarcity facing humanity.

Pre-requisite knowledge and skills

In order to benefit from the activity, participants need to have some basic background knowledge about water and the world's growing water needs.

Tips for Trainers



- Instructors should ensure that, before launching the game, participants first do the initial tutorial accompanying *Aquation*. The tutorial offers a quick guide into the game's icons and the choices the player can make. It includes some useful tips for what is possible within the game and how to win it.

Tools and Resources (including hardware, software, ppts, handouts, videos, hands-on material)



1. Computers with Internet access
2. **[Aquation: The Freshwater Access Game](#)**¹⁸ (also available on mobile – **[iOS](#)**, **[Android](#)**).

Instructional Setting (class/group/group room, online, blended)

Computer Lab or classroom (if using mobile devices)

Pedagogical Approach

The activity has utilized *Aquation*, a high-quality simulation game, in order to promote participants' systems thinking about the global issue of water management modeled through the game.



The existing international literature strongly indicates the educational value of games and their potential to serve as a powerful perspective for STEM pedagogy. There are strong indications in the literature that appropriately designed and constructively used games like *Aquation*, support experimentation in authentic contexts. They can be used as the machinery for engaging learners in complex, problem solving activities that can help raise their intrinsic

¹⁸ <https://ssec.si.edu/aquation>

interest and performance in STEM, and promote the attainment of important skills and competencies essential in modern society (e.g. critical thinking, problem-solving, systems thinking, creativity).

Aquation was 2018 nominee for The Webby Awards inaugural games category for Public Service & Activism. Webby Awards, presented by the International Academy of Digital Arts and Sciences (IADAS), is the leading international awards organization honoring excellence on the Internet.¹⁹

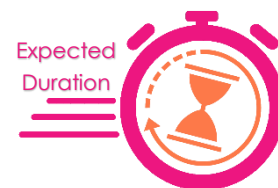
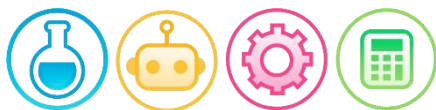
¹⁹ This activity was developed by utilizing the following sources:

1. [How Much Do You Know About Water?](#) (By Matthew Williams)
2. [Common Sense Media review of Aquation App](#) (conducted by Patricia Monticello Kievlan).

Men and Women at the Olympics



Relationship of the Activity with STEM



Secondary Education, College-level & Adult Education

Mathematics, Statistics, Technology

Lasts 60-75 minutes. If learners do not have background in Tinkerplots2, they will need to spend additional time (either at home or in a workshop organized by the instructor prior to the conduct of this activity) to familiarize themselves with the software (Tinkerplots Tutorials, (<http://www.tinkerplots.com/tutorials>), or in the additional Workshops which you will find in [fasterasmus.com](http://www.fasterasmus.com)).



Content / Description of the Activity:

DESCRIPTION:

In this activity, participants engage in analysis of authentic, real-world data, using the dynamical statistical software package TinkerPlots2 as a tool. TinkerPlots2 is a very powerful data visualization and modeling tool developed for use by middle school through university students and adult learners. During the activity, participants use the software to analyze and compare the trends of gold-medal times for men and for women in the same Olympics event. They are challenged to recognize trends in time series graphs, and to compare the time series graphs of the two genders. They are also challenged to find “lines of fit” for the time series graphs (although the data are not fit best with lines), and to make predictions about long-term patterns in bivariate Olympics data.

CONTENT:

Part 1: Initial Considerations 5'

1.1. Hand out the *Men and Women at the [Men and Women at the Olympics](#)*²⁰ Worksheet. Read through the introduction as a class. Then encourage participants to work individually to respond to the following questions, thus conjecturing as to how the data would look like:

1. How do you think the women’s gold-medal times in the 100-meter dash will compare with the men’s gold-medal times? If you think one gender’s times will be better than the others, about how much better will they be?

²⁰ www.tinkerplots.com/activity-files/Men-and-Women-at-the-Olympics.zip

2. Suppose there is a difference in the gold-medal times for men and for women. Do you think that over the years the difference is getting bigger, getting smaller, or staying the same?

1.2 After learner's finish writing down their answers in the provided activity handout, they discuss them in pairs in order to illuminate both common expectations about the data, and alternative ideas.

Part 2: Plotting and Investigating 60'

2.1 Ask each pair of learners to move to computers and open the document [OlympicsMenWomen.tp](#) to explore the Olympics data and test their conjectures. Ask pairs to consider the following list of guiding questions included in the [Men and Women at the Olympics](#) worksheet in order to detect trends in time-series graphs, and to compare the time-series graphs male and female athletes' gold metal time:

- You made a guess about how the gold-medal times in the 100-meter dash compare for men and women. Make a graph that you can use to answer this question. Include a copy of your graph with your assignment.
- Are one gender's gold-medal times better than the other's in the 100-meter dash?
- Explain. Your answer should say how your graph backs up your conclusion.
- If you think the results show that one gender tends to have better times than the other, about how many seconds better is the faster gender?
- Explain how you came up with your answer to the previous question.
- Choose another event in which both men and women compete. Compare their gold-medal times (or distances). Include a copy of the graph you make, and explain what you think the graph shows.

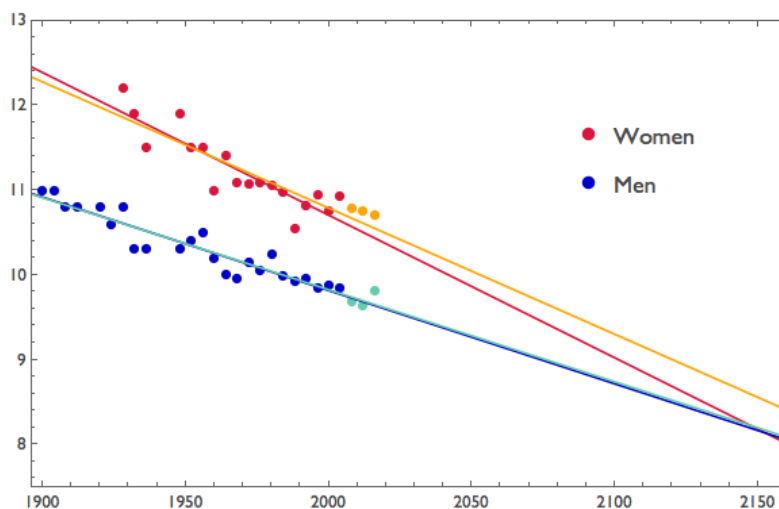
2.2 Discuss whether environmental factors (altitude, temperature, humidity, etc.) might affect the gold-medal times and distances, and which events might be most affected. Learners can make a list of conjectures and then turn to TinkerPlots to test some of them. The document [OlympicsMenWomen.tp](#) already has data about altitude; learners will need to do their own research and add an attribute for any other factor they might suspect.

2.3 Look at what happened to the gold-medal times and distances during periods when the Olympics were not held (during World Wars I and II). Learners will find that most events suffered a setback or showed no improvement in the Olympics immediately following these gaps. Discuss factors that may have contributed to these setbacks, including lack of training during war years, lack of funding for training after the wars, or loss of athletes during combat.

2.4 Challenge learners to find linear equations that fit the men's and women's data for the 200-meter dash. (Remind them, however, that a line may not be the best way to summarize the trend, particularly if they believe the gold-medal times have begun to level off, or will eventually.) Graph both lines and use the graph to approximate the point of intersection. Discuss what is important about this point (it's when the men's and women's times will be equal according to their model). If learners have learned formal methods of solving systems of equations (for example, substitution or elimination), have them solve the system algebraically and compare the solution to the graphical solution.

2.5 Ask pairs to read and reflect on the post [Case Study: The gender gap in 100-meter dash times²¹](#) by Carl Bergstrom and Jevin West. Bergstrom and West discuss a short paper published in 2004 by [Tatem and colleagues²²](#) in *Nature*, in order to alert the reader to the dangers of extrapolation, and to the fact that the linear model is not actually a good choice for long-range extrapolation.

In their *Nature* article, Tatem et al (2004) had used linear regression to fit curves to Olympic gold medal times for men and women in the 100-meter dash. Tatem et al. (2004) had noted the shrinking gap between men's and women's times and, based on their regression, had predicted that in the year 2156 women runners would beat men for the first time.



Bergstrom and West note that many authors have since criticized the claims made by Tatem et al. (2004). They then elaborate on what they consider as

²¹ https://callingbullshit.org/case_studies/case_study_gender_gap_running.html

²² <https://www.nature.com/articles/431525a>

the most convincing argument, which dismantled the original model in a simple and non-technical manner – one that came from a high school biology class in College Station, Texas.

2.6 Ask each pair to write a short report with their reflections on the ideas discussed in Bergstorm's and West's post.

3. Wrap-Up ^{10'}

3.1 Use the [Case Study: The gender gap in 100-meter dash times](#) post as a trigger for a class discussion on the dangers associated with extrapolation (i.e. predicting the response to an input which lies outside of the range of the values of the predictor variable used to fit the model). You can initiate the discussion by asking participants to comment on the following argument made by Kenneth Rice, one of the students in the Texan biology class:

*Sir — A. J. Tatem and colleagues calculate that women may out-sprint men by the middle of the twenty-second century (Nature **431**,525; 2004). They omit to mention, however, that (according to their analysis) a far more interesting race should occur in about 2636, when times of less than zero seconds will be recorded.*

In the intervening 600 years, the authors may wish to address the obvious challenges raised for both time-keeping and the teaching of basic statistics.

Training Goals



The training goal of the activity is to expand participants' ability to recognize trends in time-series graphs, and to compare the time-series graphs of two different groups (gold-medal times for men vs. women). It also aims to help participants recognize the dangers associated with extrapolation.

Learning Objectives/ Learning skills



The activity has the following objectives:

1. Expose learners to a real-world problem that can be solved using statistics
2. Familiarize learners with data-driven techniques of comparing sets of data:
 - Constructing and interpreting scatter plots for bivariate measurement data to

investigate patterns of association between two quantities

- Using time series graphs to make conjectures about trends across time
 - Justifying predictions based on data
3. Provide learners with informal understanding of key ideas related to linear regression
 4. Alert learners to the dangers of extrapolation from “lines of best fit” that go beyond the scope of the available data.

Pre-requisite knowledge and skills

Basic knowledge of descriptive statistics

It is preferable (but not necessary) for learners to have some prior experience with graphs that use two axes to compare two attributes, such as line graphs or scatter plots.

Tips for Trainers



- Because women did not compete in every year of the Olympic Games, learners' graphs will include excluded cases. When a case does not have a value for a plotted attribute, the case's icon is stacked above an asterisk to the right of the plot. If learners have not experienced excluded cases before, the instructor needs to explain them during this activity.
- During the activity, learners will probably want to use color keys to help distinguish between men's and women's results, therefore the instructor needs to be prepared to help them locate the Key button.

Tools and Resources (including hardware, software, ppts, handouts, videos, hands-on material)



1. Computers with Internet access, and the [Tinkerplots2 software](#)²³ installed
2. [Men and Women at the Olympics](#) Worksheet
3. [Case Study: The gender gap in 100-meter dash times](#) post
4. [OlympicsMenWomen.tp](#) dataset

Instructional Setting (class/group/group room, online, blended)

Computer Lab

²³ <https://www.tinkerplots.com/get>

Pedagogical Approach



Use of the technological learning environment Tinkerplots2 for dynamic data exploration.

Inquiry-based learning through exploitation of the data visualization affordances provided by Tinkerplots2.

Easy construction of dynamic graphs and detection of group differences and trends in powerful and intuitive ways through exploitation of Tinkerplots' additional (to position along axes) modalities (e.g. differences in icon size, color, and sound).²⁴

²⁴ This activity was built based on the following sources:

Activity [Men and Women at the Olympics](#) and accompanying [resources](#) located on the Tinkerplots website.

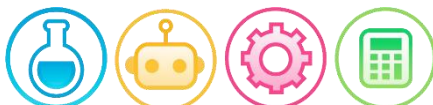
[Case Study: The gender gap in 100-meter dash times](#) article (posted by Bergstrom and West)

Data Literacy



**Girls and Young Women
May be adapted for high
school, and college-level
instruction**

Relationship of the Activity with STEM



Mathematics, Technology

Expected
Duration



1 working day

*If you tell me, I will listen. If you show me, I will see. But if you let me experience, I will learn.
- Lao-Tse, Philosopher, 5th century B.C.*



Content / Description of the Activity:

DESCRIPTION:

A huge amount of data is available, however the ability to critically read the data is not as widespread.

In the 2017 the mathematician Clive Humby, declared "The world's most valuable resource is no longer oil, but data". The ability of understanding the data allows to develop new opportunity of business.

Mandinach and Gummer (2013) define **Data literacy** as:

"the ability to understand and use data effectively to inform decisions. It is composed of a specific skill set and knowledge base that enables educators to transform data into information and ultimately into actionable knowledge. These skills include knowing how to identify, collect, organize, analyze, summarize and prioritize data" (Wolf et al.)

This activity provides a basic toolbox for data reading using a PPDAC (Problem, Plan, Data, Analysis, Conclusion) cycle for achieving an Exploratory Descriptive Analysis.

CONTENTS

Part 1: PROBLEM 15'

The aspects related to the following questions: **what data to collect, who to collect it from and why it's important** represents a core of the activity so in this step the participants collect data as evidence on different research questions (RQ).

The participants will be divided in random way in four working group and for each one will be assigned a RQ.:

To investigate the SES of their friendship network

In this part of activity, the instructor will lead the participants through a series of questions to help them think about the problem and to develop a statistical question such as:

1. How do we go about answering this question?
2. What do we need to know?
3. How will we find the information that we need?
4. What will we do with the information that we collect?
5. Who will find this information useful?
6. Is this information relevant to the problem?

The instructor will provide main concepts like variables and terms in the question need to be understood and defined by the participants, so they interpret the question correctly.

The referent for each group will explain the own RQ with statistical terms

Part 2: Plan 60'

This part has the focus on how participant will collect the data.

The instructor will suggest the sample size and discuss sampling methods students could use. Students need to be able to justify the sampling and data collection methods.

2. Further questions:
 1. How will we gather this data?
 2. What data will we gather?
 3. What measurement system will we use?
 4. How are we going to record this information?
3. Use a set of learning collaborative questions (Kahoot) to test their understanding.

Part 3: Data 15'

This activity involves how the data collection is organized. In this part of the activity, the participants should a way for visualizing the collected information for each unit. The final aim is to construct a frequency table.

Part 4: Analysis 180'

This activity is concerned with the data exploration and developing of a critical data approach.

After looking at the table, participants should think about the following aspects: are the different entries the same or different? Are they measured in the same way? Is there an increasing trend for each column? Do the variables tend to have the same behavior in terms of variability?

The instructor explains how to apply the selected measures such as media, median, quartiles, variance, boxplot, histograms, correlation, regression, scatterplots and barplots. In order to monitor the learning level will be administered many collaborative tests to the participants

Part 5: Conclusion 60'/90'

In this part, the group produces the presentation of the analysis following the illustrated four steps.

Training Goals



- Development of Data literacy
- Ability to understand the data and to realize a descriptive statistical analysis

Learning Objectives/ Learning skills



1. Acquisition of basic statistical knowledge in terms of qualitative and quantitative variables, discrete and continuous variables, measurement scales
2. Measures of position and variability
3. Correlation and regression

Pre-requisite knowledge and skills

Elementary skill of Math's

Tips for Trainers



1. To create a data literacy strategy based on the RQ where different types of data are used
2. Brainstorm mean, median, and mode. Set a timer for five minutes. As individuals, brainstorm as many situations in which calculating the *mean* might be the best type of "average" to compute. Repeat with *median* and *mode*. Then pool your responses into a common document to share with other educators.
3. Prepare to set of exercises on variability measures and distribute through Kahoot

4. Causation different than correlation: provide some details

**Tools and Resources
(including
hardware, software,
ppts, handouts,
videos, hands-on
material)**



BYOD (Bring Your Own Device) approach, some sets of ppts based on explanation of statistical elements, specific handouts. For the software, Power Point, Kahoot, Teams (or another software of instant texting) are requested.

**Instructional Setting
(class/group/group
room, online,
blended)**

Classroom or online subjected to the COVID-19 emergency

**Pedagogical
Approach**



The lesson plan is characterized by the adoption of the PPDAC cycle. The lessons will alternate theory followed by collaborative test or learning game with the participants and applications on their own devices.²⁵

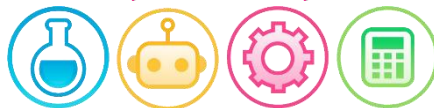
²⁵ Sullivan (2019), *Fundamentals of Statistics*, Pearson, Milano
Wolff, A., Gooch, D., Montaner, J. J. C., Rashid, U., & Kortuem, G. (2016). Creating an understanding of data literacy for a data-driven society. *The Journal of Community Informatics*, 12(3). http://datalit.sites.uofmhosting.net/wp-content/uploads/2017/08/data_literacy_in_the_real_world.pdf (viewed on 22th of May 2020)
<https://new.censusatschool.org.nz/wp-content/uploads/2012/11/how-kids-learn.pdf>

Statistics with Excel



Target Group

Relationship of the Activity with STEM



Expected Duration



**Girls and Young Women
May be adapted for high
school, and college-level
instruction**

Math's, Statistics,
Technology, Performing Art

**1 working day
If learners do not have
background in Excel, they will
need to spend additional time
(either at home or in a
workshop organized by the
instructor prior to the conduct of
this activity) to familiarize
themselves with the
functionalities**



Content / Description of the Activity:

DESCRIPTION:

Excel is very useful for several activities. The statistical analysis represents one of these applications. However, Excel, even though very simple and intuitive could result unknown to most of the young people. They are very experienced in managing social media but at same time inexperienced in the use of specific software such as Excel. Under this perspective, the use of Excel allows to complete the framework of digital competencies in the young people. The PPDAC approach has been applied.

Contents

At beginning of the course, the participant will be arranged in 4 working groups.

Part 1: Problems *Min 30'+30'*

Problem 1

a) What is Excel?

The instructor administers some questions through Kahoot to quantify the level of Excel knowledge of the participants. The instructor, based on the answers, asks specific questions about their expertise level of Excel

Problem 2

How do you use Excel?

Exercise:

In sales transaction dataset, find the proportion of customers who used PayPal and the proportion of customers who used credit card. Also find

the proportion that purchase a book and the proportion that purchased a DVD (*Adapted from Evans, 2016*)

RQ1. What are the characteristics of dataset' variables?

RQ2. How many customers use PayPal, credit card?

RQ3. What are the average charges for DVDs paid by credit card?

The first part of activity will be devoted to the introduction of Excel windows and to the basic operation of database management. The instructor after listening the participants' perspective will illustrate the Excel operation flow. This part will be completed with a learning test on Excel.

Part 2: Plan *Min 20'*

What data do you need to answer the RQs?

Part 3: Data *Min 40'*

What are the characteristics of this data on Spreadsheets? How to manage data and develop tables on Excel?

Part4: Analysis *Min 120'*

This part will treat the data visualization and the measure of position and dispersion

Part 5: Conclusion *60'/90'*

In this part, the group produces a research report and a presentation (power point or infographics or poster or video) of the analysis based on the all steps.

Training Goals



- Ability to understand the data and to realize a descriptive statistical analysis through Excel

Learning Objectives/ Learning skills



Acquisition Improving the digital and the statistical skills

Pre-requisite knowledge and skills

Elementary skill of Math's, Statistics and Technology

Tips for Trainers



To revisit the Excel statistical function and statistical measures

Tools and Resources (including hardware, software, ppts, handouts, videos, hands-on material)



- BYOD (Bring Your Own Device) approach,
- A presentation in PowerPoint, based on explanation of Excel in a statistical view, (IO1_Activity2_IULM_INTREXCEL.PPTX)
 - Kahoot use (IO1_Activity2_IULM_Learning Game.docx),
 - Teams (or another software of instant texting) Excel,

Power Point and Internet access are requested

Instructional Setting (class/group/group room, online, blended)

Classroom with BYOD and PPDAC approaches (or online dependent on COVID-19 emergency)

Pedagogical Approach



The planning of lesson will be characterized by the combination of theoretical presentation and pc applications. The theoretical lesson will be mix with collaborative learning tests.²⁶

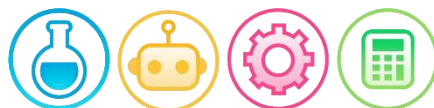
²⁶ Evans, J. R. (2016). *Business analytics*. Pearson Higher Ed

Introduction to Python



Girls and Young Women
May be adapted for high school, and college-level instruction

Relationship of the Activity with STEM



Mathematics, Technology



1 working day in class with additional time at house for downloading software



Content / Description of the Activity:

DESCRIPTION:

This activity is strictly operational and devoted to the share the basic elements of Python. The PPDAC cycle will be applied.

CONTENTS

■ Problem: What Python is?

Why we need Python? *Min 15'*

The instructor launches a short survey for discovering the Python knowledge. The responses drive the discussions between the instructor and the participants.

- Plan: The choice of compilers and the discovery of environments *Min 30'*
- Data: how do we create the data and how do we import the data? *Min30'*
- Analysis: Principal libraries and functions *Min120'*
- Conclusion *Min10'*

Each participant will develop an own code and explain it to the class

Training Goals



The participants will be able to apply the basic principles of Python in Pycharm Ide

Learning Objectives/ Learning skills



The activity aims to achieve the following results:

1. Development of simple instruction sequences in Python
2. Ability to program in Python

Pre-requisite knowledge and skills

Elements of Math are requested.

Tips for Trainers



It is advisable to prepare a mini-guide to download Python to participants' PCs.

The interaction with the teacher who constantly checks the development of every single instruction is fundamental for an effective learning, so you need to constantly supervise all the instructions made by each student on their PC.

Tools and Resources (including hardware, software, ppts, handouts, videos, hands-on material)



BYOD (Bring Your Own Device) approach, 3 sets of ppts based on explanation of Pycharm coding, Kahoot, Teams (or another software of instant texting), Power Point and Internet access are requested.

Instructional Setting (class/group/group room, online, blended)

Classroom with BYOD approach (or online dependent on COVID-19 circumstances)

Pedagogical Approach



The planning of lesson will be characterized by the combination of theoretical presentation and development of basic Python instructions.²⁷

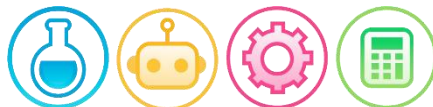
²⁷ Mueller, J. P., & Massaron, L. (2019). *Python for data science for dummies*. John Wiley & Sons

Exploratory Data Analysis with Python



Girls and Young Women
May be adapted for high school, and college-level instruction

Relationship of the Activity with STEM



Math modeling, Mathematics, Technology



180/240 minutes in class
but additional time at home



Content / Description of the Activity:

DESCRIPTION:

This activity is a bridge between the Lesson 1 and Lesson 3 focusing on the Exploratory Data Analysis with Python. The PPDAC cycle will be applied.

The participants will be divided in groups composed by 4/5 people.

CONTENTS

1) Problem *Min 10'*

Identifying the dimensions of the study and focus on the data of the example in the Lesson 2

2) Plan *Min 60'*

Defining the requested Python coding for developing analysis. The instructor will introduce the suitable statistical and relational database libraries for answering to the RQ's

3) Data *Min 20'*

Importing the data in Python and visualize it. The instructor will stimulate the participants with observations on the structure of the printed table.

4) Analysis *Min 50'*

Each group will analyze the imported data in Python with the identified coding in previous step (**Plan step**)

5) Conclusion *Min 40'*

Each group will develop a brief of the results

Training Goals



The use of Python provides a bridge between statistical theory and its application. The participants will be able to apply the basic principles of EDA with Python

**Learning Objectives/
Learning skills**



The activity aims to achieve the following results:

1. Developing digital and soft skills such as Teamworking, Problem solving and time management
2. Bring participants closer to the use of statistics through Python (and vice versa)
3. Provide informal understanding of key ideas of Exploratory Data Analysis to the participants
4. Develop critical statistical approach

Pre-requisite knowledge and skills

Tips for Trainers



Elements of Math's, Statistics and Python are requested.

- It is advisable to prepare a mini-guide to download Python to participants' PCs.
- As learners work in teams, your role should be one of a facilitator and observer. You should encourage learner groups to come up with their own solutions and should avoid questions or comments that lead them towards a particular direction.

If more follow-up is desired after presentations and discussion, allow learners to resume their groups and modify their models

Tools and Resources (including hardware, software, ppts, handouts, videos, hands-on material)



BYOD (Bring Your Own Device) approach 1 set of ppts based on explanation of Python coding, Excel, Power Point, Kahoot, Teams (or another software of instant texting).

Computers with Internet access, and the Python software installed

Instructional Setting (class/group/group room, online, blended)

Use of PPDAC cycle in the classroom

Pedagogical Approach



Front lessons with BYOD approach in the classroom. The lesson plan will be alternated between theory and coding. ²⁸

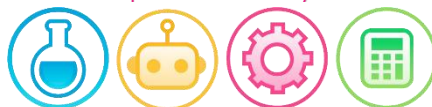
²⁸ Haroon, D. (2017). *Python Machine Learning Case Studies*. Apress.

CONJOINT ANALYSIS for STEM



**Girls and Young Women
May be adapted for high
school, and college-level
instruction**

Relationship of the Activity with STEM



Math modeling, Mathematics,
Technology

Expected
Duration



**180/240 minutes in class
but additional time at
home**



Content / Description of the Activity:

DESCRIPTION:

Customer perceptions, new products, service quality, loyalty, preferences can be discovered through the questionnaire. A questionnaire is not a confused mix of questions and answers, but it is a measurement instrument with specific rules. When a young entrepreneur is looking for a new idea or product the conjoint analysis is the most suitable technique. The conjoint analysis allows to identify the key elements of a new product or services requested by the target group. The conjoint analysis can be conducted through several tools but the use of Excel represents a simple way for implementing it.

The activity simulates - The elements are: package, price and colors.

The classroom will be organized in two working groups, the first one will be called Researchers (R1) and the second ones will be identified as Respondents (R2). A PPDAC cycle will be applied.

CONTENT

Problem: *Min 15'*

A hypothetical situation has been described: a young entrepreneur has to decide which are the elements of new biological lipstick. The goal is to identify the ideal lipstick.

The R1 and R2 groups search the components or factors of the ideal lipstick through:

1. Viewing of commercials
2. Generating ideas about the most important factors for the choice of lipstick

The groups discover that the factor can be three with different levels.

Plan *Min 180'*

The groups components enumerate all possible combination of levels and factors and create the cards.

How to identify the mix of factors that form the ideal lipstick?

The R1 group needs a new technique known as Conjoint analysis. The instructor explains this new technique using the construct of ideal product.

Data *Min 20' + 20'*

What kind of data is needed?

In order to identifying the ideal factors and its levels of a lipstick, the instructor ask to the R1 to administer to the R2 group. Each component of R2 has to evaluate each card with preference score. In this step the data have been created and reported in a spreadsheet where on the rows there are the R2 components and on the columns the cards and in cell the score for each card.

Analysis *Min 60'*

The instructor recalls the technique of regression, introduces in the Lesson 1, and gives more details on the application. After the R1 and R2 groups apply the technique achieving the composition in terms of factors and levels of an ideal biological lipstick.

Conclusion *Min 30'*

R1 and R2 group produce their briefing which present the ideal biological lipstick.

Training Goals



The activity was carefully planned to identify a new class of needs through a collected data. The knowledge of this technique represents an important asset for future entrepreneurs.

Learning Objectives/ Learning skills



The activity has the following objectives:

1. Provide participants a tool for discovering the new needs
2. Provide participants a statistical approach for measuring the preferences

Pre-requisite knowledge and skills

Elements of Math and Statistics are requested. Basic elements of Excel function are preferred

Tips for Trainers



Expertise on Excel, Statistics and web tools.

**Tools and Resources
(including
hardware, software,
ppts, handouts,
videos, hands-on
material)**



BYOD (Bring Your Own Device) approach, sets of ppts based on explanation of Excel in a statistical view, Kahoot use, Teams (or another software of instant texting) Excel, Power Point and Internet access are requested

**Instructional Setting
(class/group/group
room, online,
blended)**

Classroom with BYOD and PPDAC approaches (or online dependent on COVID-19 emergency)

**Pedagogical
Approach**



The planning of lesson will be characterized by the combination of theoretical presentation and pc applications. The theoretical lesson will be mix with collaborative learning tests.²⁹

²⁹ Curry, J. (1996). Understanding conjoint analysis in 15 minutes. *Sequim, WA: Sawtooth Software.*

Orme, B. (2002). Interpreting conjoint analysis data. *Sawtooth Software Research Paper Series.*



GOALS



WORKSHOP



4.1

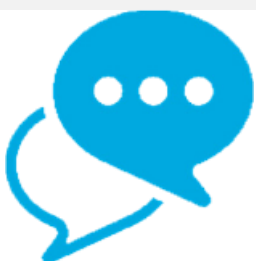
6 C's of Education promoted by UNESCO



Citizenship - Thinking like global citizens, considering global issues based on a deep understanding of diverse values with genuine interest in engaging with others to solve complex problems that impact human and environmental sustainability.



Collaboration - refers to the capacity to work interdependently and synergistically in teams with strong interpersonal and team-related skills including effective management of team dynamics, making substantive decisions together, and learning from and contributing to the learning of others.



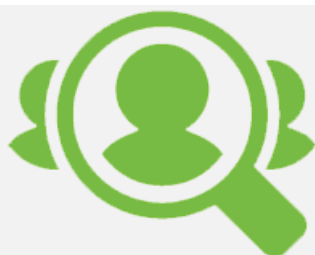
Communication - entails mastery of three fluencies: digital, writing, and speaking tailored for a range of audiences.



Creativity - having an 'entrepreneurial eye' for economic and social opportunities, asking the right questions to generate novel ideas, and demonstrating leadership to pursue those ideas into practice.



Critical Thinking - Critically evaluating information and arguments, seeing patterns and connections, construction meaningful knowledge and applying it in the real world.



Connectivity - is foundational to creating an effective learning environment. Students and teachers cannot take advantage of the opportunities to connect and engage globally or leverage high-quality learning resources without consistent and reliable access to the internet.

Workshop: 6C's of Education



High school students,
Youth age 18-29



MATERIALS

Slips of paper, pens, paper
bags



DURATION

30 minutes

Creative Collaboration

Competencies and skills to be developed: Creativity, Communication, Collaboration

Introduction:

This game is played in two rounds. Break large groups into smaller teams of four to seven.

While teams don't have to have the exact same number of participants, it should be close.

This activity uses the creative thinking technique called "concept combination."

This involves taking two concepts or objects and combining them in some novel way. For example, what can you come up with from the combination of a baseball hat and a rock, or an iPod and a cooler, or a hair dryer and a bike?

Have each participant write down the name of an object on a slip of paper and place it in a paper bag. After collecting all the slips, have someone randomly pick two slips of paper from the bag to be used by all teams in the first round of the activity. Read the items aloud and invite the teams to brainstorm to come up with a way to combine these two objects in a creative and innovative manner. Teams have six minutes to come up with the best idea. After the time is up, have each team present their idea to the group. In the second round, have someone from each team randomly pick two slips of paper from the bag. The team now must brainstorm to come up with a way to combine their two new and different objects in a creative and innovative manner. After six minutes, have each team present their best idea to the group.

OBJECTIVES

- To experience the creative process collaboratively
- To tap into the creativity of the team



Discussion Questions

- What was challenging about this activity?
- What did you notice regarding the team brainstorming?
- What were some differences in the two rounds?
- Was the manner in which you brainstormed the same for both rounds? Why or why not?
- How does the assumption of competition impact our ability to collaborate?
- During the first round, did you or your team try to prevent other teams from hearing your ideas? What about the second round? How did this affect your ability to brainstorm?
- In the first round, did you hear any other team's comments that led your team to more creative ideas?
- What is challenging about collaboration?
- What are the benefits of collaboration?
- What are some real-life situations that benefit from collaboration?

Workshop: 6C's of Education



High school students, Youth age 18-29



MATERIALS

Painter's tape, Super Stars Grid handout (provided); 16 star-shaped markers (six of one color, six of a second colors, and four of a third colors; you can use 5-inch foam stars found at craft stores or make your own out of construction paper; one copy of the Super Stars Rules handout (provided) for each team; one copy of the Super Stars Score Sheet handout (provided) for the facilitator; a Super Stars Observer Form handout (provided) for each observer; pens



DURATION

30 minutes

Super Star

Competencies and skills to be developed: Creativity, Communication, Collaboration, Conflict solving, Trust building

Tools that can be used: Handout's for the workshop which you will find them in e-learning platform in fasterasmus.com

Introduction:

Using the painter's tape, create a 4-foot by 4-foot grid on the floor (see Super Stars Grid for an example).

Split your team into two groups of three to eight (groups do not have to have the exact same number of people). If you have more than eight people for each small group, any additional group members can act as observers (up to three observers are plenty). Give each group six stars of one color and two additional "wild" stars. Wild stars are the same color for both groups. For example, give one group six blue stars and two yellow wild stars; give the other group six green stars and two yellow wild stars. Provide a Super Stars Rules handout for each group and an Observer Form for any observers.

This game is played in a series of rounds (typically three to five). At the end of each round, the facilitator tallies the points and records them on the score sheet so everyone can see the results. If, after posting the scores, someone asks

if both sides can work together, you can reiterate, “Your goal is to get the maximum number of points possible.” If they continue to pressure you, request that they refer to their rules sheet for guidance. When you facilitate this activity, you don’t say you are adding all the points together, just do it. In fact, usually post the scores after the first round is over and as they are planning their strategy for the second round. Scores usually don’t amount to much in the first round because both sides are so focused on preventing the other side from scoring; they use all their resources to block rather than score. After the first round, the lightbulbs should start to go off as some observant group members begin to realize that they need to cooperate rather than compete with each other. It is interesting to see if their group agrees or continues to compete.

Make sure to enforce the rule about not talking to the other group. Once they begin to work together and share resources, give them one last round to see how high a score they can generate by working together. Eventually it should become clear that for the team to be successful both groups need to be successful and cooperative. Blocking the other group only serves to waste resources and results in a low score for both groups and the team overall. Even though the rules specifically state, “Your goal is to accumulate the maximum number of points possible,” few groups consider a win-win option and instead immediately compete with the other group. It is interesting to note that when the groups begin to trust and collaborate, the rounds are faster and more fun. Pay attention to how the energy shifts during the activity as well, or ask the observers to notice the difference in the energy as the groups begin to work together.

Tips

If the groups are not moving in the direction of cooperation by the third round, you may consider requiring them to play a wild star by the third placement, and another one by the sixth placement. It’s a good idea to practice this game with some friends or family first. Many groups will figure it out in three rounds, but for some it takes more. If groups get locked into the competition mode, set a time limit for placing their stars; otherwise, this game can take far too long and some will lose interest and get frustrated (if this happens, use it in the debriefing discussion).

Graphics/Pictures:

OBJECTIVES

- To take the team from conflict to collaboration
- To look for a win-win in what looks like a competitive situation
- To build a high level of trust within the team



Workshop: Digital Literacy and the basic Knowledge on Word Processors and Spreadsheets Usage

This workshop is based on 4 lessons courses which describes the different categories of productivity programs and their uses. It also explains the common commands and features of the user interface of these programs. In this course, you also learn how to perform basic tasks by using the commonly used productivity programs.

Audience Description

This course is intended for anyone who wants to acquire basic digital literacy skills, more specifically understanding the purpose and using a word processor and a spreadsheet processor.

Prerequisites

Students should have basic reading and comprehension skills at the level required to read a local newspaper. Students should have some basics computer skills.

Course Objectives

After completing this course, you will be able to explain the different categories of productivity programs and their common uses, work with the user interface provided by most commonly used productivity programs, and perform basic tasks in word processors, spreadsheets, presentation programs, and databases.

Module Introduction

You need to create various types of documents to present information in various formats. You can use productivity programs to easily create these documents. Most productivity programs have some common features and commands that make it easier for you to work with different programs.

This module describes the common features and commands of different productivity programs. It also explains how to work with various categories of productivity programs, such as word processors and spreadsheets.

Module Objectives

After completing this module, you will be able to:

- **Describe the functionality of various productivity programs**
- **Identify the features and commands shared by productivity programs**
- **Use a word processor**
- **Work with spreadsheets**

Course 1: Introduction to the most common productivity programs



Introduction

Suppose you are a cook trainee and want to start a home business with two other friends. To track the evaluation of your key products (*meals, cakes, cookies*) you first need to collect the rating scores of all the people that will be helping you (you included) and identify the measures needed to improve or replace your creations. You then need to combine this data and save it in a way that helps you to easily retrieve and update this information later. After collecting and saving all this information, you need to present this data to your business partners and create the final recipes.

To complete this entire task, you need to use the different types of productivity programs. These programs help you perform a specific task easily and efficiently.

In this lesson, you will learn about the basic features of productivity programs.

Lesson Objectives

After completing this lesson, you will be able to:

- **Describe the functionality of various productivity programs**

Overview of Productivity Programs

You can use a computer to perform various tasks, such as drafting a letter, creating a project report, making a sales presentation, maintaining household accounts, or managing customer information. To perform each task, you require specialized programs known as productivity programs, installed on your computer. For example, to draft letters and other text documents, you can use a word processor. Similarly, to create presentations, you can use a presentation program.

Some common productivity programs include the following:

Type of Program:



1. Word processors

You can use a word processor to create documents that mostly contain text. An example of a commonly used word processor is [Microsoft Office Word](#) (or Open Office - an opensource alternative).



2. Spreadsheet programs

You can use a spreadsheet program to work with numbers and perform mathematical calculations. A common example of a spreadsheet program is [Microsoft Office Excel](#) or Open Office - an opensource alternative).



3. Presentation programs (not covered in this course)

You can use a presentation program to combine graphics and text to create presentations. An example of a presentation program is [Microsoft Office PowerPoint](#) or Open Office - an opensource alternative).



4. Database programs (not covered in this course)

You can use a database program to organize data, such as contact information of customers and products bought by them, in a format that is easy to use and modify. A common database program is [Microsoft Office Access](#).

Course 2: Common features and usability

Introduction

Suppose you want to create different types of documents to present different categories of information. You can use different types of productivity programs to store and present information. Most productivity programs provide features to perform some common tasks. For example, in most productivity programs, you can open and close a file, print a file, and insert, move, modify, and delete text and objects. To help you perform these common tasks, most productivity programs include some common features and commands and have a similar interface. Many programs have several common features, such as menus and Quick Access Toolbar. These features make it easy for you to work in a new program because you can apply what you learn about one program to another program.

In this lesson, you will learn about the common features and commands of various types of productivity programs. You will also learn about the main components of the user interface, keyboard shortcuts, and various key combinations.

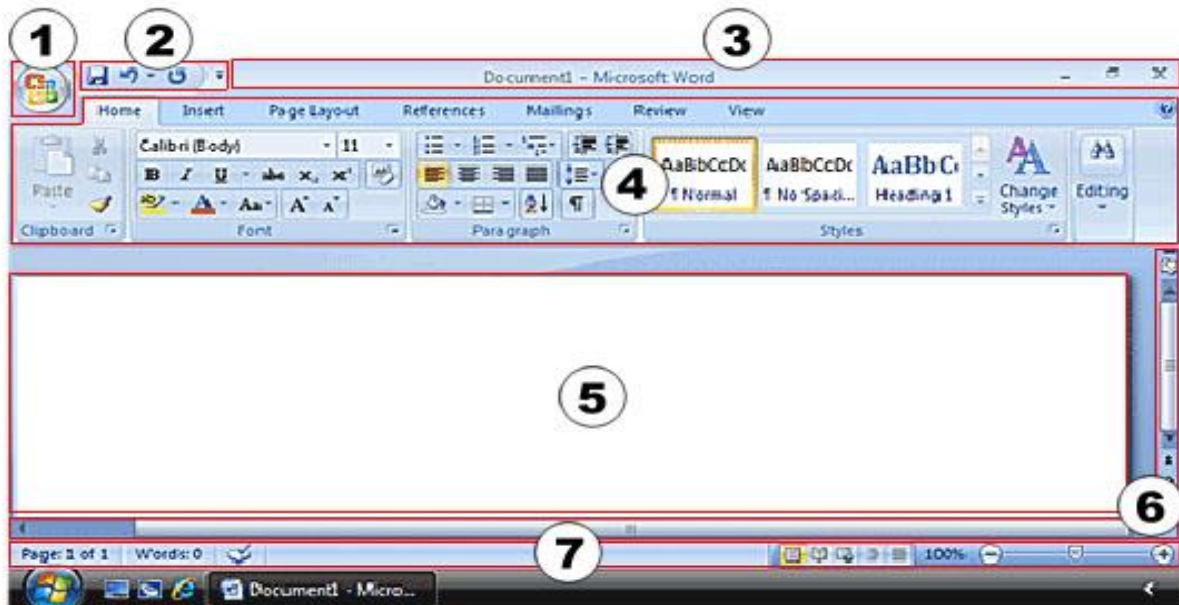
Lesson Objectives

After completing this lesson, you will be able to:

- **Identify the main components of the graphical user interface (GUI) of a productivity program**
- **Use the pointer to navigate in a program**
- **Identify the tabs, groups, and commands on the Ribbon**
- **Use the buttons on the toolbars to perform various tasks**
- **Type text and characters in a program by using the keyboard**
- **Explain the use of keyboard shortcuts and key combinations**

2.1 Introduction to the Graphical User Interface

A GUI helps you interact with a program on your computer. Most productivity programs have a similar interface that has common features. This illustration describes the key features of the GUI of a Microsoft Office program. These elements include the Microsoft Office Button, the Quick Access Toolbar, the Ribbon, the title bar, and the status bar.



1. You can click the Microsoft Office Button to view a menu that contains various commands and buttons. The commands on the menu help you create, save, and print your documents. The buttons at the bottom of the menu help you change the settings in the program and exit the program.
2. The Quick Access Toolbar provides you with buttons to commonly used commands. By default, this toolbar displays the Save, Undo, and Repeat buttons. However, you can customize the Quick Access Toolbar to include commands that you use frequently.
3. The title bar displays the name of the document that is currently open. The title bar also contains the Minimize, Restore Down/Maximize, and Close buttons.
4. Commands that help in working with document content are organized in logical groups on the tabs that make up the Ribbon. Each tab on the Ribbon is designed to help you perform a particular activity, such as writing or laying out a page. The Help button appears at the right end of the Ribbon. Using this button, you can search for topics that are related to the program.
5. The blank space within the program where you enter information is called work area.
6. Scroll bars are vertical and horizontal bars located at the side or at the bottom of a display area. You can use scroll bars to move to a specific location in the work area.
7. The status bar provides information about the document that is currently open. You can customize the status bar to show the required information by right-clicking the status bar and then by selecting the required options. The View toolbar is located at the right end of the status bar. This toolbar provides tools for adjusting the view of contents in a document.

2.2 Using the pointer / cursor

A cursor is a blinking vertical bar on the screen that indicates the location where you can insert text or graphics in a document. You can also use the cursor to select text or graphics in a document.

A mouse pointer is an on-screen arrow or another shape that moves when you move the mouse or other pointing device. Using the pointer, you can quickly move around within a document and select different commands and text. You change the location of the pointer by moving the mouse. The area of the screen where the pointer appears is the target for an action when you press one of the mouse buttons. By moving the pointer and then clicking the mouse button, you specify the new location of the cursor. For example, when working with a word processor, such as Word, you can specify the location of the cursor by moving the pointer to that location, and then clicking the left button of the mouse. You also use the pointer to point to a menu or button and to select text or graphics in a program. In this simulated lab, you will work with the pointer to move around within a document and make the required changes.

2.3 The Ribbon / Features Sets (Groups of features)

In productivity programs, such as Word, the Ribbon consists of tabs. Each tab is divided into groups. A group helps you perform a set of similar tasks, such as inserting tables or adding pictures on a page.

The Ribbon also consists of contextual tabs. These tabs appear only when necessary. For example, in a Word 2007 document, the contextual tab for editing a table appears when you insert a table in the document.

2.4 Using the toolbars

When you work with a program, you might frequently use certain commands. For example, if you are typing a business letter, you may want to copy and paste text, make changes to the font style, and indent the text. Instead of using the commands from the menu bar, you can directly access the commonly used commands by using the Quick Access Toolbar and the Mini toolbar.

The Quick Access Toolbar is a customizable toolbar that contains a set of commands. This toolbar always appears at the top of an open document. On the Quick Access Toolbar, you can also add buttons for the commands that you use frequently. The Mini toolbar appears only when you select text in a document. You can change the size, font, or colour of the text by using the options from this toolbar.

2.5 Keyboard Techniques for Entering Text

- You use a keyboard to enter information into a computer. To enter information, you must first define where to place the information, and then press the appropriate keys.
- You can use the ENTER key to instruct the computer to complete an action. Based on the type of program, you can also use the ENTER key to run a command. In some productivity programs, such as a word processor, pressing the ENTER key ends one line of text and then starts a new line of text.
- You can use the SPACEBAR to enter a space character. For example, you can press the SPACEBAR to insert a space between two words.
- You can use the SHIFT key in combination with another key to give the other key an alternative function. For example, you press the SHIFT key in combination with any letter key to type an uppercase version of that letter.
- The SHIFT key is also used in various key combinations to create nonalphanumeric characters, such as a parenthesis, or to perform special operations. For example, you can use the SHIFT key in combination with the UP ARROW or the DOWN ARROW keys to select data.
- You can press the CAPS LOCK key to type all alphabetic characters on your keyboard in uppercase. This is much easier than holding down the SHIFT key the entire time that you are typing an entire sentence in uppercase. The CAPS LOCK key does not affect numbers, punctuation marks, or functional keys.
- You can use the BACKSPACE key to move the insertion point to the left and delete a character on the left. The BACKSPACE key moves one character at a time.
- The numeric keypad is a calculator-style block of keys that you can use to enter numbers. It includes keys for the digits 0 to 9, addition, subtraction, multiplication, and division.
- The Numeric Lock key, also called the NUM LOCK key, when turned on, activates the numeric keypad. When the NUM LOCK key is turned off, you can use most of the numeric keypad keys to move the insertion point, move through the document one screen at a time, or move quickly to the beginning or end of the document.

2.6 Advanced Keyboard Techniques

- You use the function keys for special tasks in different programs. For example, you use the F1 key to display the Help file associated with a program. The tasks of the function keys are specific to each program. For example, when you press the F5 key in PowerPoint 2007, it starts a slide show, whereas when you press the same key in Word 2007, it displays the Find and Replace dialog box.
- You use the navigation keys to control the movement of the cursor. These keys include HOME, END, PAGE UP, PAGE DOWN and four arrow keys. The HOME key usually moves the cursor to the start of a line or a document. The END key moves the cursor to the end of a line or a document. The PAGE UP and the PAGE DOWN keys move the cursor up or down, one screen at a time. The number of lines that it moves will vary depending on the size of your monitor. You can also use the four arrow keys to move the cursor vertically or horizontally on the display screen.
- Keyboard shortcuts are key combinations usually involving command keys that help you quickly perform an action without using the menus or toolbar icons. For example, you can press CTRL+P to print the current document by using the default printer settings.
- While working with different programs, you may have to insert special characters and symbols. On a standard keyboard, you do not have dedicated keys for specific characters and symbols. For example, you may want to enter the copyright symbol in a document, and there is no dedicated key for it. However, you can insert special characters by using a combination of specific keys on a standard keyboard. To enter the copyright symbol, you can press ALT+0169.

Course 3: Using a Word Processor

Lesson Introduction

Suppose you need to create your resume to apply for a job. You want to create a professional resume that lists the various details in an easy-to-read format. You also want to highlight the text that describes your achievements. You can use a word processor, such as Word 2007, to create an impressive resume.

Word processors are specialized programs that allow you to change the look and feel of a text document. These programs include tools that help you to create documents by inserting graphics, charts, tables, and other media elements. These programs also help you to create a variety of business and personal documents such as reports, resumes, and letters.

In this lesson, you will learn about the basic tasks that you can perform by using a word processor. You will learn to work with text, tables, and pictures. You will also learn about the benefits of desktop publishing (DTP).

Lesson Objectives

After completing this lesson, you will be able to:

- *Perform basic tasks in a word processor*
- *Edit and format text*
- *Work with tables and pictures*
- *Proofread a document*
- *Identify the benefits of DTP*

3.1 Getting started with a word processor

A word processor provides the functionality of various components, such as paper, pen, typewriter, eraser, and a dictionary. Most computers have preinstalled basic word processors such as Microsoft Notepad and Microsoft WordPad.

You can also use advanced word processors, such as Word, to perform complex tasks that include, checking for wrong spellings, finding synonyms, inserting graphics, printing documents, and displaying documents in multiple on-screen windows.

3.2 Editing and formatting

Imagine you have written a letter to a friend about your holiday. After writing the letter, you decide to make some changes to it. You want to edit and delete some text, change the line spacing, and increase the font size. In such a

situation, you can write the letter in a word processor, such as Word 2007, so that you can easily edit and format the letter.

Word, for example, helps you to easily cut, copy, and paste text; undo and redo actions; justify text; change font parameters and paragraph spacing; and perform various other editing and formatting functions.

3.3 Working with tables and pictures

While creating documents, you may want to organize complex information in tables. Suppose you want to create an order form that contains information such as product name, quantity sold, product price, and total amount of the order. Instead of presenting this information as plain text, you can present the information in a table. Tables help you present complex information in an easy-to-understand format. You can divide the information into logical sections within a table to group different types of data, making it easier to read the entire document.

In addition, you can also include pictures in a document. For example, you may want to include your company logo in the order form to distinguish your document and make it visually appealing.

3.4 Proofreading a document

Advanced word processors, such as Word, can automatically detect the language of the typed text and then use the spelling dictionary, grammar checker, and punctuation rules for that language. You can also search for synonyms and variations of words by using the thesaurus in Word.

In addition, you can configure the AutoCorrect function in Word to automatically correct misspellings and grammatical errors as soon as you start typing the text. For example, AutoCorrect can be set up to automatically correct misspellings, such as 'teh' for 'the'.

Testing:

At the end of this lesson you should be able to create a document and use different techniques to format it, trying to select features mentioned such as keyboard usage.

Course 4: Introduction to Spreadsheet Programs

Lesson Introduction

Suppose you have to calculate the expenses of an entire month. You note the expenses for each day and calculate the total expenses for the month. You use a calculator to do the calculation, or you can manually add the figures. After you finish the calculation, you realize that some of the data that you used in the calculation was wrong. Now, all your time and effort is wasted, and you have to do the entire calculation again.

If you use a spreadsheet, you can avoid these types of calculation problems, and save time and effort. A spreadsheet is a table in which you can store and organize data, and also perform numeric calculations. This makes your work easier because there is no need to perform calculations manually or with a calculator. It is easy to modify the data in a spreadsheet. When you modify the data used in a calculation, the result of the calculation is modified automatically. Therefore, you do not have to spend time or effort in recalculation.

In this lesson, you will learn about the components of a spreadsheet and how to store data in it. You will also learn to perform basic mathematical tasks and create charts and graphs in a spreadsheet. In addition, you will learn about the various options available for printing a spreadsheet.

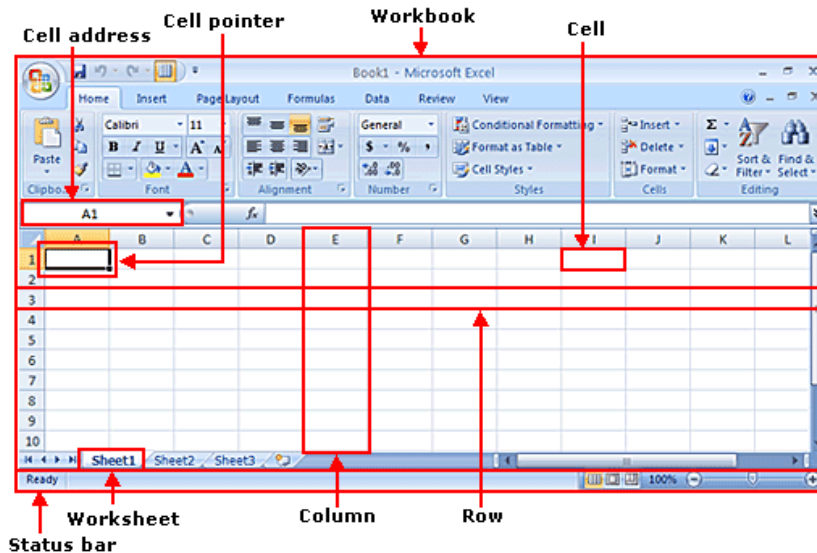
Lesson Objectives

After completing this lesson, you will be able to:

- **Identify the components of a spreadsheet**
- **Enter data into a spreadsheet**
- **Perform basic mathematical tasks in a spreadsheet**
- **Insert charts in a spreadsheet**
- **Print a spreadsheet**

4.1 Overview of Spreadsheet Programs

Using a spreadsheet program, such as Excel, you can store and modify data. You can also perform various mathematical calculations, such as addition, subtraction, and multiplication.



The interface of Excel 2007 includes the following parts:

- Workbook and worksheets. A workbook is a file created in Excel 2007. A workbook can contain one or more worksheets and related items. An Excel 2007 workbook contains three worksheets. A worksheet is a single spreadsheet in a workbook. You can add or delete worksheets in a workbook as required.
- Rows and columns. The horizontal divisions in a worksheet are called rows. Each row is identified by a number. For example, the first row in a worksheet is 1. Columns are the vertical divisions in a worksheet. Each column is identified by a letter. For example, the first column in a worksheet is A.
- Cell. A cell is formed by the intersection of a row and a column. The highlighted rectangular border formed around an active cell is called a cell pointer. An active cell is the cell in which you are working currently. There can be only one active cell at a time. You can use a cell to store and display different types of data such as text, numbers, or formulas. Each cell in a worksheet is identified by a cell address. A cell address is made of the column letter and row number of the cell. For example, the cell formed by the first column and first row has the cell address A1. The cell address indicates the exact location of a cell in a worksheet.
- Status bar. This bar provides information about the present status of work in the worksheet. For example, if you are not working on the worksheet, the status bar displays the message "Ready". When you click in a blank cell to enter data, the status bar displays the message "Enter".

4.2 Entering Data

You want to tabulate the scores of the recipes in a spreadsheet. For this, you need to enter details such as recipe names, ingredient names, and the scores of each recipe. Then, you need to calculate the overall results using formulas in a spreadsheet.

To work with a spreadsheet, you enter data in the cells of the spreadsheet. You enter data by clicking a cell and typing the data. To edit data in a cell, you click the specific cell and type the new data. The new data automatically replaces the old data.

You can enter several types of data in a spreadsheet, but the most common are:

- Text. Text data has no numeric value associated with it
- Number. A number has a constant numeric value, such as the test scores attained by a student
- Formulas and functions. Formulas and functions are mathematical equations. The numeric value of formulas and functions automatically changes when the numeric value of variables associated with them changes

You can also arrange the data that you enter in a spreadsheet. For example, you can sort the scores attained by recipes in ascending or descending order to find the top scorers. Similarly, you can sort the names of the recipes alphabetically.

4.3 Performing Mathematical Tasks

An important advantage of a spreadsheet is that apart from storing and manipulating data, you can also use it to perform various mathematical tasks on the stored data quickly and accurately. To perform these mathematical tasks, you use functions provided by the spreadsheet program. A function is an operation that is performed on the data in the cells by using calculation tools available in the program. For example, after recording your household expenses in a spreadsheet, you can use the AVERAGE function to calculate the average amount you spent for groceries. You can also create your own formulas to perform mathematical calculations.

Using formulas and functions in a spreadsheet helps you to easily modify any data in your calculations. This is because formulas and functions refer to the cell address, not the data in the cells. When you change the data in a cell, the applied formula or the function does not change, and the result of the formula is updated automatically.

4.4 Inserting charts to view data

Suppose you need to submit a monthly sales report to your partners. You also want to show the sales trend by comparing the sales figures of the last three months with the sales figures of the current month. You have created a spreadsheet that contains the sales figures. Now, to show the sales trend, you can either plot a chart manually or create a chart in a spreadsheet program. In this situation, the latter method is clearly easier and quicker.

With a spreadsheet program, such as Excel, you can represent numeric data in the form of charts. These charts are useful when you want to show the trends in data. It is easier to understand numbers when they are displayed as a chart. Excel has wizards that provide step-by-step procedures for creating charts to display numerical information.

You can choose from a variety of chart types, such as pie, line, and bar, based on your needs. For example, if you want to know how much money you spent on various household items in a year, you can make a pie chart. This chart indicates the percentage spent on items such as groceries, rent, or car maintenance.

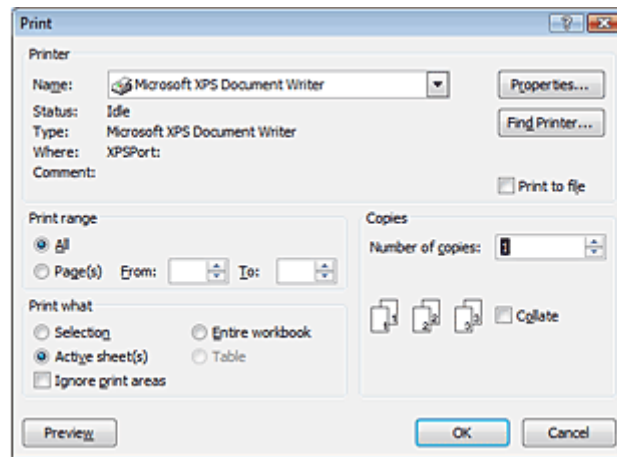
4.5 How to print spreadsheet data

After you create and save a spreadsheet, you may want to see how it looks on paper, share it with someone who does not have access to a computer, or simply create a copy on paper. You can use the Print command in Excel to print the data of a spreadsheet in different formats. You can print portions of the spreadsheet and turn on and off elements like lines and borders.

You can also customize the way you want to print a spreadsheet based on the type of data that the spreadsheet contains. For example, you might have a spreadsheet that contains numeric data and a pie chart, and you want to print only the pie chart. In this case, you can customize your print settings to print the pie chart separately.

To print a spreadsheet in Excel, perform the following steps:

- To print a spreadsheet, click the Microsoft Office Button, point to Print, and then click Print.
- To specify the pages that you want to print, in the Print dialog box, under Print range, in the From and To boxes, type the pages that you want to print.
- To change the layout of the pages, click Properties.
- In the Microsoft XPS Document Writer Document Properties dialog box, on the Layout tab, click the Orientation arrow, change the layout of the page as required, and then click OK.
- To preview the pages, in the Print dialog box, click Preview.



To show margins on the pages, on the Print Preview tab, in the Preview group, select the Show Margins check box.

To print the spreadsheet, in the Print group, click Print.

Testing:

At the end of this lesson you should be able to create a spreadsheet with a list of recipes and ingredients and organise them by name and scores collected. Use different techniques to format it, include a chart and try to select features mentioned on keyboard usage.

Workshop: Introduction to TinkerPlots



Primary/Secondary,
Higher & Adult
Education



MATERIALS

[Tinkerplots Dynamics Statistics
Software](#)

TinkerPlots Basics Tutorial
(IO1_WORKSHOP
1_EUC_TinkerPlots Basics
Handout)



DURATION

40-45 minutes

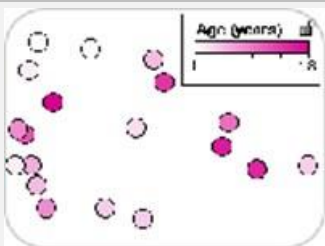
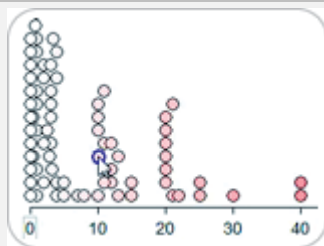
TinkerPlots Basics

Competencies and skills to be developed:

In this workshop, participants will learn to:

- Enter data
- Use Sample Documents
- Stack and order data in different ways
- Create common graphs
- Use different icon types to illustrate data
- Import data from an external source

Tools that can be used:

Movie: TinkerPlots Basics	Movie: Making Common Graphs
	

Introduction:

For this workshop, participants will look at data collected from high school students in the United States back in 1990. First, they will learn how to enter their own data, and then they will explore a sample data set included with TinkerPlotsGraphics/Pictures.³⁰

³⁰ **Source:** Tinkerplots Basics Tutorial: <http://www.tinkerplots.com/tutorials/tinkerplots-basics>

Workshop: Introduction to Data Analysis



Primary/Secondary,
Higher & Adult
Education



MATERIALS

[Tinkerplots Dynamics Statistics
Software](#)

TinkerPlots Basics Tutorial
(IO1_WORKSHOP
2_EUC_Analyzing Data
Handout))



DURATION

40-45 minutes

Analyzing Data

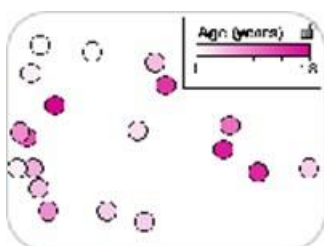
Competencies and skills to be developed:

In this workshop, participants will learn to:

- Measure averages
- Use the ruler tool to measure distances
- Use dividers and hats to estimate central clumps
- Use counts to see the number or percent of data in a bin, division, or plot
- Use the color meter to see the average color in a selected area of the graph

Tools that can be used:

- **Movie: Comparing Groups**



Introduction:

For this workshop, participants will learn to measure averages and distances, estimate central clumps, see the number or percent of data in a bin, division, or plot, and see the average color in a selected area of the graph.³¹

³¹ **Source:** Tinkerplots Basics Tutorial: <http://www.tinkerplots.com/tutorials/analyzing-data>

Workshop: Introduction to Data Simulation



Primary/Secondary,
Higher & Adult
Education



MATERIALS

[Tinkerplots Dynamics Statistics
Software](#)

TinkerPlots Basics Tutorial
(IO1_WORKSHOP
3_EUC_Simulating Data
Handout)



DURATION

40-45 minutes

Simulating Data

Competencies and skills to be developed:

In this workshop, participants will learn to:

- Build a sampler to model data
- Use a variety of sampler devices to best represent data distributions
- Use branching devices to reflect real data
- Create a sampler with a hidden or locked element

Tools that can be used:

- Movie: Building a Data Factory



Introduction:

For this workshop, participants learn how to use a variety of sampler devices to model data distributions, and branching devices to reflect real data. Before creating their own "data factory" (a sampler), they explore a pre-made sampler built to simulate data about cats.³²

³² **Source:** Tinkerplots Basics Tutorial: <http://www.tinkerplots.com/tutorials/simulating-data>

Workshop: Introduction to Probability Modeling



Primary/Secondary,
Higher & Adult
Education



MATERIALS

[Tinkerplots Dynamics Statistics
Software](#)

TinkerPlots Basics Tutorial
(IO1_WORKSHOP
4_EUC_Modeling Probability
Handout))



DURATION

40-45 minutes

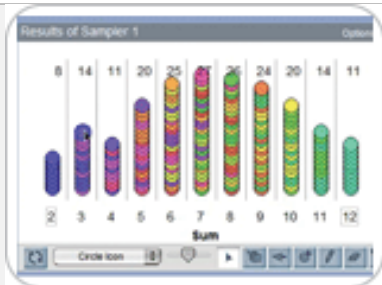
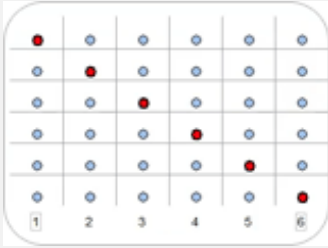
Modeling Probability

Competencies and skills to be developed:

In this workshop, participants will learn to:

- Model a probability experiment
- Use a formula to calculate an attribute
- Use color to see the different simple outcomes that make up an event
- Use a counter device to determine a sample space

Tools that can be used:

Movie: Probability Simulation	Movie: Creating Sample Spaces
	

Introduction:

In this workshop, participants learn how to build and run a sampler, generate the sum of values, and plot and color results to analyze a probability experiment. They also learn to modify a sampler and use a counter device to generate a sample space.³³

³³ **Source:** Tinkerplots Basics Tutorial: <http://www.tinkerplots.com/tutorials/modeling-probability>

Workshop: Use of Excel common functions



Primary/Secondary,
Higher & Adult
Education



MATERIALS
Excel App

dataset_WA_2.txt



DURATION
40-45 minutes

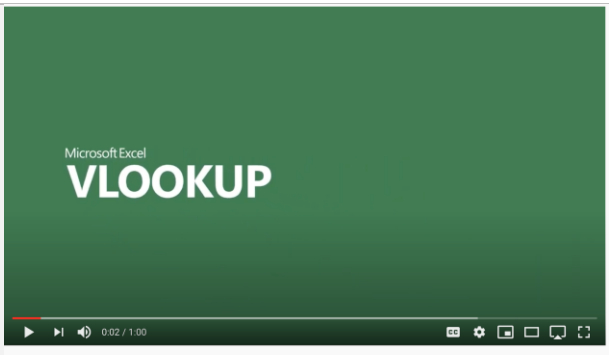
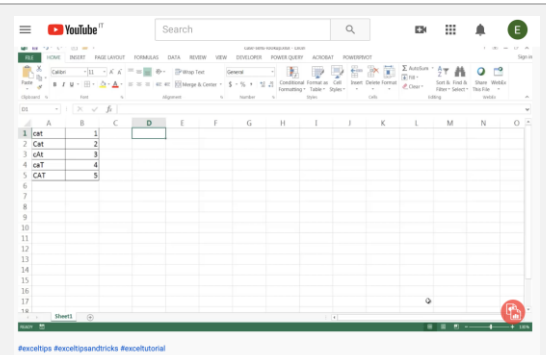
Vlookedup Function

Competencies and skills to be developed:

In this workshop, participants will learn to:

- Import data from txt in xlsx format
- Use two popular functions of Excel
 - Vlookup for exact match
 - Vlookup for case-sensitive

Tools that can be used:

<p>Movie: <u>How to use VlookedUp in Excel</u></p>  <p>How to use the VLOOKUP function in Excel</p>	<p>Movie: <u>Perform a Case sensitive VLookup in Excel</u></p>  <p>Perform a Case Sensitive Lookup</p>
---	---

Introduction:

For this workshop, participants will use the dataset called Growth rates of personal consumption and personal income in the USA composed by 187 rows and 5 columns (dataset_WA_2.txt).³⁴

³⁴ **Source:** Excel Basics Tutorial:

<https://www.excel-easy.com/examples/case-sensitive-lookup.html>

<https://www.excel-easy.com/examples/vlookup.html#vlookup-is-case-insensitive>

Workshop: Creation of frequency tables in Excel



Primary/Secondary,
Higher & Adult
Education



MATERIALS
Excel App



DURATION
40-45 minutes

Comparison of the price
between Porsche and
Jaguar dataset

Frequency Table in Excel

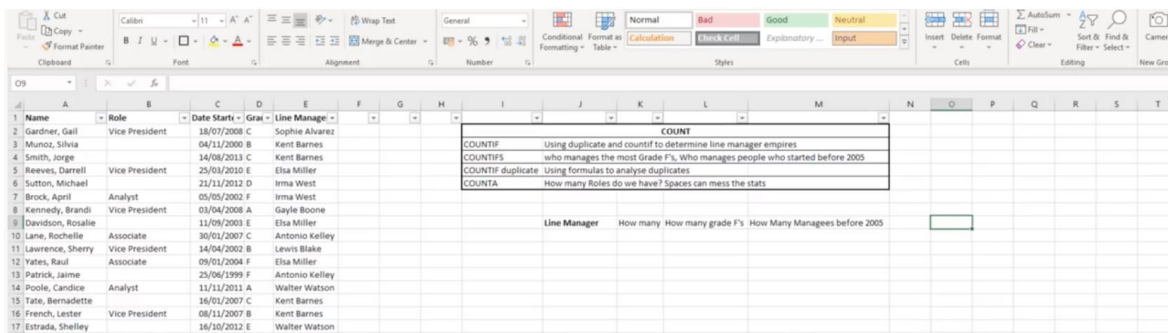
Competencies and skills to be developed:

In this workshop, participants will learn to:

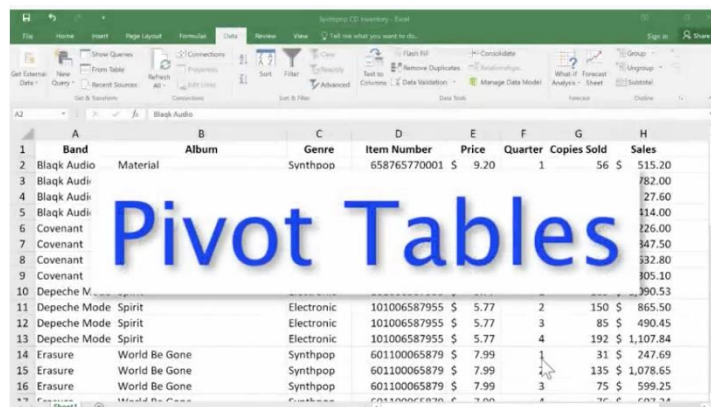
- Import data
- Construct a frequency table from a dataset
- Use two popular functions of Excel
 - Countif
 - Pivot

Tools that can be used:

- Movie: Countif



- Movie: Pivot



Introduction:

For this workshop, participants will use the dataset called Porsche and Jaguar Price composed by 60 rows and 4 columns (dataset_W2_price.rtf).

Source:

Excel Basics Tutorial:

<https://www.youtube.com/watch?v=xWRt5ldf1Do>

<https://www.youtube.com/watch?v=BkmxrvlfDGA>

Workshop: Introduction to Descriptive Statistics with Python



Primary/Secondary,
Higher & Adult
Education



MATERIALS

Anaconda platform installed
(<https://www.anaconda.com/products/individual>)
Internet Access



DURATION

40-45 minutes

Anaconda Environment and Jupyter

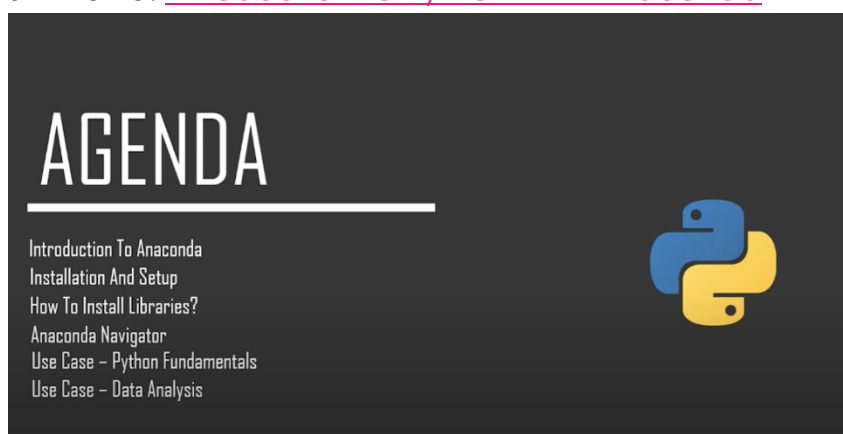
Competencies and skills to be developed:

In this workshop, participants will learn to:

- Python language
- Install several libraries
- Use Jupyter
- Construct a frequency table from a dataset
- Visualize data table frequency (histogram, barplot, boxplot, pie and scatterplot)
- Obtain descriptive measure (mean, median, mode, variance, standard error, regression)

Tools that can be used:

- Movie: [Introduction to Python with Anaconda](#)



Introduction: For this workshop, participants will use the Anaconda Environment and install several libraries for applying data analysis.³⁵

³⁵ **Source:** Haroon, D. (2017). *Python Machine Learning Case Studies*. Apress
<https://www.youtube.com/watch?v=beh7GE4FdnM>

Workshop: Conjoint Analysis with Excel



Primary/Secondary,
Higher & Adult
Education



MATERIALS

[Handouts on Conjoint Analysis](#)
Excel
Internet Access



DURATION

40-45 minutes

How to find an ideal/new product/service?

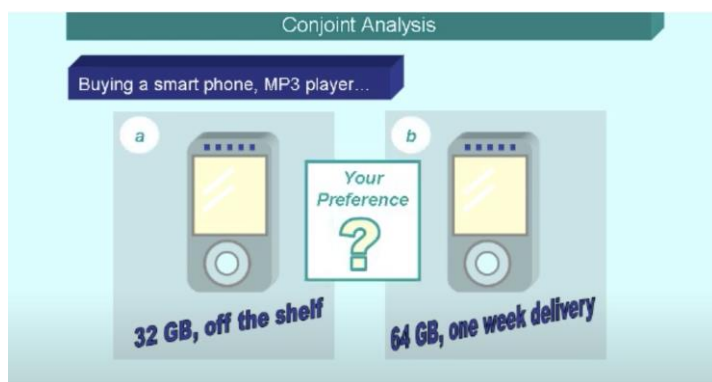
Competencies and skills to be developed:

In this workshop, participants will learn to:

- Familiarize with Excel
- Use Linear regression analysis
- Apply Conjoint Analysis

Tools that can be used:

- Movie: [Conjoint Analysis in ten minutes](#)



Introduction:

For this workshop, participants will use Excel and the spreadsheet (conjoint 10.06.2010.xls) elaborated for the handouts.³⁶

³⁶ **Source:**

<https://youtu.be/yiRNcHU2ZGU>

<https://bpmmsg.com/wordpress/wp-content/uploads/2012/03/conjoint-HD-7.7.2010.pdf>

Workshop: Conjoint Analysis with Python



Primary/Secondary,
Higher & Adult
Education



MATERIALS

[Conjoint Analysis handouts](#)
Anaconda platform installed
(<https://www.anaconda.com/products/individual>)
Internet Access



DURATION

45-60 minutes

How to find an ideal/new product/service?

Competencies and skills to be developed:

In this workshop, participants will learn to:

- Python language
- Install several libraries
- Use Jupyter
- Import external file in Jupyter
- Use basic operation of data management
- Apply Linear regression analysis
- Apply Conjoint Analysis

Tools that can be used:

Example of Coding: [Traditional Conjoint Analysis with Python](#)

Introduction:

For this workshop, participants will use the csv file called "[ConjointInput.csv](#)". The file contains the preferences (expressed as ranking) for three characteristics of TV measured on 17 customers.³⁷

³⁷ **Source:**

<https://www.youtube.com/watch?v=beh7GE4FdnM>

<https://www.youtube.com/watch?v=kmanlJXGpp0>

<https://github.com/Herka/Traditional-Conjoint-Analysis-with-Python/blob/master/Traditional%20Conjoint%20Analyse.ipynb>

Workshop: Correlation is not Causation



Primary/Secondary,
Higher & Adult
Education



MATERIALS

Reading 1: [Big data failure](#)
Reading 2: [Correlation is not
Causation](#)
[Handouts](#)
Internet Access



DURATION

45-60 minutes

Big mistake in Big data

Competencies and skills to be developed:

In this workshop, participants will learn to:

- Distinguish the methodologies
- Familiarize with Big Data
- Improve statistical literacy

Tools that can be used:

Excel or Tinkerplot or Python

Introduction:

Some examples of correlation with causation in the real world can be presented from the book "[Spurious correlation](#)".³⁸

³⁸ **Source:**

<https://hbr.org/2014/03/google-flu-trends-failure-shows-good-data-big-data>
<https://towardsdatascience.com/correlation-is-not-causation-ae05d03c1f53>
<https://www.abs.gov.au/websitedbs/a3121120.nsf/home/statistical+language+-+correlation+and+causation>
<http://www.tylervigen.com/spurious-correlations>



5



The current situation of **women entrepreneurs in tech startups** is slowly changing. Women leaders are taking over the initiative and launching their own companies. They are beating the statistics by establishing constantly growing startups. Female CEOs are still a minority compared to men in technology owning only 5% of tech startups, but they inspire future generations for changes and women empowerment.

There are many tech startups founded by women, which have exceeded those established by men. Studies show that the reason behind the success lies in the innovative approach of women in tech. **Women beat men by 5%** in presenting and selling a product due to their unique and innovative way of placing the product on the market. Also, it is not only their approach but also the idea or created product which sells for itself.

Statistics also show that *“Female-owned businesses hire more women (25%) than their male counterparts do (22%), according to the World Bank”*. Therefore, we can add that women entrepreneurs create teams that embrace gender diversity in the workplace.

The lack of funds women entrepreneurs get is one of the reasons the percentage of female business owners in startups is low. However, those women who have overcome such obstacles have created startups men can learn from.

The European tech community is still dominated by men – [The State of European Tech](#) Report shows that only 22% of tech-event attendees are female, having made little progress from 2017 to 2018.

Portugal ranks in the top 10 countries with tech events more attended by females, with a proportion of female attendees that is only **25%** (the highest-ranking country is **Albania with 33%**).

Even though the community is far away from the ideal rate of gender diversity and inclusion (especially when it comes to investment as 93% of all funds raised by European VC-backed companies in 2018 went to all-male founding teams), there are some amazing women who founded startups in Portugal and abroad and are kicking ass in the industry.

STEM/STEAM in Fashion Industry

In her article, *Why Fashion Designers are Pursuing STEAM Education*³⁹, Amanda Dodge explains how technology is revolutionizing fashion and how tomorrow's designers can change the industry with tech and other STE(A)M skills. The author notes that while people tend to view fashion only through the lens of art, "*what looks effortless and beautiful as a finished product requires the work of dozens of people*", with more and more of those people coming from STE(A)M backgrounds, especially the designers themselves.

STEM is an integral part of 21st century fashion industry, playing a key role both in the selection of raw materials and in the creation process. Selecting textile, for example, has become much more complicated than in the past since clients expect their fabrics to do more (e.g. dry more quickly, be waterproof and/or water repellent, keep the person wearing them cool etc.). To meet and satisfy their customers' needs, textile manufacturers are hiring mathematicians, scientists and engineers, who work alongside fashion designers to create smart fabrics and e-textiles, and to add smart technology and other gadgets to their products. Engineers and other scientists can also help with the logistics of production and distribution, and can suggest solutions for maximizing profit margins.

The fashion industry is one of the major polluting industries worldwide, hugely contributing to water, air, and soil pollution. To combat this, a (small but growing) number of companies have turned into *sustainable manufacturing* or *green manufacturing*, in order to reduce environmental impact while maximizing conservation of energy and natural resources. In collaboration with environmentalists and other scientists, they adopt environmentally-friendly, economically-sound practices influencing the product design, process design and operational principles.

In the following websites one can find examples of eco-friendly companies in the fashion industry:

- **12 Eco-Friendly Clothing Brands That Care Deeply About Our Planet**⁴⁰
- **Top 13 Sustainable Fashion Designers Making a Change in 2020**⁴¹
- **20 Best Sustainable Fashion Brands You Can Actually Trust**⁴²

Technological advances have also affected fashion houses' production schedules and methods of reaching their clients. Fashion hubs are becoming increasingly digital, and are no longer restricted to fashion capitals like New York, Paris and Milan. Trendy designs can nowadays originate from anywhere in the world, and be shared instantly through social

³⁹ <https://ozobot.com/blog/why-fashion-designers-are-pursuing-steam-education>

⁴⁰ <https://www.thegoodtrade.com/features/eco-friendly-clothing-brands>

⁴¹ <https://motif.org/news/top-sustainable-fashion-designers/>

⁴² <https://www.goodhousekeeping.com/clothing/g27154605/sustainable-fashion-clothing/>

media. In order to optimize their production schedules and meet the demands of digital consumers, brands draw upon many different types of STEM skills and expertise. They use engineering processes, for example, to increase production based on demand, and audience sampling and logistics to predict the fashion items that will be most profitable to produce, and to improve their promotion campaign.

The expansion of ecommerce has provided the opportunity for young, local designers to tap into international markets through the internet. At the same time, it has increased the need for them to keep up with technological evolutions in order to remain competitive in the global market, where they compete with millions of other designers around the world.

In *'The Conversation'* article **"STEM subjects and fashion design go hand in hand"**⁴³, Mark Liu elaborates how "fashion is a unique blend of business, science, art, and technology". He provides several examples of the fashion industry embracing STEM concepts:

Yoga clothing from Lululemon that are "anti-bacterial" are actually fabrics that coated in silver **nano-whiskers**⁴⁴.

High-tech athletic footwear produced by sportswear companies such as **Nike**⁴⁵ and **Adidas**⁴⁶, are designed based on truly "cutting-edge science", because these sportswear giants engage in "a technological arms race of materials and technology".



In his article, Mark Liu stresses the need for the new generation of designers to acquire STEM skills in order to keep abreast of technological advances and stand out in the fashion industry. To make the point, he provides the example of the *supermodel Karlie Kloss who advocates*

*the importance of STEM skills for future careers in the tech industry and offers a scholarship program **Kode with Klossy**⁴⁷ teaching computer coding to young girls.*

⁴³ <https://theconversation.com/why-stem-subjects-and-fashion-design-go-hand-in-hand-63649>

⁴⁴ <https://eng.thesaurus.rusnano.com/wiki/article1257>

⁴⁵ <https://www.materialise.com/en/cases/software-solutions-help-nike-in-supporting-great-art>

⁴⁶ <https://www.materialise.com/en/cases/adidas-futurecraft-ultimate-3d-printed-personalized-shoe>

⁴⁷ <https://www.kodewithklossy.com/>

Kode with Klossy creates learning experiences and opportunities for young women that increase their confidence and inspire them to pursue their passions in a technology driven world.



Design Thinking in Product Development and the Role of STEM/STEAM Education

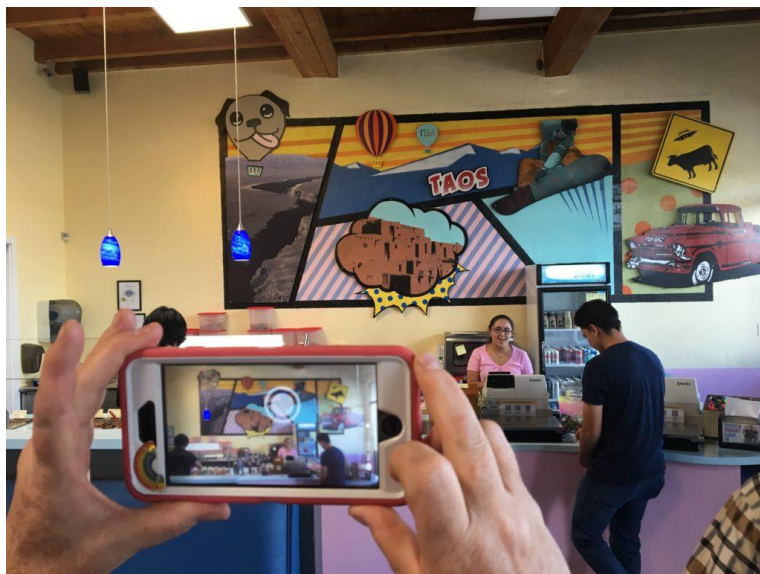
Design thinking is a modern transdisciplinary, person-centred approach that helps create innovative products, services, applications or processes that are based on real needs and desires of users. It is a very popular methodology adopted by major international organizations and taught by leading universities worldwide, as it has proven to be extremely effective in solving complex real-world problems and in building human-centric products.

According to the design thinking methodology, designing a new product or service begins with clarifying human needs. This initial research phase is crucial because it forces designers to break away from their own beliefs and hear, observe and understand exactly what users are looking for and how. The research phase ends with the identification of a specific issue, a challenge that the business/organization will deal with, and the formulation of the problem in "human-centric" terms. The next creative phase, encourages the production of as many possible solutions as possible, even "extreme" ones. The purpose of this ideation is to explore different perspectives on the problem. The ideas are then evaluated and the one that is generally accepted can be an opportunity. The point is to create a prototype, that is, a solution designed in a simple way and materials so that, although incomplete, it is clear enough when tested by users. The purpose of this experimental phase is to identify any weaknesses and changes that need to be made. Comments, reviews, and reactions from users are recorded to be used for refining the product or service.

In recent years, efforts have been made to introduce design thinking methodology into STEM/STEAM curricula in order to develop relevant skills at an early age. Students' involvement in product design and

development practices is considered to be a pedagogical practice that integrates all STEAM disciplines and introduces students to the maker movement and to entrepreneurial thinking and culture. By combining the use of modern technological tools (e.g. digital manufacturing, 3D modeling, 3D printing) with appropriate pedagogical practices, the application of design thinking methodology can provide unprecedented experiences for students to enhance their motivation and knowledge of the STEM/STEAM disciplines, while also contributing to the development of important 21st century skills (critical thinking, imagination, creativity, innovation, interpersonal communication, participation in teamwork, problem solving).

A good example of how this could be achieved is the **AR Mural Work/Study Project**⁴⁸, coordinated by the STEMarts Lab (<http://www.stemartslab.com>), a research Lab providing innovative sci-art and STEAM youth programming for The Paseo Festival and for TISA (Taos Integrated School of the Arts) in Taos New Mexico. In this project, STEMarts Lab brought in artists that had been exploring AR technology to collaborate with a class of eighth grade students in order to paint a mural for a new frozen yogurt store. The students worked together with the artists and with the shop's owners to design and create an AR mural that made the whole space interactive – with animated images popping-off the wall when pointing a smartphone or iPad at the mural.



In line with the design thinking approach, students were involved in all stages of the mural production, from visiting the space and meeting the “clients”, to developing the concept, to designing the technology that creates an AR experience for visitors. This involvement provided them with invaluable real-world, community-based STEAM skills: business skills by working with a client to design a site specific installation, design and critical thinking skills (e.g. designing stencils and laser cut vinyl patterns), project planning skills (e.g. identifying budget, materials and other design constraints), cutting edge technology skills to create AR experiences, skills in building of a scale model of the site, collaboration skills, negotiation skills, etc.

⁴⁸ <http://www.stemartslab.com/artaos-tisa-augmented-reality-mural-at-ziggys-frozen-yogurt-shop/>

<i>Dimensions</i>	<i>Item</i>	<i>Strongly disagree</i>	<i>Disagree</i>	<i>Agree</i>	<i>Strongly Agree</i>
Confidence	I have self-confident when it comes to STEM LITERACY				
	I am confident that I can solve problems by using computing				
	I think I will do well in STEM LITERACY				
	I can learn STEM LITERACY without a teacher to explain it				
	I am sure I could do advanced work in STEM LITERACY				
Interest	I would take additional STEM LITERACY courses if I were given the opportunity				
	I hope that my future career will require the use of STEM LITERACY				
	I like to use STEM LITERACY to solve problems				
	The challenge of solving problems using STEM LITERACY appeals to me.				
	I like writing computer programs				
Belongingness	I feel comfortable in STEM LITERACY				
	I feel I belong in STEM LITERACY				
	I feel accepted by my peers in STEM LITERACY				
	I know someone like me who uses STEM LITERACY in their work.				
Usefulness	Knowledge of STEM LITERACY will help me earn a living.				
	Learning to use computing skills will help me achieve my career goals.				
	STEM LITERACY is a worthwhile and necessary subject.				
	Computing skills used to understand STEM LITERACY material can be helpful to me in understanding things in everyday life				
Encouragement	A friend or peer has encouraged me to study STEM LITERACY				
	Someone I know has discussed with me the STEM LITERACY field. Someone in my family has encouraged me to study STEM LITERACY				
	Someone I know his given me the desire to study STEM LITERACY				
	Someone I know has praised my work in STEM LITERACY				

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Designed by: **Nusret Iseini**



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