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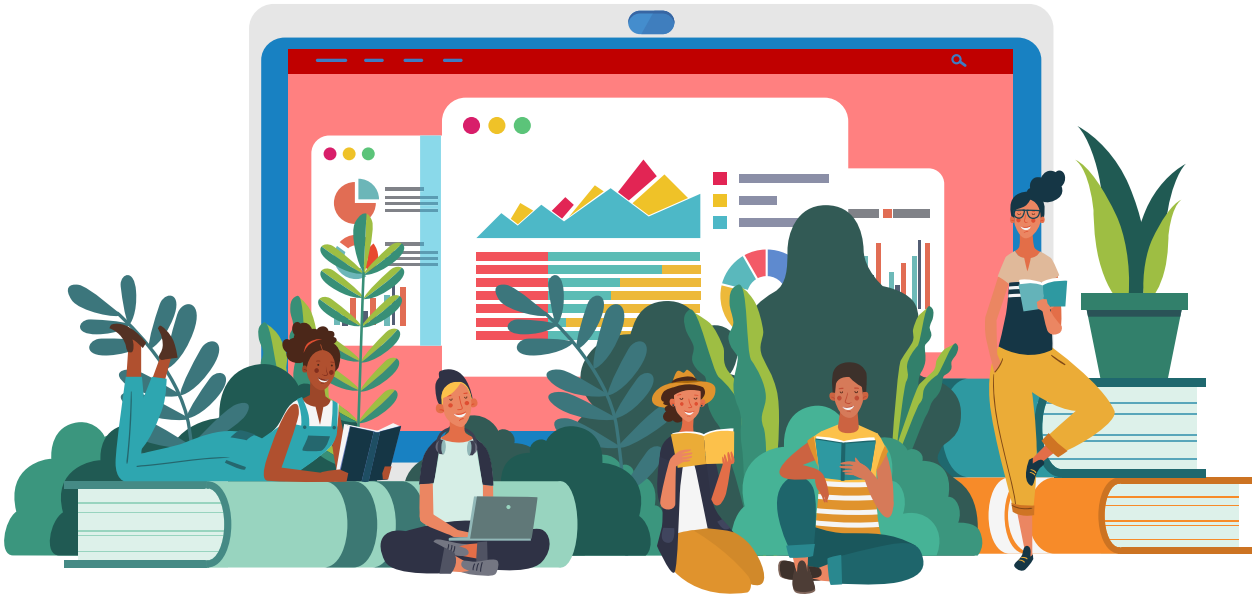
Digital Technology Imagination Creativity and Entrepreneurship for a High Quality Teaching



Examples of Good Practices and Recommendations for Promoting Holistic Education Through Collaborative Problem-Solving Strategies

DTICEQT Multimedia Guide

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1 Project background

A good problem-solving strategy in your classes ensures that students are encouraged to deal with real problems. Teachers need to design learning activities that allow their students to develop their skills like to be innovative thinkers, develop creative solutions… It implies students take on the responsibility for their own learning and take personal action to solve problems collaboratively, discuss alternatives, focus on thinking…

The target groups are: University lectures, teachers, students of Primary and Secondary, but also teachers centres and advisors. They project try to meet the following objectives:

1. Equip teachers to meet the challenges presented by the recent sudden change to online and distance learning, supporting teachers to develop digital competencies. The innovative digital education, it is part of the general educational objective to equip teachers and students with the most innovative teaching, assessment methods and tools (this is an added value to the high-quality cooperation between the European schools & universities).

2. To achieve high-quality inclusive education by design strategies in a way that supports broad competence development, necessary methodological changes to provide high quality, digital education. Each topic aims to make students develop the ability to work with other languages and cultures through international collaboration.

3. Improve the area “Personal” (Development, Autonomy, Creativity, Citizenship, Civics…) is at hart of all project activities, student, while they get knowledge and competencies, they build personal competences and skills like self-improvement, self-driven and self-disciplined learners, encourage personal autonomy, the assignments stimulate students to be creative, putting their imagination to work to finding intelligent solutions. The project is focused on social entrepreneurship; problems arise in the local community and students seek Innovative solutions that can lead to improvements through small changes.

4 To implement digital technologies in each curriculum areas in a creative way, identifying exactly what practices are appropriate for students’ engagement in learning process. Working two by two in classes form different partner counties to design and end- product which stimulates in students’ creativity, personal skills and knowledge.

5. Implement creative and playful learning environments that encourage imaginative solutions, collaboration, innovation, and entrepreneurship facilitated by technologies. There is a process of discovering a problem, look for evidence and select innovative solutions. Each topic aims to make students develop the ability to work with other languages and cultures to build values through international collaborative work.

6. To reduce school failure and increase the number of students who perform post-compulsory studies. Partners will develop new ways of collaborating supported by a wide range of digital technologies They´ll plan changes in pedagogic strategies and interdependent challenge ideas through cross-national teams. We´ll improve entrepreneurial education which means development of a culture to establishes entrepreneurial behaviour. This area requires active, learner-centred pedagogies and active learning that utilize practical, real-world learning opportunities.

Problem solving provides students with opportunities to use their newly acquired knowledge in meaningful, real-life activities and assists students in working at higher levels of thinking This will lead to an innovative education of high quality.

* Innovation means an improvement of learning processes and results

** Quality is focused on managing the processes that lead to knowledge management and continuous improvement.

The project will propose activities which reinforce and complement the cooperation with virtual mobility between schools and other institutions (universities and experts, …) turning schools into broader learning communities in order to implement education and training of professionals to meet challenges of excellence, equity, diversity and inclusion in the school environment.

2 Project results

The project looks for excellence at school learning, in addition it'll bring equity, diversity and inclusion in the school environment.

The area "Personal" (Development, Autonomy, Creativity, Citizenship, Civics…) is seen as transversal abilities, student, while they learn build self-improvement, self-driven and self-disciplined learners, encourage personal autonomy and teacher´s assignments stimulate

them to be creative, putting their imagination to work, provide opportunities for them to finding innovative solutions. The project is focused on social entrepreneurship; problems arise in the local community and students seek Innovative solutions.

To be creative students must imagine, implement, think while working on a problem. The project also promotes students be active citizens, as well as to enhance European identity and the participation of young people in democratic life of Europe, and further enhancing knowledge of European institutions. All these skills and competencies will be integrated (transversely) and evaluated in collaborative problem solving activities (CPS).

A face-to-face CPD course for teachers to explore digital technology and remote teaching across the project topics Teachers will be able to design CPS on four basic areas Personal, Cultural heritage, STEM and Economy, analyse and develop innovative pedagogy and assessment approaches and methods to support these diverse collaborative learning pathways in order to help learners to acquire knowledge, skills, working in clases two by two.

Virtual courses on personal skills, Cultural Heritage, STEM & Economy will be implemented in May, the 2nd year, this will be virtual course to explore digital technology and remote teaching across the project topics, The two courses once tested will then be developed into "open online course" on the project website (publish in English , Portuguese and Spanish) Teachers will create CPS using Digital tools

A Piloting and assessment of the CPS were led by Westcountry Schools Trust in collaboration with teachers with the support of university lectures, experts in digital technologies, and economy experts.

2.1 Thursday 4CPS

Every two months last Thursday of the month we celebrate "Thursday 4CPS". The teams of 8 classes, two by two, of the same level from different countries present their CPS to the classes We try to make each CPS from one basic area and will try students from different countries interact , making it very lively and participatory,

To solve each CPS, the two classes in charge of the same CPS will hold formal and informal virtual meetings in order to solve the CPS in the most innovative way. It is very important

that students interact between different countries as much as possible. The teachers from two countries will make an effort to ensure that there is this interaction between the different classes , university lecturers and Experts will collaborate. There are four basic steps to solving a problem: Defining the problem, alternatives, analysing innovative solutions, implementing the best solution.

A Multimedia Guide will include CPS Products and methods.

APP for teachers to self-evaluate digital skills, entrepreneurship and STEM it contains all the skills a teacher must achieve in adapting creative digital online technology and into subject-specific teaching and learning, it reflects the digital skills that a teacher after COVID-19 are essential for quality teaching.

A final conference will be implemented to disseminate project results. The Final conference will be held in Santiago. Teachers and university lectures will present the different output.

Four students per country will be invited and they´ll introduce the best presentations showed in workshops, these presentation will be selected by students. The results of the conference will be presented to disseminate project results .

During the morning will be organized workshops 4students They will be focus on 4 basic areas: Personal, Cultural heritage, STEM, and Economy. In addition, students will present the best CPS during the conference.

Students will include some of the CPS in eTwinning platform.

Other results include an efficient project management.

Virtual meetings will be organized once a month, also for teacher training and piloting, to do dissemination meeting al local level.

A web where will be published the Courses and tutorials, and the CPS created by teachers, and solved by students.

A platform for teacher training and file sharing.

A dissemination plan and report (dissemination products: logo, posters, brochures...).

An evaluation plan and report.

2.2 State of the Art

In addition, partners decide to explore de State of Art; we are not trying to reinvent the wheel but to explore what has been done in Pisa, projects… and use it as an innovative methodology in the classroom. This was part of the face-to-face training.

Here are some examples the partners have selected:

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AEPI Sabón [SPAIN]

Collaborative solving problem (CPS) description form.

Title:	**Cross Design (CPI O Cruce).**
Proposing teacher(s)	Milagros Trigo, José Maria Ferreiro
Target group	Students 14 - 16 years old.
Subject focus	Economy, undertaking, technology, mathematics, graphic design.
Topic(s) addressed	Business creation and management, financial education, organization, IT, professional and personal development.
Short description of the content	Creation and management of an "educational" company
Methodology	The methodology used was the CPS methodology with an entrepreneurial approach, where students had to create a company that would allow them to obtain profits that they would use in part to finance an end-of-course excursion, and in part a community charity.

	Given the proximity to the completion of compulsory studies, the target students should reflect on their professional future, considering entrepreneurship as a useful and valuable way to explore their creativity and professional potential. For this, they had to create a company from scratch, defining what they were going to do, who their target customers were, what value they were going to offer, what they needed to do it, how to organize themselves, etc. In this case, the scope of their activity was 3D printed design and textile printed products. They choose the management team and define and organize the different departments of the company. They design the products, buy raw materials, produced them, and sold them. In this way, they learned to be entrepreneurs by creating their own company, facing and solving by themselves all the different problems that appear in each phase of the process, until they sell their products and generate profits.
Key competences implemented	Teamwork and leadership, creativity, good design, digital competences, critical thinking, communication, active listening, open-mindedness, planning.
Transversal skills worked	Cooperation, emotional intelligence, empathy, respect, confidence, digital communication, data analysis and presentation, business management, customer service, financial skills.
Resources needed (software, hardware, other tools...)	Computer, 3D printer, 3D design software (free version), Internet connection, webpage (any free CMS will do), classroom/meeting space.
Related materials	Company website, company social media (Instagram account).

(links, pdf, etc. if any)	
IT requirements	The students needed to access the Internet (under guidance) to do benchmarking and market research, as well as to access their social media and carry out digital communication.
Website	http://proyectoscpiocruce.com/wordpress_proem/ https://www.lavozdegalicia.es/noticia/carballo/cerceda/2018/05/31/premio-cross-designs-cpi-cruce-cerceda/0003_201805C31C11994.htm

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Plymstock School [United Kingdom]

Collaborative solving problem (CPS) description form.

Title:	**The Island Innovation Project**
Proposing teacher(s)	Shaun Rogers
Target group	Students to whom the activity is addressed
Subject focus	Science, Technology, Geography and Computer Science
Topic(s) addressed	Students will design and collaboratively create man made islands like those made off the coast of Dubai using the Minecraft Education environment.
Short description of the content	<u>Guiding ideas</u>: → What skills are involved in designing and creating man-made islands like world leader Dubai? → How much earth needs to be mined to create the innovative island designs safely? → Can students work as teams to design both islands and creative structures / purposes for the islands? → Are there innovative new designs that Dubai has yet to employ? <u>Student activities</u>:

	Students will choose or be assigned one of the three+ coastal villages. They will mine from the land to build in the water new innovative island designs like Dubai. Students should perhaps have a quick look at YouTube Dubai projects to both inspire and inform them before their engineering begins. Students will design, mine, build and then create a purpose and structures for the islands that were created. Tourism hotels or resorts? Science research? Residential homes? Other Ideas?
Methodology	Introduce the Minecraft Educational Edition environment. Introduce the challenge set out for them i.e. choose a village and use its natural resources to create a new island and build useful building off shore. Students will have to collaboratively plan who is going to mine, design and build the structures as well as who is going to decide where these structures will go. This will simulate town planning, time management, resource management etc.
Key competences implemented	Creativity, Collaboration, Problem Solving, Thinking Algorithmically
Transversal skills worked	Critical thinking, decision making, learning to learn, problem solving
Resources needed (software, hardware, other tools...)	Minecraft Educational Edition PC capable of running the above High Speed internet connection
Related materials	https://doc.co/BwmikK https://www.youtube.com/watch?v=cWElZICyBns

(links, pdf, etc. if any)	
IT requirements	A PC or device capable of running HTML5 and Minecraft Educational edition.
Website	https://education.minecraft.net/en-us/lessons/the-island-innovation-project

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AEPI Sabón [SPAIN]

Collaborative solving problem (CPS) description form.

Title:	**School of fishes**
Proposing Person(s)	Marta Marzoa, Xabier Sánchez
Target group	Students participating in the project
Subject focus	Economy, undertaking, mathematics, sustainability, technology.
Topic(s) addressed	Business creation and management, organization, communication, professional and personal development, sustainability, and strategy.
Short description of the content	Business management with a sustainability approach
Methodology	The methodology to be used will be the CPS methodology with an entrepreneurial approach, where the challenge of the students will be to manage fisheries resources to balance their profits with the sustainability of the fishing grounds. The students, in groups and with no previous indication of the activity objectives other than making a profit out of it, will manage a fishing company through a simulation software, initially operating a small fleet, which can be increased, deciding by themselves how many boats will operate in each fishing ground, and catching and selling fish.

	As the fleet goes bigger, the concerns about sustainability will arise by themselves, having to face the issue of finding a balance between the economic profit and the sustainability of the resources.
Key competences implemented	Teamwork and leadership, creativity, negotiation, sustainability, team building, long-term strategy.
Transversal skills worked	Decision making, cooperation and competition dynamics, business management, emotional intelligence, confidence, empathy.
Resources needed (software, hardware, other tools...)	Computer, Internet connection, simulation software (Fishbanks, available for free through the Internet), classroom, meeting space.
Related materials (links, pdf, etc. if any)	Fishbanks: A Renewable Resource Management Simulation Fishbanks simulator (online game)
IT requirements	The students need to learn how to use the simulation software.
Website	https://forio.com/simulate/mit/fishbanks/simulation/login.html

You can see more CPS here:

- AEPI Sabón:
  - → Sweet Health [learn more]
  - → The new is out! [learn more]
- ATLME:
  - → Environmental education [learn more]
  - → Hair accessories [learn more]
- New Wave Federation:
  - → Podcast [learn more]
  - → Scaffolds [learn more]
- Plymstock School:
  - → Designing a modern island [learn more]
  - → The island innovation project [learn more]
- CEIP Ría do Burgo:
  - → Historical heritage of my city [learn more]
- UK Haddlewood School:
  - → Creating a computerised lighthouse [learn more]

3 Multimedia guide

The Multimedia Guide lead by USC in collaboration with Westcountry School Trust with the results from experimentation and evaluation. Westcountry School Trust will have also an important role in the reflect in the guide the project impact through evaluation. to AEPI Sabón and ATLME will collaborate in all about Economy Entrepreneurship and STEM and Personal skills: Teachers will collaborate by testing the designed CPS; and evaluation will be responsibility of USC and Westcountry School Trust. The schools will participate in CPS implementation and will also participate with their expertise to the guide.

3.1 Methodology

The methodology will be based on collaborative work, teachers experimentation, pilot evaluation…

3.2 The Guide includes

The courses for teachers training, contents, experimentation, impact with links to the website. The Guide will have a big impact, because is very useful for teachers and also to better understand the project results. The guide is in English.

4 Collaborative Problem Solving (CPS) general framework

- Work in teams (learn with and from others).
- Identify the problem.
- Identify strategies and choose an approach.
- Draw a plan.
- Execute the plan, to solve the problem.
- Afterwards, reflect on the process.

5 Didactic proposals

- Webquests.

- Project work.
- Proposals that lead students to collaborate on end–of–project presentations / products to formally present their findings.
- Gymkhanas.
- Novels by chapters (students write collaborative novel by Chapters).
- Laboratory experiments (recorded in video).
- Questions to be solved by students (phenology studies Scientific questions).

5.1 Collaborative problem-solving in practices

Collaborative problem-solving in schools: current practice. This is especially marked with younger learners' certain subjects like maths, the humanities…

Studies show that most of the learning interaction and talk occurs during whole class teaching. Students were least likely to be working collaboratively with peers in maths and humanities, and most likely to in science.

Some studies suggest that on some occasions when teachers attempt collaborative activities, the quality of group interaction and dialogue may be poor (Bennett, Desforges, Cockburn, & Wilkinson, 1984; Galton & Williamson, 1992). Some teachers believe that conversation between students impairs learning rather than enhances it.

In 2013 Collaborative solving problem became part of the PISA report. The results of the OECD survey in 2013 reinforce the idea that collaborative approaches are rare. In the survey, teachers were asked to report on the frequency with which their "students work in small groups to find a joint solution to a problem or task." The results indicate that, on average, in the 34 countries surveyed, 8 percent of teachers said they use small groups in all or almost all their lessons, while only 40 percent said they used them frequently. Again, math teachers were less likely to promote collaborative work Advanced education.

Although problem-solving and team working are often considered integral to vocational education, there is a lack of research both in terms of its impact and presence. despite that there are points that are consistent with the learning theories related to collaborative

problem-solving. For example, encouraging students to be proactive, creative and innovative in advancing their own learning under the principle of 'maximising student agency.

	(1) Establishing and maintaining shared understanding	(2) Taking appropriate action to solve the problem	(3) Establishing and maintaining team organisation
(A) Exploring and understanding	(A1) Discovering perspectives and abilities of team members	(A2) Discovering the type of collaborative interaction to solve the problem, along with goals	(A3) Understanding roles to solve the problem
(B) Representing and formulating	(B1) Building a shared representation and negotiating the meaning of the problem (common ground)	(B2) Identifying and describing tasks to be completed	(B3) Describe roles and team organisation (communication protocol/rules of engagement)
(C) Planning and executing	(C1) Communicating with team members about the actions to be/being performed	(C2) Enacting plans	(C3) Following rules of engagement, (e.g. prompting other team members to perform their tasks)
(D) Monitoring and reflecting	(D1) Monitoring and repairing the shared understanding	(D2) Monitoring results of actions and evaluating success in solving the problem	(D3) Monitoring, providing feedback and adapting the team organisation and roles
The 12-cell matrix provides a set of definitions for guiding assessment of collaboration skills			

Matrix of collaborative problem-solving skills for Pisa 2015. Source: oecd.org

5.2 About Learning

Apprenticeship Standard, require covering generic skills such as "personal learning and thinking skills". These fall under six groups: independent enquiry; creative thinking; reflective learning; team working; self-management; and effective participation.

Though there is a lot of guidance for providers for audit purposes to show skills descriptors have been 'achieved', there is little on how they can be learnt effectively.

New models of learning are being designed trying to introduce personal learning and thinking skills. This will contribute to create a space for more innovative teaching and learning. It is being recognized that working in a team and solving problems is essential for acquiring transferable skills that could be applied to real life and not just learning.

6 Definitions

Collaborative problem-solving brings together thinking about the separate topics of collaboration and problem-solving, each with its own research history.

The combined term is an area of interest for some looking at changing workplace needs.

For example, the OECD included collaborative problem-solving as one of the four topics assessed (alongside mathematics, English, and Science) in their 2015 PISA survey (some results pending).

There are different definitions for collaborative problem-solving, ranging in detail. In layman's terms, we might simply describe it as solving problems together. From an academic perspective, a common definition now is "the process of a number of persons working together as equals to solve a problem". The OECD go further for their PISA assessments, specifying it as:

"The capacity of an individual to effectively engage in a process whereby two or more agents attempt to solve a problem by sharing the understanding and effort required to come to a solution and pooling their knowledge, skills and efforts to reach that solution."

The relevant literature goes back 50 to 60 years and uses a range of different but overlapping terms, including cooperative learning, collaborative learning, peer co-learning, peer tutoring, peer assisted learning and more. Some authors use these terms specifically, others use different ones.

However, what is clear is that collaborative problem solving is more than individual problem solving among several people, it requires interaction skills, used to propose evidence-based solutions together in order to find a common goal. We can define collaborative problem solving as a group working together to achieve a common output.

6.1 What does collaboration mean?

The verb to collaborate means to work together. In this sense, it pre-supposes conditions of cooperation (agreeing to work together, multiple parties contributing).

Collaboration can involve participants working together, oriented to a jointly agreed goal and often generating ideas to form the basis for a solution or decision. There is also a sense in which collaborative learning involves working together a team to to complete a task, while cooperative learning can involve individuals undertaking different sub-tasks but cooperating in the overall endeavour.

Teachers assume that collaboration is a natural interaction, taking place when people come together to work on an assignment. Collaboration is in addition dependent on the skills, attitudes, engagement of the participants … relative to each other and the specific task they try to solve. A teacher can only make collaboration more effective by creating an environment, circumstances, good planning, and a topic that is interesting to the students.

6.2 Barriers to collaborative problem-solving in education

The following barriers to implementing the widespread take-up of collaborative problem-solving, have been identified.

1. The collaborative problem solving is not easy for all teachers to include in the educational system and curriculum.
2. Collaborative problem solving is not easy for teachers, whose training in digital skills requires continuous updating.
3. Teachers can be sceptical about the benefits of collaborative problem solving. Some teachers may consider that the evaluation is more difficult than when working with textbooks.
4. Teachers have little training or experience to apply collaborative learning within their classrooms (Kutnick, Blatchford & Baines, 2005).
5. Students may lack collaborative problem solving skills and there is uncertainty about students' ability to work together (Lewis & Cowie, 1993).
6. Students are concerned about collaborative problem solving: working with peers can be a risky experience to carry out, but it could also be motivating and creative.

7 CPS principles and characteristics

- Students have to be personally involved: “they have to solve a real task/s”.
- The students must be able to do research work on a topic using multiple sorts of sources, both inside and outside the school: books, internet, audio-visual material, visits monuments ….
- The topic should be nor too extensive neither too limited. The task must be in accordance with the age of students and the time students will have to solve it.
- The topic has needs to have personal, social, scientific … relevance.
- The research must set a problem and, in the process. solve a problem if possible.

8 CPS on personal skills & cultural heritage

8.1 What do we call personal skills?

Personal development skills are abilities and skills that help you grow both personally and professionally. In other words, they are skills that help you to promote your personal development. Understanding and improving these abilities can help a person maximize his or her potential. This process is also known as self-development or personal growth.

8.2 Why are personal development skills important?

Personal development skills are important because they allow individuals to create strategic and tactical plans for their own personal and professional growth toward goals. It is very important to improve personal development skills through your daily routines in order to use them for:

- Achieve proposed personal goals.
- Advance self-development and personal growth.
- Improve your strengths and talents.
- Find achievement and personal satisfaction.

We present some examples of personal development skills.

Personal development skills to be gained through education and training. People will value different personal development skills depending on their challenges & goals, but here are some examples of skills that people try to acquire to facilitate personal growth:

- Communication.
- Self-confidence.
- Interpersonal / social skills.
- Open mind.
- Organization.
- Problem-solving.
- Adaptability.
- Integrity.
- Leadership.

I. Good communication skills.

Good communication skills include the ability to speak, write, and listen. With these skills, you can understand better others are saying and feeling, and also pass on your own ideas, feelings and ways of thinking. Good communicators can speak clearly and confidently, using an appropriate tone for the situation.

II. Self-confidence.

Self-confidence is the belief in one's own abilities, actions, and decisions. If you have self-confidence, you are more likely to pursue bigger goals, explore new things, and believe that you can succeed.

III. Interpersonal / social skills

Social skills, interpersonal skills are verbal and non-verbal behaviours and reactions to interactions with other people.

IV. Open mind.

Being open-minded means having the ability to consider other perspectives, other points of view, and trying to be empathetic with other people, even when you disagree with them. Open-mindedness has its limits; It does not imply that you should agree with everyone, but rather know how to see things from other ideological points of view.

8.3 Cultural heritage

The didactic proposals stimulate students to be creative putting their imagination into practice, offering them opportunities to find intelligent solutions. The student, while achieving knowledge, acquire skills of self-directed and self-disciplined learners, fosters personal autonomy; within the process of human growth, we will promote behaviours or customs that directly affect optimal personal development as a citizen.

The project also prepares students to acquire public speaking skills with the conviction that effective communication makes any activity easier; this competence is also achievable through practice; speaking in public is considered a relevant competence nowadays.

Teachers make didactic proposals based on collaborative solving problems (CPS) where the subjects will be interconnected; once the subject has been agreed upon by university researchers; The teachers two by two (one class from each country) will give you the most innovative approach they consider. The CPS will be piloted in two classes that will interact through video conference: Asking questions, looking for imaginative solutions together, ... Once the (CPS) is completed, the teachers will analyse together with the evaluators how it can be improved and will elaborate a final proposal that will be included in the Multimedia Guide.

8.4 The use of digital tools in teaching and learning

Today's society requires creative, entrepreneurial, critical, and competent individuals in ICT. Partners have designed a global and sustainable plan to implement in the project and to promote innovation by creativity and efficiency in the use of digital tools in order to offer our students a quality education in accordance with the needs of the 21st century student. The project tries to implement leadership at participant schools, accompanied

by organizational changes and development plans in them with the intention of offering innovative and quality education and minimizing school failure.

Partners have designed a high quality of learning / teaching combining pedagogy and digital tools, integrating them into the curriculum. For this, an institutional leadership based on a solid community feeling will be built in each school, together with the use of ICT, pedagogy, content and curriculum with student-centred instruction.

A quality education implies the combination of Contents + Pedagogy + Technology. The three factors are essential for the successful acquisition of knowledge, key competences, and transversal skills in educational processes.

Teachers need solid training in all three fields as well as in their application. Technology expands the possibilities of pedagogy, but it does not replace it. Current learning should not focus on content but on the interactions and processes that occur around it. The digital society requires competencies that educational systems have to develop (personal autonomy, students being self-driven and self-disciplined learners, able to do information search, information processing, etc.).

9 CPS on STEM

In STEM, following the eight Science Framework for K-12 Science Education identifies as essential:

- Asking questions and defining problems.
- Developing and using models.
- Planning and carrying out investigations.
- Analysing and interpreting data
- Engaging in argument from evidence

We plan to do prototypes using 3D printing and to do scientific investigation based on a question, students do research works to problem solving.

All STEM experiments should contain elements of at least two disciplines in STEM, and all of them when possible. STEM activities are one of the best ways to prepare children for

problem solving and learning in the real world. Students engaged in STEM activities are better able to solve problems, going through a logical process to come up with an answer, and are able to explain why they chose a certain solution clearly.

STEM is not so much a topical study as it is an approach to teaching and learning the subjects of Science, Technology, Engineering, and Math. STEM uses all these subjects together to solve real-world problems. STEM activities help illustrate the concepts of science, technology, engineering, and math in a fast, easy-to-see way. A child interested in STEM topics is a child who will succeed throughout life and have a thirst for knowledge that can't be quenched. STEM based activities encourage children to see subjects like math and science in a new light, and how to use those subjects to solve their day to day problems and the problems that they might face as adults.

9.1 Practical activities

9.1.1 Introduction

In programming logic, it is worth pointing out that mathematics is a necessary resource for the construction of an algorithm, after all, a program is developed based on mathematical operations such as logical and arithmetic operators, orders of precedence, comparisons of values, among others.

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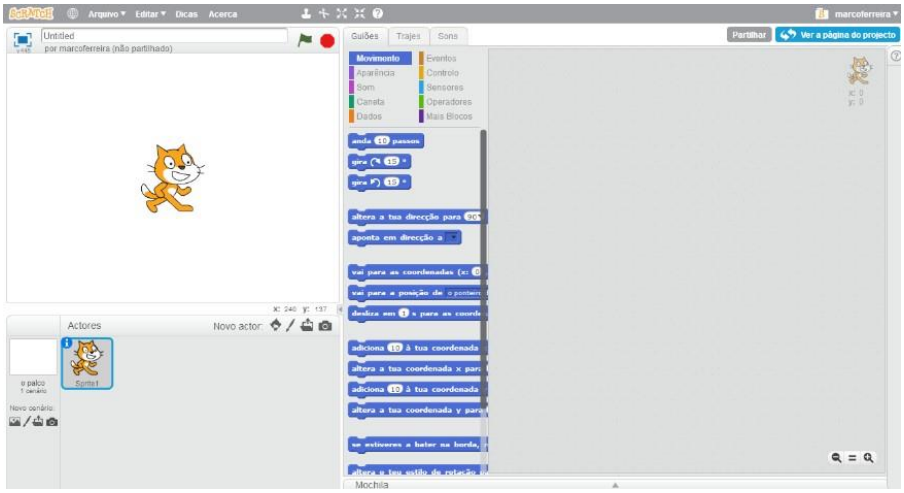
Thus, in the introduction to programming logic, students are directed to perform calculations, create variables, insert, process, use condition structures and repetition, and display values through lines of code, which need to follow a logical sequence so that problems can be solved. Through STEAM methodology, in this activity it was possible to apply pedagogies that use Technology, Art and Mathematics

9.1.2 Goals

Let's create a game where the blue rectangle is controlled by the computer mouse. The ball will have a random movement. If the ball touches the red base of the stage, the player loses. With the blue rectangle, the player must prevent the ball from touching the base of the Stage, since when the ball touches the rectangle it will be redirected upwards again.

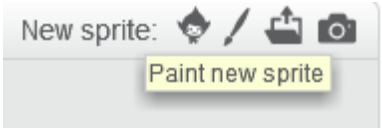
9.1.3 Development

1. Go to Scratch and create a new project.



2. Remove the Sprite "cat".

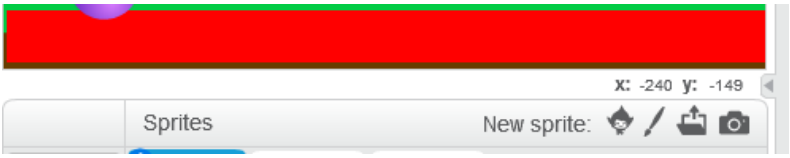
3. Click on the "Paint a new Sprite" button.



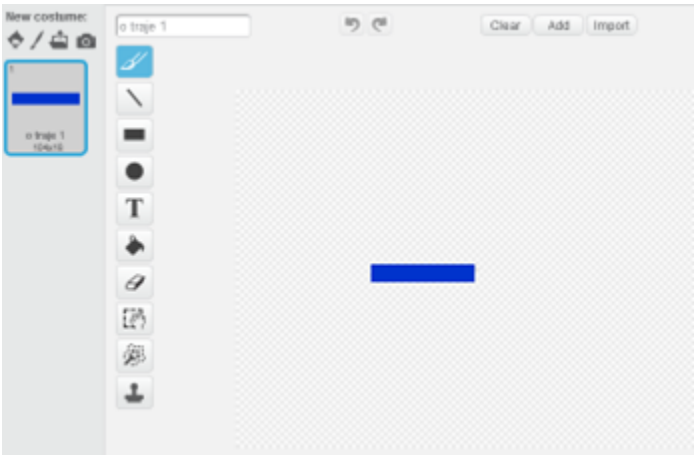
4. Select the "Rectangle" tool and click on the fill colour option (in the tool options).

5. Draw a red rectangle that fills the entire base of the drawing area.

6. Click on the Sprite thumbnail to make it appear on the Stage. You will probably need to move the rectangle so that it occupies the entire base of the Stage.



7. Create a new Sprite, this time a smaller blue rectangle.



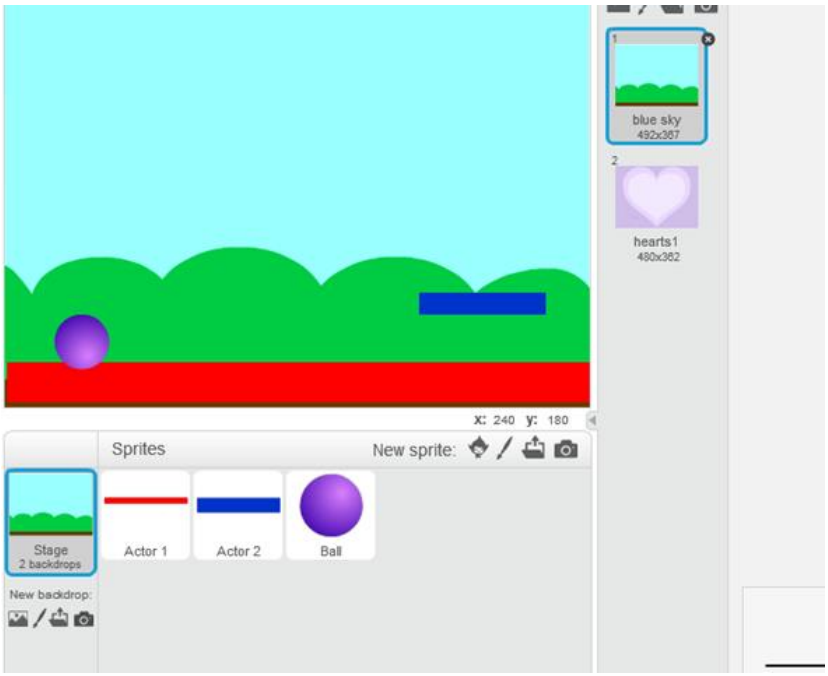
8. Then load Actor "Ball" from the "Sports" theme of the Actor Library.

9. Load the "bluesky" scene from the "Nature" theme from the Scenery Library into your project.

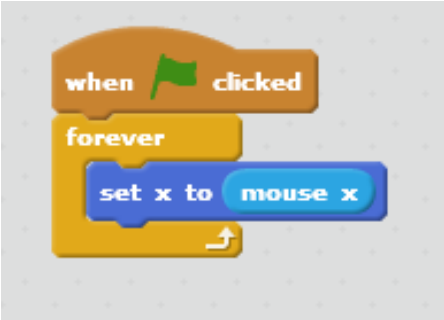
10. Delete the blank scenario by clicking on the cross.

11. In this project we are going to work with two scenarios. Load into your project the "hearts1" scenario, from the "Other" category of the Scenarios Library

12. in the "Scenarios" tab, activate the "bluesky" scenario. Your project should look roughly as in the image below.



13. Let's start by writing the script for the blue rectangle. When someone clicks on the green flag the rectangle will change its position from the x-coordinate, to the x-coordinate of the mouse, which will cause the rectangle to move horizontally, according to the movement of the computer mouse. Drag the following blocks:

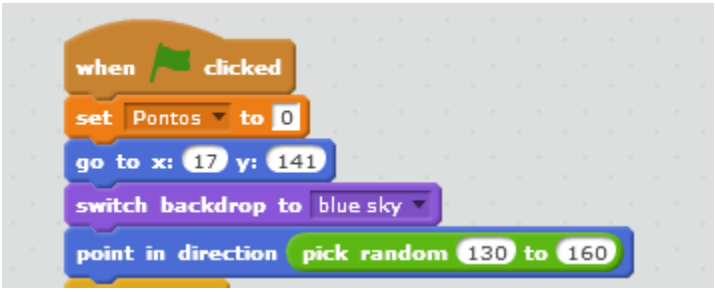


14. Click on the green flag and try it out.

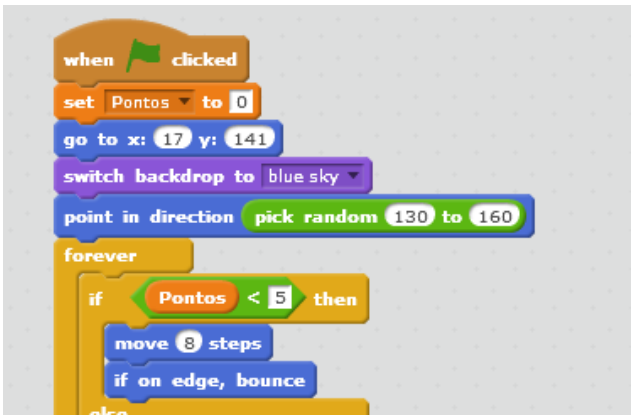
15. Next, we will write the script for the ball. When someone clicks on the green flag the ball should go to the coordinates (x:17, y: 141), approximately in the middle of the stage, near the top, and then start moving. The scenario should change to "blue sky" as throughout the game it will change to the "hearts1" scenario and so we ensure that at the start of the game it returns to the initial scenario. Drag the following blocks.

16. Now, let's give the ball a direction in a certain range.

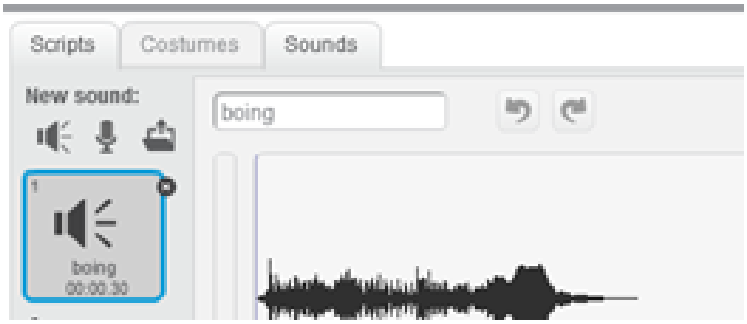
17. Change angles, so that it always takes the downward direction, towards the bottom of the Stage. Drag the following blocks:



18. Create the movement of the ball by dragging the following blocks:



19. We will then program the ball so that: if it touches the rectangle (Actor 2), then it plays the "boing" sound and moves on to the next costume. The "boing" sound must be added to the Actor in the "Sounds" tab. Drag the following blocks:



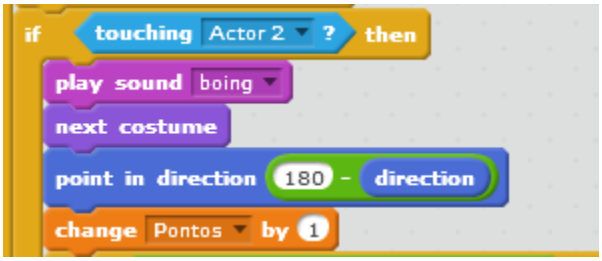
20. When the ball hits the rectangle, it must change its direction. To do this, drag the following blocks:

21. What happens is that the ball's direction will change to 180 minus the value of the direction it brings when it hits the rectangle. As we initially set a direction between 130 and 160 degrees, the ball will leave the rectangle with a direction between 20 and 50 degrees, that is, towards the top of the Stage.

22. We must also write in our script: if the ball touches the red rectangle, the player loses. When the ball hits the red background, the sound "computer beeps1" should be heard, which should be loaded from the Sound Library, on the "Sound" tab. Also the message "You lose!!!" should be displayed. Remember that when you place the block "is playing in the colour..." you should click on the square with the colour and then click on the red rectangle on the Stage to set the exact colour. Drag the following blocks:

23. Each time the ball touches the blue rectangle, the player must add one point. On the "Data" tab, create a "Points" variable, applicable only to the Actor "ball".

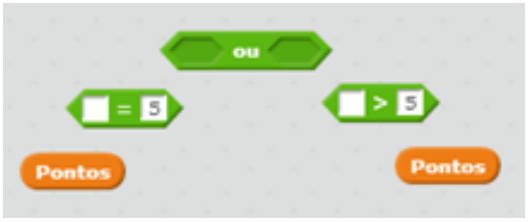
24. Add the block "add to Points the value 1" to the script.



25. At the beginning of the script, you must put the block "reset points to 0", so that the points counter restarts with each new game.

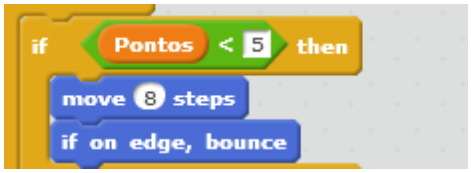
26. We want when the player reaches 5 points, the ball increases its speed and the scenario changes. We want that when the player reaches 5 points, the ball increases its speed and the scenario changes. First, we are going to make the scenario change after the player reaches 5 points. After the "add to Points the value 1" block, we will put a condition block. If a certain condition is met, the scenario changes to "hearts1". Drag the "changes the scenario to hearts1" block as well.

27. Let's now put the condition for the scenario to change. If the number of points is equal to or greater than 5, the scenario should change. You should use the following blocks:

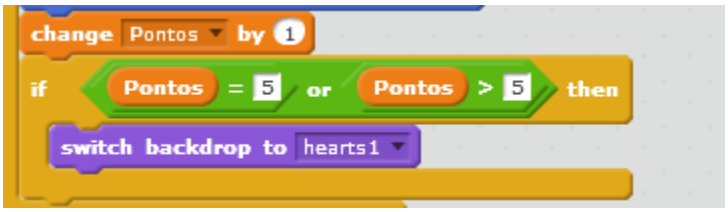


28. These blocks should be fitted together as you see in the picture below.

29. And then put into the script.

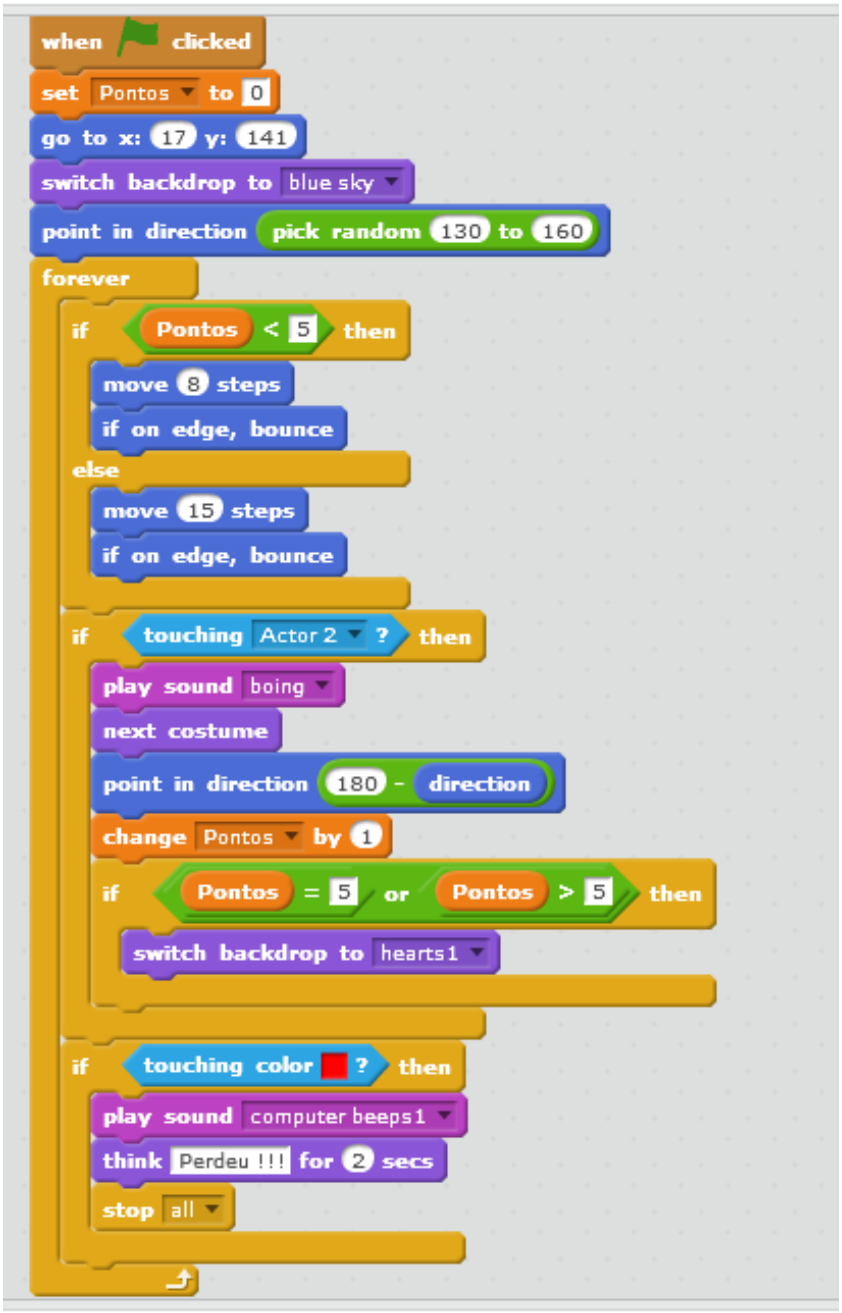


30. Now then change our script so that the speed of the ball increases from 5 points. To do this, we use an "if..., then... else, ..." block. The condition is "number of points less than 5". Drag the following blocks, but do not put them in the script yet:



On the next page is the full ball script.

Test your script.



10 CPS on economy & entrepreneurship

10.1 The importance of talking about undertaking and economics

There are a several reasons why it is important to talk about undertaking and economics to students in school:

- We need new enterprising people in our communities, in other to have new companies that create value and generate wealth.
- It allows students to see things "from the other side", instead of seeing them always from a customer's perspective.
- To understand the limitations of resources and the importance of their sustainable management.
- To get more responsible and aware consumers.
- To understand the ability of companies to be drivers of change with their decisions.
- Greater proximity of the theoretical knowledge to the real world.

10.2 CPS for running a business. Problems and challenges

Next you will see, concentrated, some of the problems and challenges that entrepreneur people have to face throughout their activity, from the beginning of their project until their company develops and evolves in the market.

Therefore, it is an ideal scenario on which to apply the CPS methodology to solve problems and face challenges, as a daily management tool.

I. The growth of the company

Make the right decisions to balance available resources with needs. To grow we can:

- Sell more to customers we already have.
- Sell to more customers.
- A combination of both.

And for that, we can:

- Grow on new products.
- Grow in new markets.
- Grow in new territories.
- Grow into new customer groups.

II. The evolution of customers

You should bear in mind:

- What it is new today, tomorrow it is obsolete.
- What surprises us today, tomorrow we will take it for granted.
- What satisfies us today, bores us tomorrow.

For that reason, it is important for the company to evolve at the pace of their customers, and for that you must consider:

- How do the expectations and needs of our target customers evolve?
- What are our competencies doing to respond to the changes?
- What can we do to respond to these changes, consistent with our identity?
- Can we maintain our competitive advantage?
- How should the company evolve its offer?
- How can the company maintain a balance between its available resources and new needs?

III. The competition

The company should also stay alert to its competitions, to react accordingly and stay in a good position in the market. This implies being aware of:

- How does the competition react to changes in the market?
- How does the competition react to our decisions?

- Have old competitors left the market? Why?
- Have new competitors emerged?
- What new needs or expectations of our clients do they satisfy?
- Is our competitive advantage at risk?
- Is our position in the target customer group at risk?

IV. Changes in the scenario

The scenario in which the company develops its activity does not remain unchanged over time either, emerging new regulations and new sensitivities among society that must be taken into account.

- Have new legal frameworks emerged (or are them foreseeable) that will hinder or impede our activity? Or that turn out to be an opportunity?
- Have new social movements or trends emerged (or are emerging) that pose a risk to our business? Or could they be an opportunity?
- Has an event occurred that has changed or could change the consumption habits of our target customers? In which way?
- Have new technologies emerged that affect our products or services, or the way we deliver them or engage with target customers? Are new profiles required in the business to deal with these technological changes?

10.3 Basic economy tools and concepts we are going to be using

In this section we are going to introduce fundamental concepts that teachers must know in order to work with students in the CPS in the field of economics and entrepreneurship.

I. Entrepreneurial mindset

When we talk about an entrepreneurial mindset, we talk about the attitude of people who, when they want to achieve a goal in their life, do not wait to depend on other people, but take the initiative and do everything in their power to achieve it.

We do not necessarily speak of the attitude when launching an undertaking project, but as a vital attitude when facing any challenge. Let us see one examples to understand it better:

Fabio is a young Italian from the Cesena region, who wanted the rock band Foo Fighters to perform in his village, something unlikely given its small size, which makes it off the beaten path for great musical performances.

However, and being a person with an entrepreneurial attitude, Fabio thought about doing what was in his power to achieve his goal. So, he decided to organize a performance with 1,000 musicians playing one of Foo Fighters' hits live to try to get his attention and convince them to come to Cesena.

This performance was recorded live and uploaded to YouTube on the channel "Rockin' 1000", along with a message from the organizer to the band transmitting his request.

Source: Youtube

Fabio Zaffagnini (Cesena, Italy).

Click on or scan code to access video on Youtube

The video went viral (at the time of writing this material it has 60 million views) and caught the attention of the Foo Fighters, who finally came to play in the small Italian town.

These is just one examples of people with an entrepreneurial attitude, not specifically related to the business world but with their attitude in their life in general. Therefore, the entrepreneurial attitude does not have to be exclusive to entrepreneurial people, but it is

an important requirement that people who want to be successful in any area of their life must work in.

II. Marketing mix: product

The product or service that the company wants to sell is the first component to consider in relation to the marketing mix. In this regard we must consider:

- **Prior knowledge of the activity.**

  It is always convenient to know the activity to which we are going to dedicate ourselves before starting the company. If we have not known it through our professional or work experience, we should at least investigate about it (applicable regulations, raw materials used, manufacturing processes, required machinery ...).

- **Identify a business opportunity.**

  As highlighted in the previous topic, it is important that the idea passes the filter of the business opportunity, evaluating if it really has commercial potential.

- **Define the product (and its associated services!).**

  When defining the product and its characteristics, we cannot just stop there, but we must define the services associated with the product. We will see more about this below, given its importance today.

- **Target customers: needs and expectations.**

  To make an attractive product, the company must know the needs and expectations of our target customers. Therefore, they must know with precision and in depth the customers we are addressing, and how they value the different characteristics and benefits of the product that we want to sell them.

- **Plan your differentiation.**

  To attract customers in a market where there are already alternatives to the company's product, the company must offer something different from what already exists. And not just because, but doing it in a way that is relevant and appreciated by their target customers. Therefore, the company must decide and plan its difference based on the knowledge it has of its customers.

- **Develop the business plan.**

  Starting from the identified business opportunity and with the desired differentiation, the complete business model must be developed around the value to be created.

- **Assess feasibility.**

  Finally, the feasibility of the design carried out following the defined requirements must be evaluated, to see if its expected performance is commercially interesting.

III. Marketing mix: price

The second component of the marketing mix is price. We define price as the number of monetary units the consumers must pay for each unit of product that the company sells in the market, as a counterpart to the value that the consumer perceives when achieving a certain level of satisfaction with the company's offer.

But how do we set it?

The key in this definition is in the conception of the price as a counterpart: the client weighs the cost on the one hand and compares it with everything he gets in return. Not just the product, but the product and the services associated with it.

The process to set a price for the company's product goes according to the following flow:

- **Which is the cost per unit produced?**

  The first thing to consider is what it costs us to produce each product. In this cost we must include everything that the company has to spend to produce a product. We are talking about raw materials, production equipment, supplies, or personnel costs.

  In some cases, the calculation will be simple because the cost will be directly transferable (for example, with raw materials), but in other cases we must calculate the proportional part used in each product (for example, the cost of electricity or the corresponding part of the staff salary).

The amount that results from this calculation is called “dead point”, since it defines the lowest price that can be established simply to cover operating costs, so that the company is not forced to close.

- **Is there competition? How much are they charging?**

  Once the company is clear about its dead point, the second question is to know if there is already a price in the market for products like the ones the company is offering. If there are already competitors in the market that offer similar products, customers already have a perception of what an "adequate" price may be.

  This means that the price must be set somewhere close around to this market price, for if the price is set too high, customers will perceive it as expensive and will demand more value in exchange; while if it is set excessively low, generates distrust in relation to the quality of the product.

  Of course, this market price must be higher than the dead point, in order to achieve the business profit.

- **Is there little or no competition?**

  If the product does not exist in the market, or there is little competition, then the company has more freedom to set the price.

  In this case, the company will attend to other factors that can add value to customers, such as the differentiation that the company's product provides compared to other alternatives (status) or emotional factors that link the clientele with the company (because they belong to the same community, for example).

IV. Marketing mix: promotion

The third component of the marketing mix is promotion. We talk about promotion, although we better talk about communication, since nowadays and with the ease that social networks and technological means provide to establish two-way communication channels, the company must take advantage of this potential to obtain more information about what its customers want and need, and to retain them.

- **It is not enough being good, it must seem so.**

  In the global competition scenario, with a multitude of companies competing for the attention of customers, it is not enough for the company to be good in what it does, but it must also be able to get its message to its potential customers so they can value your offer.

- **The purchase decision is based on quality.**

  As a management concept, quality is defined as the level of satisfaction of the needs and expectations that the customer experiences with a product.

  Therefore, quality does not necessarily have to do with the components of the product, and it does have to do with customer satisfaction, and the purchase decision will be based on "value for money", so the person compares the satisfaction he can get with the money it will cost him and based on the outcome will make his decision.

- **Quality is based on perception.**

  Yes, as indicated above, quality is entirely based on the customer's perception of the level of satisfaction he or she achieves with de product.

  Therefore, quality is not determined by the company when it designs the product but is determined by the level of adjustment of the product to the needs and expectations of its target customers. Hence the importance of knowing them in detail and knowing what they value about the product prior to its design, to respond to those requirements.

- **What the customer does not know, does not exist.**

  Precisely for this reason, because the purchase decision is linked to the customer perception and to what extent this perception translates into satisfaction, what the customer does not know he cannot value, and if he does not value it, it is not useful for him to take a decision, making it money wasted uselessly by the company.

Therefore, it is one of the challenges of the company to be able to adequately communicate to customers all the characteristics of the product so they can value them and keep them in mind when evaluating their purchase decision.

- **We need to know the opinion of the customers.**

  If the company has done things right, it has listened to the needs and expectations of its customers and it has designed its products and associated services in accordance with this information.

  Therefore, once the product is placed on the market, the only thing missing is to know what the customer's opinion is, once they finally have received it. Is the product satisfactory? Does it meet its expectations? Has the company succeeded with its design?

  This part is essential to close the circle of continuous improvement, and this information about the opinion of the customer should be used by the company to improve the product and make it more attractive in the future.

- **Two-way communication is key.**

  This need to communicate with the customer and to be able to reach them effectively with the relevant information about the product that the company wants to send them, makes two-way communication a key factor.

  We must add to this the proliferation of social networks and technological media as elements that facilitate and speed up communication, which in practice means that customers have the opportunity to comment on the company's products (either for good or bad) even if the company did not give them the chance to do it and can reach hundreds or thousands of people with their opinion.

  That is why it is important to offer the customers communication channels, so that they can express their suggestions, comments, complaints, or observations to the company without having to expose them to third parties (which could damage the reputation of the company) and in a way that the company can take advantage of them to improve.

V. Marketing mix: placement

The fourth and final component of the marketing mix is placement. We can define placement as the place we want to occupy in the perception of real and potential customers, and to determine this place, the company must ask the following questions:

- For what qualities do we want to be recognized?
- What value do we add?
- What does our competition do?
- How can we differentiate ourselves from the rest?
- Why would the potential customers prefer us?

The underlying question is the following: if the company is not capable of generating a differentiated space within the customers' mind, why would customers choose its product over the ones they already know?

This is what differentiation is about, to generate a brand, an idea, a message that the customers can recognize and appreciate, an image that encourages them to buy the company's products over those of the competition.

How can the company work its difference? Following these steps:

- **Identify the competition.**

  The first step is to clearly identify who the competition is, to know the field in which the company is going to play and against whom its products are going to face.

- **Attributes of the product / service relevant to the customers' base.**

  The second step will be to identify the attributes (related to expectations) that are relevant to the target group of customers.

- **Preferred attribute combinations (in the market).**

  Next, it is necessary to determine which are the combinations of these attributes (since generally not all will be able to be catered for) that can be more successful in the market.

- **Determine our competitor positions.**

  Before configuring its final offer, the company must know what the offer of its competitors is and what is the position of each of them in the market, since the final offer must be defined taking into account, among other things, what already exists.

- **Identify the ideal position for the market.**

  From that information, the preferred position of the market and the position of the competitors, the company must identify what the "ideal position" is for its products in that market.

- **Select own position (feasibility and profitability).**

  Finally, the company must analyse the viability and convenience of placing itself in that ideal position and develop its own proposal.

The reasons for not adopting the ideal position will be, fundamentally, two: because it is not economically viable to adopt that position, or because it is not commercially interesting compared to the offer of the competition.

This is an important aspect that the company must manage: if the competition has a very limited offer compared to what the company could make, it must assess whether it is interesting showing all its cards, or if is better to "reserve" certain attributes for later, so when competitors respond, the company always has something more to offer its customers and continue to differentiate itself from the rest.

VI. Needs vs expectations

Let us take a minute to think about the differences between need and expectation, and why it is important to understand them and use them in favour of the company.

Starting with the need:

- **It is the minimum to achieve.**

  When a person searches for a product, they do so to satisfy a need. If you buy a pen it is because you need to write, if you buy a car it is because you need to travel, if you buy a house it is because you need a place to live.

Therefore, that need determines the minimum that the product has to offer: the pen has to write, the car has to move, and the house has to shelter. The problem is that all pens write, all cars move and all houses shelter, so responding to the need does not allow differentiating one product from another and does not give the customer elements of judgment to prefer one offer over another.

- **It does not satisfy, but…**

  That the product responds to the need for which it was created does not generate customer satisfaction (or, in other words, does not generate "quality"), because that is the least the customer expects. Of course, it must comply with the need.

- **It can generate dissatisfaction.**

  On the other hand, if the product does not meet the need that originated its purchase, it will generate dissatisfaction in the customer: if the pen does not write, if the car is constantly in the workshop or if the house is uninhabitable, the customers will fell rejection towards that product.

So, the first lesson would be the following: the company must make sure that the product complies properly to respond to the need that the customers have when they buy it, just to be able to go on the market.

Now the expectation:

- **It is not necessary.**

  The expectation, as the name suggests, is not something that the person needs, but they do hope (the “expect”) to be able to enjoy it along with the product. Different types of people have different types of expectations, so responding to them does allow the company to position its product in the market and offer a differentiated offer.

  Let us think about pens again: if we consider the group of students, they expect their pen to be affordable, durable, and sturdy. On the other hand, if we consider the group of top company executives, they expect their pen to be exclusive, luxurious, and expensive.

Both groups require a solution for the same need, which is writing, but they expect different things from their pen, which allows different companies to offer different products according to their strategy.

- **It connects with the emotions.**

  What the customers expect is related to their wishes, and it is connected to their emotions. For this reason, when we see advertisements on the media, products are often advertised without actually showing them or without showing how they work, precisely because companies seek to connect with the emotions of their potential buyers and appeal to their expectations.

- **It does satisfy.**

  Contrary to what happens with need, meeting their expectations does produce customer satisfaction. However, not all expectations are equally important, and generally there are too many to be able to comply with all of them. For this reason, different competing companies may focus on different expectations to differentiate their products from their competition.

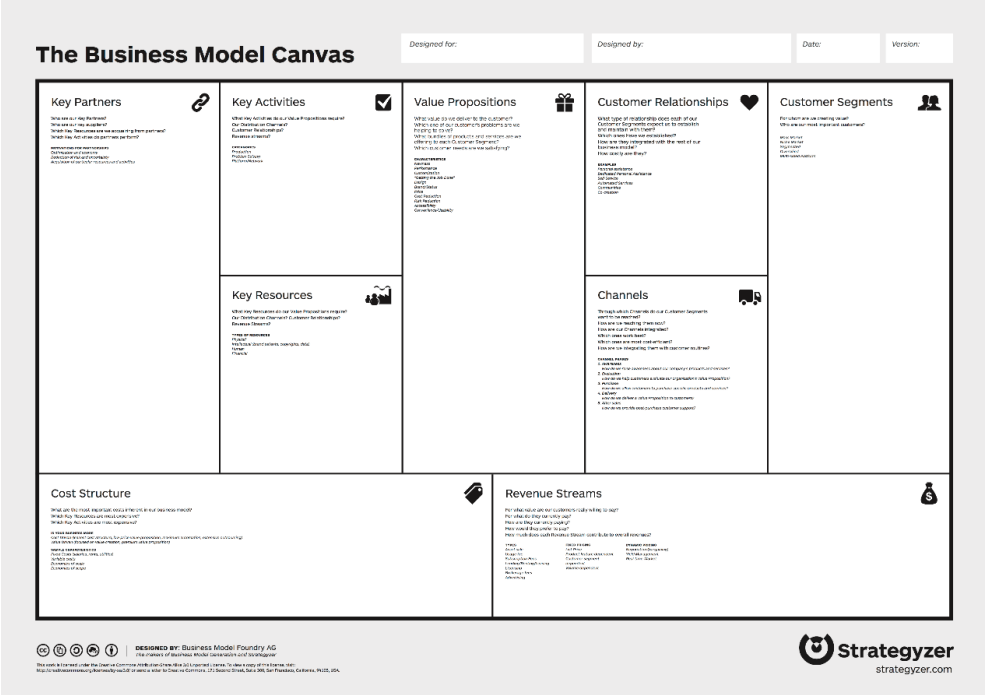
So, the lesson here is prioritizing attention to the customers' expectations that, according to the company's knowledge, they most want, creating a different and differentiated combination from that of the competitors and being able to transmit it effectively to the target customers.

VII. Business Model Canvas

The first step when creating a new business is the simplest of all and consists of reflecting on the business model. For that, it can be used the Canvas model and methodology.

To do this is not required a specific knowledge of economy or entrepreneurial theory, and it simply requires answering a set of questions, with a deep reflection on the different sections that make up the model, to see if the identified business opportunity really passes the first serious test.

In our case, this will be the only one of the three steps that will be developed in practice in this guide, so later we will detail it in depth.



Example of a Canvas

VII. Corporate identity

The corporate image is the hallmark of the company and acts as a recognizable element for customers, so it must be cared for and carried out considering a series of issues:

- **Better if it is clearly referred to the product / service.**

  This is not essential, but unless the company has a significant amount of money to dedicate to the creation of a brand image so that it is recognized in the market, it is best to go for an image that allows potential customers to deduce what is the activity that the company develops when they see it.

- **Be consistent with the position the company sought.**

  If the company wants to position itself as an innovative company, the image must be innovative; If the company wants to position itself as a reliable company, the image must convey confidence. The image must be made considering the place the company wants to occupy in the market and in the minds of its customers, to accompany and reinforce that message.

- **Unique (at least, different from what is known).**

  To allow customers to differentiate the company and its offer, it is important that the corporate image chosen is also different from that used by competitors, so the customers can become familiar with it and recognize it in front of others.

- **Simple (easy to remember, interpret and reproduce).**

  When talking about corporate image, less is more. The simpler the image, the fewer elements and shapes it contains, the easier it will be for customers to retain, recognize and differentiate it at a glance.

- **Careful using the colours.**

  Colours have meaning, so the choice of colours must be done carefully and in accordance with the ideas that the company wants to convey, in relation to its positioning. For example:

  - Red is associated with power, strength.
  - Blue conveys confidence, reliability.
  - Green represents the natural.
  - Black represents elegance.
  - Purple represents creativity.

  As in the previous case, when talking about colours in the corporate image, less is more. A discreet and appropriate use of colour helps to remember the image and avoid conveying contradictory messages. In addition, the simpler the image and the less colour it uses, the easier and cheaper it will be to reproduce, while giving more flexibility to combine it on different advertising media.

- **Adaptable (sizes, supports, applications).**

  The image should work well in small sizes (such as on a web page or a business card), but also in larger sizes such as on a sign, a poster, or a brochure.

- **Modern appearance, but not "fashionable" (as it must last).**

  It is important that the image looks modern at the time of its creation, but "fashionable" elements should be avoided as much as possible, since when that fashion passes, the image will automatically look outdated and will force its change.

Examples of good (left) and bad (right) corporate images. Source: companies web site

In the image, on the left side we see simple images with a very limited use of colour. These are images that we all know, remember, and recognize quickly.

On the right side there are some examples of bad corporate images, where we see in some cases (Office of Basic Energy Sciences) an excessive use of different colours that makes it very difficult to remember, others (Highlight) present a use of colour makes it difficult to read; we also see an example (Cat Wear) with an unfortunate use of the image and, finally (Kate's Florist), we see a logo that conveys lack of professionalism and care.

Also, to take into account when designing the image:

- **The logo in positive and negative version.**

  The logo must be developed in a positive version (to be used on light backgrounds) and a negative version (to be used on dark backgrounds), so all possible uses are covered, with a good contrast and flexibility to use and recognize it in any application.

- **Take care of resolution (better in vector).**

As far as possible, a vector design must be used, to avoid pixelation from appearing when modifying its size, since it transmits an unprofessional and careless image. In any case, the resolution with which the image is used must be adequate to the size in which it must appear on the medium on which it will be used (web, social media, paper).

- **Assess the possibility of a slogan.**

  Lately it is a widely used resource to include a slogan that reinforces the message of the image. It should be short, simple, easy to remember and meaningful.

- **Provide basic applications.**

  For its use to be appropriate in each medium, the basic applications of the image must be defined at hand, which must include at least:

  - The product (label, package).
  - Company's web site.
  - Advertising (print, web, wallpapers ...).
  - Stationery (proposals, invoices ...).
  - Business cards.

VIII. Organization chart

The organization chart is the way in which the organization of the company is graphically reflected. There are multiple possibilities:

- **Depending on the size of the company.**

  Generally, the larger the company, the larger the organizational chart in terms of departments and levels.

- **Depending on the philosophy (authority vs. delegation).**

  In organizations with an important hierarchical content, the organization chart tends to have more levels, each one representing authority with respect to subordinates. On the other hand, companies that choose the delegation of

responsibilities present "flatter" organization charts, with hardly any authority levels.

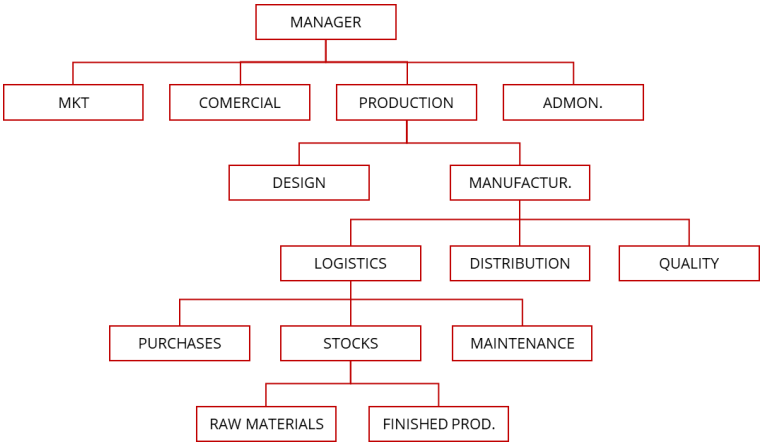
- **Depending on the strategy (relationships between areas).**

  Depending on the strategy and the difference that the company has chosen, it can prioritize some departments over others. Thus, for example, in two companies that operate in the same market with the same product but different approach, one may choose to give priority to the design department and place below it the manufacturing department, since it wants to prioritize innovation; while the other does it the other way around and puts the design department as a subordinate of manufacturing department, since it wants to prioritize the optimization of production costs.

- **Depending on the affinity of knowledge (HR).**

  Another possible way to define departments is to use the affinity of the knowledge required to execute the activities it encompasses. Thus, for example, a company could group the areas of innovation, design, and manufacturing, since all of them require personnel with knowledge of industrial engineering.

There is no one option that is better than the others, nor that works better than the others in all cases. The company must choose the one that best allows it to achieve its value proposition, and that is consistent with its work philosophy and the business culture it wants to promote.



Example of organizational chart

But how can we organize ourselves?

Some clues in relation to how the company should be organized:

- **The organization must be adequate to achieve the desired results.**

  The definition of the organization of the company must always come after the definition of the value proposition and the objectives that the company wants to achieve. This is because the organization must allow an effective response to these objectives, and it must be the best possible to achieve the value proposition in an efficient way.

- **Be clear about what we want to achieve (product + final service).**

  For this reason, the company must define very clearly what is the value proposition that it wants to achieve, and from it define clearly and completely both the specifications of the product that it is going to manufacture, and the associated services defined as part of positioning.

- **Define the processes necessary to achieve it (those that add value).**

  Once this is clearly defined, the next step is to define all the processes that need to be developed in the company to achieve the value proposition.

  By process we are going to understand a grouped succession of closely related activities that convert some inputs into different outputs. It should be considered that the output of a process can be the input of another or other subsequent processes.

  When adopting a processes approach, it must be clear which are all the activities that must be carried out to achieve the value proposition, as well as the sequence in which they must occur and their relationships. We will look at it in more depth in a moment.

- **Get organized so that processes are efficient.**

  Once we have defined the processes that are necessary to generate the value proposition, their relationships and dependencies, the way to organize the

company must be considered so that the operation of the processes is as efficient as possible, and no activity is left out of some area.

IX. Diversification

When the company wants to continue growing within the same market in which it operates, its best option is to diversify its product portfolio. This is what is called "diversification", to expand the offer of products and services of the company. There are two ways to do this is:

By adding new products or activities related to those the company is already fabricating. We can do this in three ways:

- **Vertical forward.**

  The company integrates new products related to the ones it already manufactures, but which are obtained later. For example, if the company manufactures and markets packages of sheets of paper, a forward vertical integration could be to start manufacturing notebooks, since it would make them from the sheets it is already manufacturing.

- **Vertical backwards.**

  Contrary to the previous one, in this case the company would integrate new products or activities that would take place before those that it already carried out or manufacture. Following the same example, the company could start its activity in the paper pulp sector, which would later be used to manufacture its packages of sheets of paper but could also be marketed to other companies that use this raw material in their processes.

- **Horizontal.**

  In this case, the integration is done with a product or activity that is related to what the company already does but is not directly related. In the example used, the company could start manufacturing pens, since they are necessary to write on its sheets of paper, or briefcases to transport them.

By adding completely new activities.

In this case, the company opts for a completely new and different activity. For example, the company that makes sheets of paper may start manufacturing electric scooters, simply because it sees a good business opportunity in it.

Example of diversification in IKEA: from furniture to food

Like any other business decision, diversification has both pros and cons.

The main pros are:

- **Reduces risk.**

  By increasing the product portfolio, the company does not depend so much on each of them, and in case one of them suffers a crisis, it can always reinforce the others. Therefore, it reduces the risks associated with the crisis of a specific product.

- **Increases turnover (and benefits?).**

  If it has more products, the company will be able to sell more and that will increase the turnover. However, an increase in turnover does not mean that profit increases, as new products may be less profitable or even cause losses in their early stages.

- **It allows to grow in the same market.**

  Diversification allows the company to grow in the market in which it already operates, without having to assume the necessary expenses to reach new markets (for example, through distribution to other countries) or to make itself known to new customers (through advertising and communication).

- **It starts with a customer base.**

  As it operates in its own market, the company is already well known, it already has a brand, and it already has customers who know what to expect from its products.

- **It reaches new customers.**

  At the same time, by offering new products, new customers who previously did not need the products the company offered can approach it to buy the new ones, increasing their customer base.

On the opposite side, the main cons are:

- **Increases expenses.**

  By increasing the production lines, their facilities and equipment, as well as the raw materials that the company needs and possibly its staff, the production costs that the company must bear are also greatly increased.

- **Increases complexity.**

  More products and more activities imply more processes, changes in the structure and, necessarily, adds layers of complexity to the management of the company, since there are more issues to take into account when making decisions.

- **Uncertain result.**

  As in the start-up of any project, there is always a certain level of uncertainty in relation to the result, despite how well the company has previously prepared and no matter how much it has planned. As long as the company does not start producing and selling the new products, it will not know if they really work as expected.

- **Risk for what we already do.**

  Just as introducing new products can be an opportunity, it can also pose a risk to those that the company already makes and to its reputation. If the new products cause operational problems, generate complaints or dissatisfaction among customers, it can have an impact on the image of the already established products, negatively affecting them. And if financially the new products generate low

profitability, they could absorb the profitability of the products it already had on the market.

X. Corporate Social Responsibility (CSR)

Corporate Social Responsibility is a concept that young entrepreneurs must learn, to take it into account and apply it tomorrow when they start their businesses. According to the Green Paper "Promoting a European Framework for CSR", Corporate Social Responsibility is the "Integration, by companies, of social and environmental concerns in their business operations and their interactions with their stakeholders on a voluntary basis".

Click on or Scan code to access the Green Paper

So, let us see some key points here:

- **Volunteer.**

  Corporate social responsibility is applied voluntarily by companies. Therefore, complying with the law is not acting in a socially responsible way, since that is the framework that all companies must comply with. Social responsibility goes beyond mere compliance.

- **Integrated.**

  It must be an inner part of the company's way of working, not something to be added from outside. It must be present in all decisions and in the way the company works every day.

- **Social and Ambiental concerns.**

  It seeks to balance in the company the social and environmental perspective with the economic one. This concept of balance is paramount, as will be seen later.

- **Stakeholders.**

  It does not only consider the closest agents, the shareholders, but also broadens its radius of action to include the interests of the stakeholders.

In this case, just as it is important to define what the CSR is, it is also important to clarify what it is not:

- **Change the purpose of the company.**

  Applying the CSR does not mean that the company is going to dedicate itself to something else or that it pursues a different purpose. The primary purpose of the company is to generate wealth over time, so the CSR must also serve this purpose.

- **Putting environmental or social aspects before the economic.**

  Again, the primary purpose of the company is economic. What is intended when applying CSR is to achieve a harmonious balance between the different perspectives, so that environmental and social aspects are also considered during the decision-making process with the importance that the company decides in each case, but always subordinate to the economic vision.

- **Be a non-profit entity.**

  For a company to be able to sustain itself over time and continue to generate wealth, profit is essential. Therefore, that will continue to be the company's primary goal, even if when it applies CSR.

- **Being a philanthropist.**

  Companies that apply CSR do so because they know that they will make a profit this way. Therefore, they do not do it solely for philanthropy, but because they understand that they have a debt to their community and want to return part of the profit they obtain thanks to it.

Considering the CSR, we have to state its value for the company.

The company obtains its value from various areas, which complement the strictly economic vision:

- **Allows society to give a positive value to business activity.**

  By seeing that the company really cares about social and environmental problems, the community improves its perception of the company's activity and sees it as an ally.

- **Protect the company against competitors.**

  If the company cares and listens to the stakeholders in its community, they will prefer it over other competitors who do not, so this fact will constitute an entry barrier for other companies, protecting the company's market share.

- **Ensures better human capital.**

  People will prefer to work in a socially responsible company, so the company will be able to choose the best workers, and therefore it will be able to be more productive and profitable.

- **Allows the company to access the best sources of financing.**

  When the company needs financing, the fact of being a recognized and supported company can open better financing possibilities, supported by the community.

- **Awards recognition in certain markets.**

  In certain markets, customers value positively that the company is socially responsible and take this criterion into account when making their purchase decision.

- **It is recognized by public authorities.**

  Public authorities usually recognize the efforts of responsible companies and it is usually easier for them to access the authorities when they need it, being able to positively influence the definition of public policies.

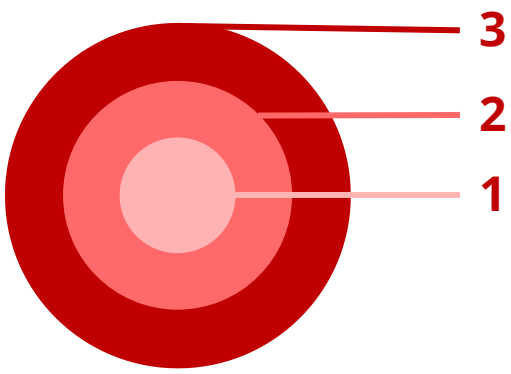
How can the CSR be deployed in a company?

To do it well and authentically, the deployment of CSR in the company must follow a certain order.

In the first place, the company must attend to the internal circle, in which its workers, its customers, its suppliers and its shareholders are, and apply the principles of CSR to them and their relationships.

Once this level has been consolidated, the company will apply the CSR with respect to its community (local or regional government, schools, clubs ...).

Only when this second level has been consolidated too will it be the time for the company to move on to applying CSR on a larger scale, moving on to social action in developing countries or supporting disadvantaged groups, for example.



Different levels to apply CSR

In certain cases, it is possible to find companies that apply the last of the levels, but that are constantly in the media due to problems with their staff or with their customers. These are companies that do not really apply CSR, but rather want to benefit from the positive image that social action can provide. This type of behaviour, which is often called social marketing or "green washing", is an attempt to take advantage of the benefits that CSR can bring without a true commitment to its principles.

These are some of the tools that companies can use to get into CSR, from less to more complex:

- **CSR statements and policies.**

  General statements of senior management's willingness to apply CSR principles. They are useful for the workers, because they provide a framework to making decisions and adopting behaviours, which must be consistent with the spirit of these statements.

- **Self-assessment tools.**

  Questionnaires that, when completed, allow the company to obtain precise information about its performance in terms of social responsibility and allow it to obtain information on areas for improvement. These evaluation questionnaires can be repeated over time to assess progress and find new avenues of development.

- **Social balance.**

  Document with economic balance format in which normalized results are presented from the three perspectives of interest: economic, social, and environmental. There are specifications in which it is precisely defined how it should be carried out and with what content.

- **Codes of conduct.**

  They are internal documents that describe the expected behaviours in certain situations and circumstances, so that no one has doubts about how to act when these situations occur.

- **CSR strategies.**

  Document of a business strategic nature in which it is detailed in the long term what are the challenges, axes and measures that must be applied in the company at all levels and in all areas, to achieve the expected results in the field of CSR.

- **Sustainability reports and memories.**

  Documents defined and structured by international reference organizations in matters of social responsibility, serve for the company to make public its performance in CSR with standardized content.

- **Integrated Management Systems.**

  Management system defined by international organizations that contents the requirements that a corporate responsibility management system must meet, and that are certifiable by authorized third parties, so the company can obtain an

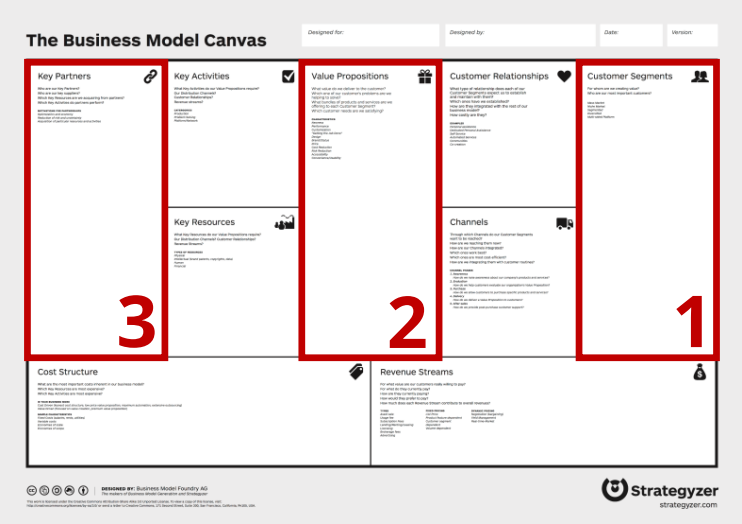
"approval seal" from an independent entity, which will also verify it periodically, to show that it is truly committed and complies with the CSR standards.

10.4 Business Model Canvas

This section provides some basic guidelines for building the Canvas, organized accordingly to the process to create it.

10.4.1 The big three

We will begin to cover the Canvas by answering the questions of the big three:



We call the big three to:

- Value proposition.
- Customers segments.
- Partners.

To complete each block, the students (in general, the undertaking people) should answer a series of key questions, as follows.

I. Block 1. Value proposition.

- What value is delivered to customers by the company?
- What problems does it solve for them?

- What need will it satisfy?

Guidance for finding answers:

To be successful in the market, it is key to be able to differentiate the offer of the new company from the other existing ones, and to ensure that potential customers perceive that offer as different and valuable, since only then will they decide to acquire your products or services.

This, the differential value that the new company is going to offer to potential customers, is the most important aspect that must be clearly defined in this block, because otherwise it will be difficult for the company to gain a place in the market.

In this sense, it is necessary for the company to think about the benefits that the offer entails for customers, defining the value attributes for each customer's segment. Some value attributes are appreciated by customers in technological advances, in design improvements, personal status, brand, price, proximity, customization ...

II. Block 2. Customer segments

- For whom is the company creating value?
- Who are the most important customers (groups)?

Guidance for finding answers:

Once the students are clear about what the differential value of the product will be, it is time to define the clientele to which they are going to address, to be able to learn more about their needs and expectations about the product at the detailed level and, above all, to find out if their number is enough to keep the company in business with their purchases.

They must establish the criteria to segment the potential clientele, defining one or more segments to which the offer is directed and, for each of them, identify their needs, the value attributes for which they are willing to pay, the channels to reach with the product...

III. Block 3. Key partners

- Who are the providers and suppliers of the key resources?

- How important are they in the production process and in the business model?
- Do you have a lot of influence over the company?
- Are they also competitive suppliers?
- Who do you collaborate with to innovate?

Guidance for finding answers:

By establishing alliances with suppliers, or even with competitors, the risks of competition and rivalry in the market are reduced since it is possible to minimize risks and uncertainty in supplies. It must be considered that the business project and the effectiveness of its business model depend on the success in the interaction with other organizations to create value with.

10.4.2 Connections

After the three big blocks, it is time to consider the connections between them. First we will consider the "forward" connections, which allow us to link the company's value proposition with the customer segments.

I. Block 4. Customer relationships

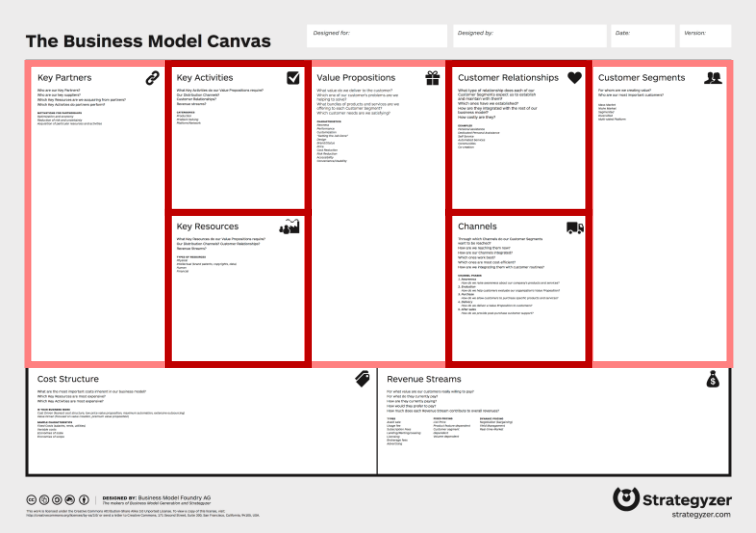
- What kind of relationship do the company want to establish with customers?
- Can customer relationships be different for each segment?
- Will it take a lot of effort for the company to maintain these relationships?

Guidance for finding answers:

The students must define what kind of relationship they want to maintain with customers, since the relationships that can be established with them can be very close and personal (for example in the retail trade) or quite the opposite (for example, if the customer even serves himself and is alone). They can even be automated and highly standardized through a website.

The type of relationship that is defined will be conditioned by the channels that are selected, but these will not delimit them in a strict way either. For example, even if the

service is provided through a website, the company may decide to opt for a closer and more personal relationship by appointing an interlocutor, including his or her name and a photo, to generate a stronger emotional bond.



Connections between the big blocks

II. Block 5. Channels

- What channels will be used to communicate with customers?
- Which ones will be used to distribute the product or service?
- Are they preferred by customers in each segment?
- Are they efficient and their costs manageable?

Guidance for finding answers:

Once the potential customer segments have been identified, the students must identify and define the channels to reach them.

The channels refer to how the company's offer is communicated, how its differential value is made explicit, so potential customers perceive it, and how the product or service is distributed. They must facilitate the purchase and cover the customer's needs satisfactorily, even after sales.

Now, the "backwards" relationships are considered, those that allow moving forward from the key partners to achieve the value proposition.

III. Block 6. Key activities

- What activities are required to carry out the production process and the value proposition?
- What activities does require the distribution of the product?
- What activities are required by the income sources?

Guidance for finding answers:

The students must describe the most important activities to carry out the production process and to offer the value proposition: how to produce or to provide the services, how to serve the customer, to solve problems that may prevent their satisfaction ...

Key resource needs will emerge from the output of this block and will be assessed after it.

IV. Module 7. Key Resources

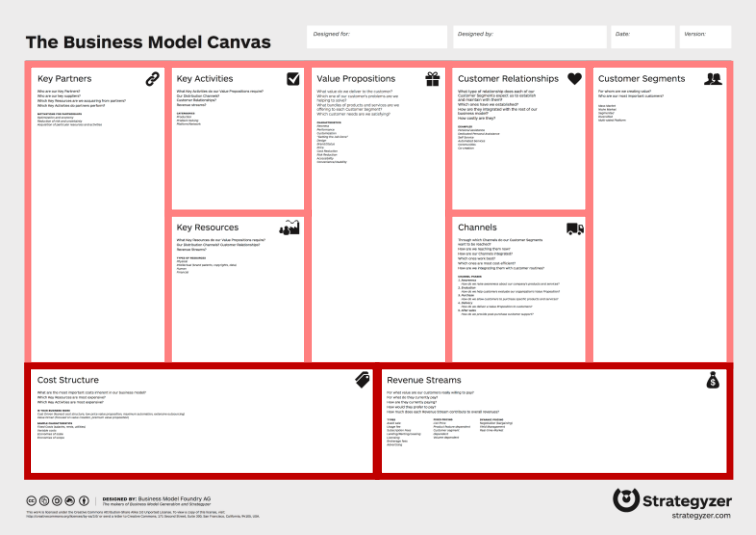
- What resources of all kinds (material, technological and personal) are required to create the value proposition?
- What resources do the channels of distribution and communication with customers require?
- What resources do we need to achieve our sources of income?
- And to maintain the relationship with customers?

Guidance for finding answers:

The students must describe the necessary means (resources) for the company to function efficiently. These resources could be owned or rented and could also be tangible (physical) or intangible (like trademarks, patents, knowledge ...), personal, financial ...

10.4.3 Inputs and outputs

Finally, the base of the model is made by the inputs (revenue streams) and the outputs (cost structure) of money that the model requires.



Inputs and outputs

I. Block 8. Cost structure

- What investments does the business project entail?
- What are the most important supplies?
- How important are personnel expenses?
- Will there be financial costs (from bank loans, for example)?

Guidance for finding answers:

It will be necessary to consider all the productive factors or resources that the company will use to create value.

II. Block 9. Revenue streams

- Which are the value attributes the customers are willing to pay for?
- Are they already paying for that today?
- How will they pay?
- Is this their preferred payment method?
- What percentage does each revenue stream represent?

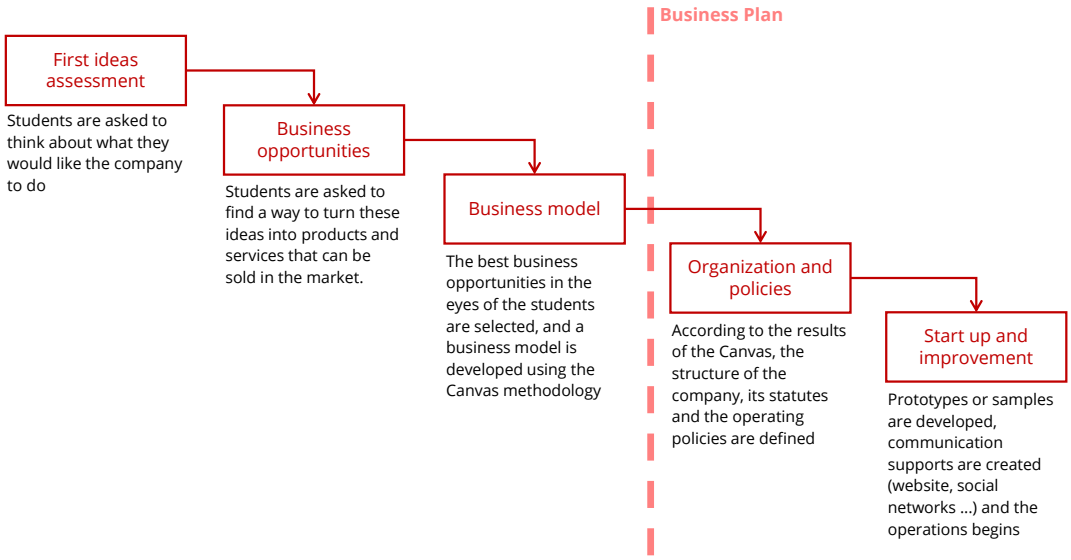
Guidance for finding answers:

The prices that the student set will be decisive for the income obtained. The prices may be paid with postponement or in cash, in one or more instalments, they may be fixed or negotiable prices, paid for use, time, unit, etc., which it is essential to define prior each sale.

In the same way, the payment methods can influence the purchase decision (payment in cash, by card, using PayPal...).

These decisions are important because they will influence both the purchase decision of the potential clientele and the ability to generate income at the time it is needed to sustain the cost structure.

10.5 The general process for undertaking



Overview of the undertaking process

Is an undertaking person born or made? Although there are people who have an entrepreneurial attitude, these attitudes can be learned and improved, and are useful in life, not only when carrying out business projects.

When we talk about what does it take to undertake, some issues came to mind:

- **Motivation is better than necessity.**

If the person has the motivation to undertake, he or she will be on the lookout for new opportunities for starting his or her own business, and their effort and dedication will be focused 100% on the project. On the other hand, if the person undertakes out of necessity (because he or she sees no other option to be able to achieve an income), his or her mind will not be focused on developing the project, but on finding alternative sources that, with greater security and less risk, allow him or her to get a salary.

- **Entrepreneurial attitude.**

  Having an entrepreneurial attitude is essential to launch an undertaking project. This attitude, like any other, can be trained and acquired, and ensures that the person takes a proactive approach towards achieving their goals. We will see it more in detail below.

- **An idea? no, a business opportunity.**

  Wrongly, it is often thought that the first thing a person needs to start an undertaking project is to have a good idea, but this is not true: what the person needs is to identify a business opportunity, an idea that has the possibility of a real projection in the market.

- **A plan.**

  It is essential, when launching an undertaking project, to have a clearly established plan to know where you want to go and what path you want to follow to get there.

- **Set limits (red lines).**

  It is also important to set limits in advance, to think calmly and without the stress of the moment to establish the red lines that should not be exceeded under any circumstance, and that will determine the moment in which the project should be abandoned if the adequate results are not achieved.

- **Find the right people for the trip.**

  When starting a company, it is very difficult for a single person to know everything necessary for management, and at the same time be able to carry out all the

necessary activities to take care of everything in the business. Therefore, it is always good to find other people with whom to share the project, and who can contribute with other resources and skills.

Once this scenario is established, it is time to start working on developing the process.

I. Idea vs business opportunity

- Can it be materialized and sold?
- Is there anyone willing to pay for it?
- Are there enough potential customers in our market?
- Will we have competitors?
- What are we going to do differently from them?
- How are we going to reach customers?

II. The business model (value)

- Focused on clearly defined target customers.
- Identify characteristics that matter to them (significant).
- Know what the competition offers.
- Define the value in terms that the customer understands.
- Build the competitive edge.
- Establish channels to communicate value.
- Open communication channels with customers.

III. Complete the business plan

The business model is just a static first approach. Before starting, a more detailed and dynamic analysis in required:

- Market analysis (market volume, consumers, suppliers, competitors...).

- Business plan (market segmentation, products offer, prices, advertising and communication...).
- Organization (facilities, production equipment, layout...).
- Human resources plan (job profiles, training, experience, categories, salary...).
- Legal aspects (company creation procedures, relations between shareholders, taxes...).
- Economic and financial analysis (estimate of income, estimate of expenses, sources of financing...).
- Conclusion on feasibility.

IV. Starting up

- Balancing available resources with needs.
- Forecast financing and cash needs.
- Follow the plan outlined.
- Communique.
- Built identity, relationships and competitive edge.
- Respect the limits set.
- Measure and improve.

10.5.1 How to work with your students

According to our experience, these are the key tips to create a students' company as described:

Combine theory and practice, so the new entrepreneurial concepts learned are put into practice immediately, facilitating their understanding and assimilation, making the sessions more engaging, entertaining, and motivating for students. Combining theory with practice allows the students to internalize the entrepreneurial concepts and experiment with them.

Follow the real process and steps sequence needed for creating a real company as the storyline, so coherence is maintained in the development of the topics all throughout the course, and the students understand when each activity should be developed in the process.

Always maintain a flexible approach in relation to the time spent on the project in the classroom, to avoid generating stress in the students at specific times (exams periods, academic obligations…). In this way, anxiety or stress among students is avoided, creating a better learning environment, and achieving a better perception of the project and its objectives.

Space the sessions to allow the students to work in a coordinated way on their own, fitting the activity with others they may have (for example, dedicating an hour of class every week as general rule, and adapting according to the status of the project and the needs and circumstances of the students). It is important that they can dedicate time to the activities by themselves, so they can learn by doing, and the result they achieve is felt as their own.

Anyway, it is important to maintain permanent contact with the leaders of the different groups of students, to ensure that they progress at the expected rate, and establish communication channels so that they can solve any problem as soon as it arises.

10.6 Proposal of CPS on entrepreneurship and economy

There are some questions that must be addressed to focus the CPS approach at each school.

I. Age of students.

According to the age of the students with whom you are going to work, you can select one approach or another in the CPS to implement: the older they are, the more complex can be both the project and the concepts to work with; while if the students are younger, the workshop approach, with the introduction of fewer new and simpler concepts, would be recommended.

II. Time constraints.

Another important issue to consider when selecting the ideal CPS to work with is time constraints: at what point in the course does it start? Is there enough time left to develop the CPS in a way that does not stress students due to lack of time? Are there vacation periods or exams?

III. Academic obligations.

As students advance in their education, and the closer they get to the end of their training at school, academic obligations take on a greater role to the extent that they can condition the continuation of their academic life (especially for those students who prepare their access to the university). Therefore, in these circumstances, the time available to devote to the SCP project is also limited, and this must be taken into account when selecting the type of project to work with.

10.6.1 Different approaches proposed

I. As a workshop

As a workshop (or series of workshops), with the following methodology:

1. Explain the general undertaking process and the CPS methodology to students.
2. Present the topic they are going to work on.
3. Divide students into groups.
4. Let each group work on the problem with the defined methodology, going through every step, asking them to write down their conclusions.
5. At the end of the session, each group will present their main results from each phase, and these will be discussed among all groups (each group will focus on the different or more original results in relation to those already presented).
6. Among all the groups, the best of the solutions presented will be selected by consensus.

I.A. Shopping basket

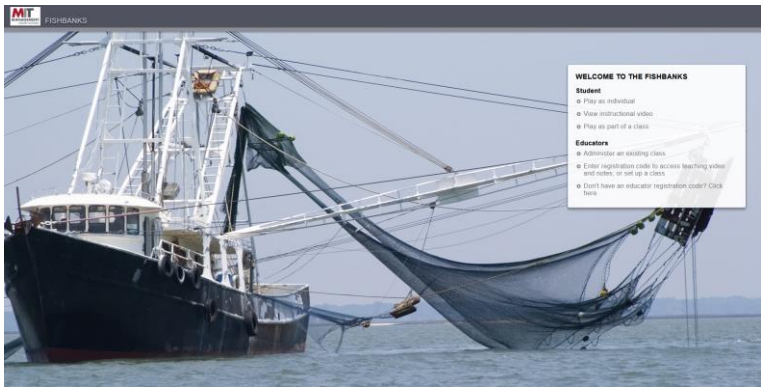
1. Chose a basic but complete shopping list.
2. Divide students into groups.
3. Let each group look for prices for the products (can be done online or by going to actual shops). They should look for the cheaper version and the most expensive version of each product.
4. They should try to find out what explains the price difference by several means (own research, interviews with adults in their households…).
5. Each group will present their results, and these will be discussed among all groups. If possible, it should be discussed between international teams, to see the differences in prices for the same product in different countries, and they should try to find out why the differences.
6. They can make their virtual supermarket using VR tools, with the conclusions of their work.

Steps:

1. Define a shopping basket that is healthy (research aspects related to nutrition).
2. Research on the origin of the products and the carbon footprint of their distribution (production process and logistics).
3. Create a virtual supermarket reflecting the information collected and highlighting local products.
4. Finally choose:
    - The healthiest.
    - The most attainable.
    - The one with the lowest carbon footprint.
    - The one preferred overall.

I.B. Fishbanks

Fishbanks is a business simulator of a fishing fleet. Students must manage their fleets to obtain the greatest possible benefit over time. It requires registration, but is free for educational centers.



Fishbank simulator

Click on or scan code to access Fishbanks simulator

When using the simulator, students will focus on making each campaign as profitable as possible. By doing so, in a few years they will see that there are no longer enough fish to continue the activity, due to the overexploitation of resources.

In this way, students learn the need to develop sustainable activities, and to think about obtaining benefits in the long term instead of focusing on maximizing benefits in the short term.

Steps:

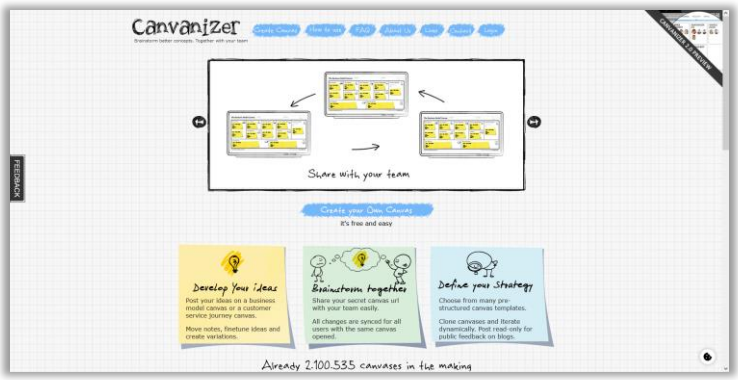
1. Ask teams to organize their fleets to maximize profits using the Fishbanks simulator.
2. At the end of the game, discuss the results obtained and why.
3. Carry out a new campaign using what was learned in the previous one.
4. Compare the results and draw conclusions.

It is highly recommended that a previous simulation is carried out by the teachers, in order to get more confidence with the tool.

There is an instructional video available on the Fishbank simulator webpage.

I.C. Business Model Canvas

Students will be required to create the business model for a business project using the Canvas methodology. To make their filling work easier and to share it with the rest of the groups, the use of the Canvanizer tool is recommended.



Click on or scan code to access canvanizer.com

Steps:

1. Explain the questions that must be answered in each section of the canvas and the order to cover it.
2. Give students the possibility to decide the activity they want to make the canvas about.
3. Introduce the Canvanizer application so they can build their business model.
4. Once they complete their proposal, each group will exchange its canvas with other team (in pairs) and will try to improve it.
5. At the end, the groups that have exchanged Canvas meet to discuss their assessments.

II. As a project

1. Explain the undertaking process and the CPS methodology to students.
2. Divide them into groups.
3. Each group must create a company following the methodology of the undertaking process, facing the different challenges that arise in each stage using CPS, until they produce and sell their products. General criteria of interest to the curriculum can be defined by the teacher to define the activities of the companies (based on sustainability, recycling, circular economy ...).
4. Each work session will focus on a specific aspect of the undertaking process, and the session will begin with a brief theoretical explanation on that aspect, followed by group work.
5. When reaching a project milestone, each group will present the main results from its work, and these will be discussed among all groups to try to identify improvements.

11 CPS implemented by the schools

The schools worked in two teams to implement the designed CPS:

TEAM 1	
new wave federation Shacklewell Primary School [United Kingdom]	CEIP PLURILINGÜE RÍA DO BURGO CEIP Plurilingüe Ría do Burgo [Spain]
Examples of CPS the work together in:	
STEM CPS [learn more]	STEM practices [learn more]

TEAM 2	
COLEGIO PADRE FEIJOO - ZORELLE OURENSE CPR Padre Feijoo –Zorelle [Spain]	AGRUPAMENTO DE ESCOLAS DE BARCELOS EDUCAÇÃO PÚBLICA DE QUALIDADE Agrupamento de Escolas de Barcelos [Portugal]
Examples of CPS the work together in:	
Virtual School library [learn more]	DPS digital tools [learn more]
Evidence of digital tools [learn more]	

12 The courses

A face-to-face CPD course for teachers to learn the use digital technology and remote teaching across the project topics Teachers were able to design CPS on four basic areas Personal, Cultural heritage, STEM and Economy, analyse and develop innovative pedagogy and assessment approaches and methods to support these diverse collaborative learning pathways in order to help learners to acquire knowledge, skills, working in classes two by two.

Another virtual courses will be implemented in May, the 2nd year, this will be virtual course to explore digital technology and remote teaching across the project topics, The

two courses once tested will then be developed into "open online course" on the project website.

12.1 Trainer's feedback from the Pilot

This section reflects on the lessons learned by teachers from the pilot, based on feedback and observations from each partner organisation recorded with support of Westcountry Schools Trust.

12.1.1 Strengths

- **Course Platform.**

  From the perspectives of course development and course delivery, the Aula CESGA was created by ATLME, AEPI Sabón and the USC. The ability to create learning paths with a variety of embedded content facilitated a rich course environment combined with a number of interactive tools. The platform's ease of navigation allowed participants to move through the content requiring minimal technical support. The good side is that can be used as an online course available for general interested teachers and schools.

- **Course Methodology.**

  The Learning by Doing methodology proved pragmatic and was widely praised by teachers for its practicality, allowing them quickly introduce learning from the course into their own classroom environments. The platform tools and content fits well with this methodology. Teachers participating, whether they are beginners or advanced users of ICT, will benefit from the course. The main challenge were the first steps, especially for teachers with not so high digital skills level and those who are not familiar with developing and implementing European projects (two schools are beginners in K2 projects).

- **Course Content.**

  Participants found the tools, strategies, theory, and resources available within the course accessible and applicable to collaborative solving problems. The course improved the levels of digital tools competency and technology usage confidence.

The different tools and strategies for teachers to try out allowed them to select those most appropriate to their own and their learner's needs. Teachers of different age groups, various subjects and different levels found the course very useful.

- **Course Tutors.**

  Collaboration between course trainers, schools and teachers was noted as a major strength of the course and facilitated a blended model of learning.

- **Challenges and Areas for Improvement.**

  Opportunities for Interaction between teachers and students. The course needs motivated teachers from different schools and different countries to interact. Communication between teachers from different countries was a very good help and very much innovative and enriching. They had the opportunity to share CPS at international level, by discussing the way of solving problems, contents, methods…

- **Partner Collaboration.**

  The collaboration between schools on developing and implementing the CPS contents and tools, allowed for joined-up thinking and shared workload in order to provide the best possible learning experience for participants and introduce new methods at schools. Teachers collaborate in designing the CPS and finally students from the two classes in different schools and countries presented their innovative solutions. AEPI Sabon provide their expertise in Economics and Entrepreneurship. Two teams solve a CPS and then each team present it to the other, and a different country (the other school) evaluates it. Students can ask questions and interact between schools. After the presentations, the two teams of students debated about how that activity could be improve, while the teacher and university lectures Westcontry Schools Trust evaluate them.

- **Community Building.**

  There is a need to better develop and exploit tools for building and collaboration (see here the European Framework for the Digital Competence of Educators DigCompEdu) and the Apps for self-evaluation implemented at this project. While

the teachers who participated in the course expressed satisfaction about collaborate with their classes and also expressed enthusiasm to interact with other teachers internationally and in partner countries, this was fully realized during the life of the project using the tools available. Teachers could capture ideas to develop their projects through videoconferences. The students also had the opportunity to share experiences from other countries the different ways of learning.

- **Introduction of the course in a face-to-face meeting in Portugal and supported by Webinars.**

  Webinars, specially about the area of economics which was new for them, could be introduced at the initial stages of the course with more support by the AEPI Sabón team. Videoconferencing sessions indicating their timing and topics were provided at the start of the course. Templates and continuous communication contributed to reach the course results (a 2nd round of the training was established in October because it was something new in teacher training).

12.2 The piloting

Teacher training acts as catalyst for the quality of teaching. Learning is most effective when teachers and students work together to achieve a goal (final product). The teacher guides and helps the students and together they achieve a final product, but also the process is very important for students to acquire knowledge, competence skills.

Collaborative work allows students to develop joint systems of understanding with their classmates and with the teacher. The teacher helps to create a common context of experiences within each TWO participant classes. Technology expands the possibilities of pedagogy, but it does not replace it. Current learning should not focus on content but also on the interactions that occur around it. It will be achieved by enhancing the skills of teachers to implement innovative teaching approaches though collaboration between university lecturers, teachers, experts in economy and Digital technology. This fits the priority Strengthening the profiles of the teaching professions.

The project intends an inclusive education "Personal" area (Development, Autonomy, Creativity, Citizenship...) which is at the centre of all activities. The didactic proposals

stimulate students to be creative putting their imagination into practice, offering them opportunities to find intelligent solutions. Students, while achieve knowledge, acquire skills of self-directed and self-disciplined learners, fosters personal autonomy; within the process of human growth.

The priority supporting individuals in acquiring and developing basic skills and key competences, the project aims to train students to be active citizens, able to act at social levels. We must train students to be critical thinkers, who know how to make decisions, participate in debates, and know how to propose solutions, ... Students will have the opportunity to use Digital Technology and actively and creatively find innovative solutions.

In a global economy, entrepreneurs look for that boost inquisitiveness, to bring information and new ways to find solutions to a problem. In consideration of the importance of creativity and innovation in the application of entrepreneurship and economy will be very present throughout this project

In order to implement quality and efficiency, the methodology put classes work two by two from two different countries. They designed together a collaborative solving problem (CPS) on the same topic. There is a process of discovering a problem, analysing evidence and then designing, developing and delivering innovative solutions, It will be transmitted by streaming to participant classes.

The training was done on 4 areas.

Cultural Heritage is very important in our lives. Therefore, we must explore the opportunities that technology / science provides to improve the quality of teaching. Students had the possibility of taking virtual routes (virtual reality) or studying monuments in detail with AR or Apps. Cultural Heritage is an expression of ways of life developed by a community and transmitted from generation to generation, thus helping students to deepen the acquisition and development of basic skills and key competencies.

Collaborative activity and discourse (between teacher and students who work collaboratively) facilitate a high level of knowledge transmission; Together they will use "science practice" ideas to solve real world problems. Science education requires students to operate at three dimensions of learning: Science and Engineering Practices, transversal concepts, and area knowledge.

The USC, Westcountry Schools Trust, AEPI Sabón and ATLME produce the CPD course face-to-face that was implemented the first year in May, the 2nd year will be implemented online and then will be published on the web as an open online course. Teachers were training on innovative ways of using digital tools, for active, learning. Universities and experts will train teachers to design CPS on four basic areas: Personal, Cultural heritage, STEM and Economy using emergent tools like virtual reality, augmented and Virtual reality and 360º film.

Target groups are teachers, university lecturers, advisors, decision makers.

The development course was divided into 4 main phases as follows:

- **Stage 1. Needs Analysis, Planning and Scoping the Project**
  - → Assessment of existing resources, etc. and gathering different resources.
  - → Researching content for the course.
  - → Video production.
  - → Production of VR/AR animations and electronic learning interactions.
  - → Production of audio materials and video materials.
  - → Testing the materials and interactions with a target group of learners.
  - → Gaining feedback on resources developed.
  - → Integration of the course materials into the virtual learning platform.
- **Stage 2. Production of the online course.**
- **Stage 3 – Piloting (learning by evidence).**
- **Stage 4 - Testing, trials and revising the teachers' course.**
  - → Testing and evaluation of the course by learners and Westcountry School Trust.
  - → Course revisions.

USC is responsible of two basic areas: Personal and Cultural heritage. They will use VR/ RA , Apps... we have a lot of experience in it using different tools and students can produce

works for other students to learn though VR glasses. Students have to do activities like answer questions.

ATLME implemented the CDP related to STEM. All areas will be interconnected so the collaboration between trainers and teachers It will be periodic and will be done by videoconference.

The course will explore the improvement of opportunities technology/science providers to improve the quality of our lives, how it enhances our education/business and how it helps to preserve our cultural heritage, not only manifested through tangible forms such buildings or landscapes but also through intangible such as values, traditions, oral history.

We explore the theme STEAM (Science, Technology, Engineering, Arts and Maths), and the areas of Personal Development and Economy. What does it mean to be entrepreneur? Key components of the competence profile of an entrepreneur person: leadership and motivation, strategic vision, change management ...

The teacher presents to the students a question and they have to show through research work the evidence found and how the lead to conclusions.

Teachers will learn to building a prototype and with its help students would formulate hypothesis and reach to evidences and solutions (students also learn to build prototype).

AEPI Sabón will lead the area of Economy and Entrepreneurship. Their role was focused on social entrepreneurship; problems arise in the local community and students seek innovative solutions. While students acquire knowledge, they are developing personal and entrepreneurial competencies and Economy abilities.

To learn about economics students have different engaging activities e,g. simulation where participants play the role of sailors / shipowners, buying and selling and building boats, deciding where to fish considering the variation of the fish population and where they can consider the application of permits or quotas. The activity is not purely business decisions, it is an opportunity to work on the sustainable management of resources.

Teachers will take part in the training, then will get the support of the universities and experts to design the CPS. So the role of the school teachers will be learn to design CPS using emergent tools like VR/ AR , and learning design.

Piloting is putting the knowledge into practices, de ability to creating CPS to stimulate student to learn. Westcountry Schools Trust also leads evaluation.

Once teachers did the training with the support of university lecturers and experts to develop CPS on the Personal area, Cultural Heritage, STEM and Economy, all using digital tools.

Teachers learned to design them in two classes from different countries with the help of university lecturers or /an experts according to the subject they want to do. In the training, each teacher class can prepare as many CPS as they can, but they will prepare CPS in remote. The two teachers from two different countries agree on a topic and request help from an expert or a university lecturer.

Students and teachers can meet virtually.

Students from two classes will present a CPS and will apply the evaluation criteria, students do the self-assessment, and the students not involved in the presentation will be able to indicate how they could improve; in what they think would be good; what they have learned.

Westcountry Schools Trust also will do the pilot evaluation.

Lecturers and experts will contribute to the evaluation actions and national reports. Westcountry Schools Trust is responsible for final report of the piloting.

12.2.1 About Schools Piloting

How do we get the most of the school's teachers involved in the project?

At Padre Zorelle Plurilingual CPR, we have been working on the DTICEQT project for two years. This project allowed us to deepen in the Collaborative Problem Solving methodology in Compulsory Secondary Education and improve the academic performance of students in 1st and 2nd ESO.

Methodological innovation and the implementation of project-based learning is part of our school's educational plan and for this reason, we try to involve all the teaching staff of the levels involved in the project.

In the first year of ESO, we work from the subjects of Geography and History, Ethical Values and English. Besides, in the second year of ESO, we tried to get all the teaching staff involved in the implementation of the project: we organized an initial meeting to launch the proposal. After that first contact, we held a training session at the school in which we introduced the teachers to the CPS methodology, introducing all teachers in the school to the basic elements of it (teamwork, development of key skills, formative assessment, etc.). We also presented developed CPS examples in the first year of secondary school so the teachers got familiar about how to put into practice didactic units based on that plan.

At an organizational level, we decided that every month, in the two groups at the 2nd ESO level, a didactic unit would be implemented from a specific subject, and we created an implementation schedule.

To monitor the project, we hold weekly meetings where we shared experiences, questions, and results. The CPSs products were shared with AEB Barcelos and we did a videoconference with two classes (one from AEB Barcelos and one form Padre Feijoo) about the CPS, then it was sent to the project coordinator and uploaded to the project's Teams folder.

At the same time, we carried out trainings in other schools in the province where we had the opportunity to present the project we are involved in and, as a result, we were asked to teach a specific course on Collaborative Problem Solving at IES Taboada Chivite de Verín. This way, we achieved that the impact of the project was greater and that it was not only located in our school but that we became agents of transmission and dissemination of the project objectives and results.

12.2.2 How do we integrate classroom activities in the curricula?

The classroom activities were integrated in the curricula in several ways: introducing the topic to be discussed through a question about it to make the students reflect, watching extracts of videos that had to do with the chosen topic or some simple activity that allowed the students to come into contact with the subject to be discussed for the first time.

Once the first contact had been made, the next step was a brainstorming session in which the class shared their previous knowledge on that topic to later contribute with ideas on

how they could search for information, what content was the most important and how to distribute the work of the activities they carried out in teams and do it collaboratively to reach their solution. The CPS became the teaching method at school lessons, in our opinion.

It was very much innovative because teachers were motivated and worked collaboratively with other teachers at the own school and students were very much motivated and engage in the learning process.

13 APPs created

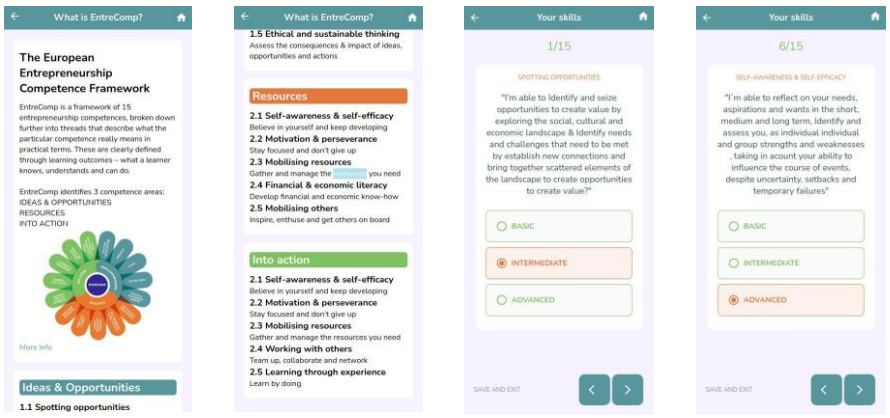
As a result of the project, two mobile applications were developed to help teachers, and anyone engaged in education to self-evaluate their skills in the competences related to the EntreComp (entrepreneurship) and STEM Frameworks.

Both apps can be installed in multiple systems: Android, Windows, Linux, macOS, and are installable from the web browser, so no app store needed.

13.1 EntreComp self-evaluation app

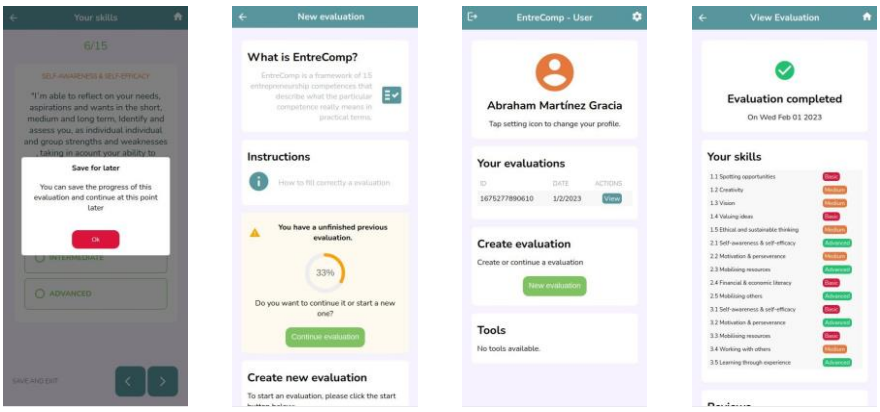
EntreComp App was created as a tool to allow users to create self-evaluations based on The European Entrepreneurship Competence Framework.

The App will guide the users through the 15 competences of the framework, helping them to measure their competences in entrepreneurship. Users can select 3 different Skill Levels for each competence: Basic, Intermediate and Advanced.



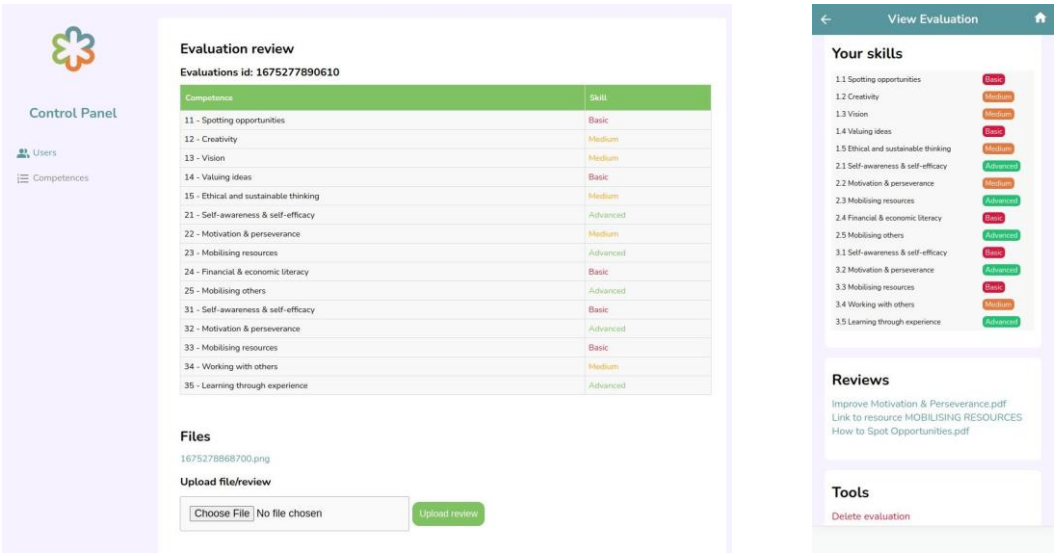
Different views of the EntreComp app.

The app also let users to save the evaluation progress at any point and continue with the evaluation later on. Once an evaluation is finished, it will be saved in the user's main screen. Users can review at any time. User can also edit and delete all their evaluations.



Progress of the assessment in the EntreComp App.

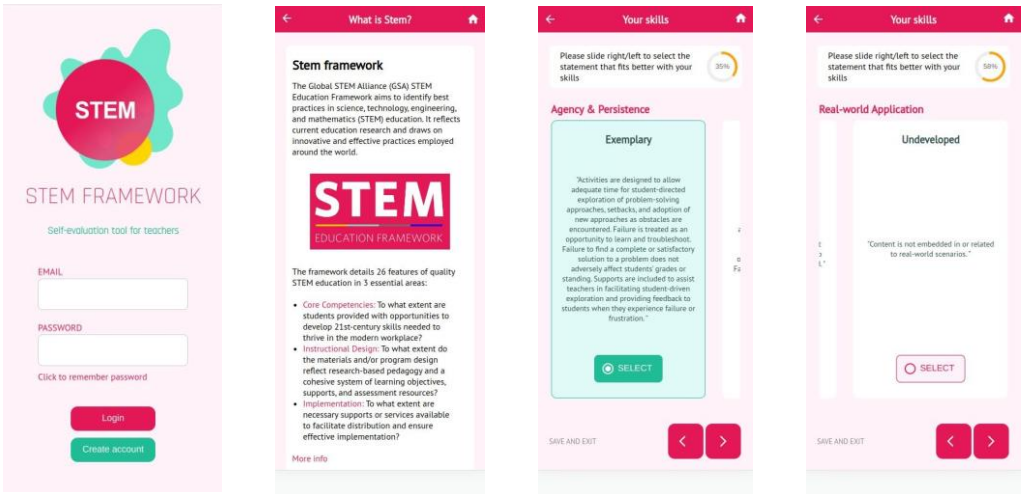
The evaluation is also saved in the cloud in a private Control Panel that allow the reviewers (usually teachers of teachers) to view the user skills. Reviewers can attach multiple resources to the evaluation that can help users to improve their knowledge in different competences. Those resources will be shown in the user's evaluation page in the mobile app. They just have to click on any resource to open it.



Cloud version (on the left) and resources shown to the user (right)

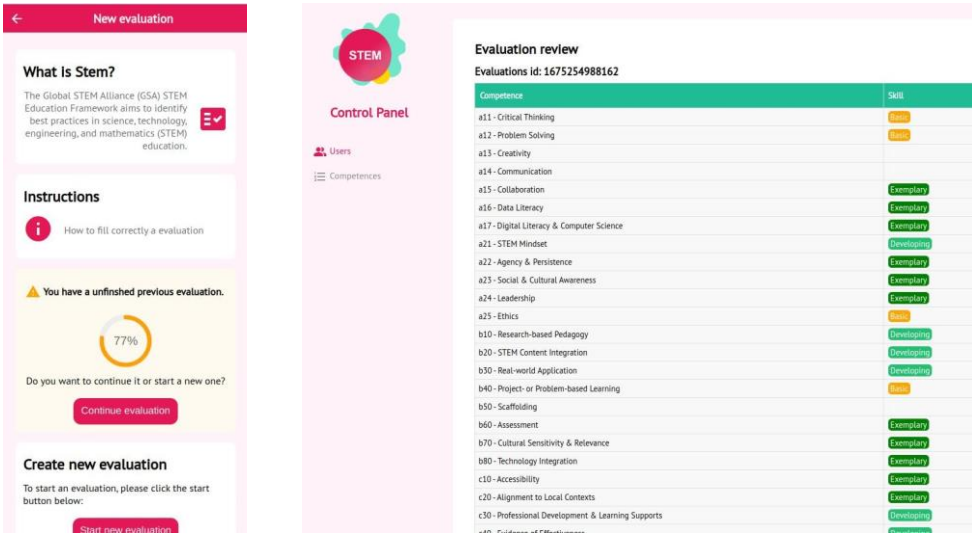
13.2 STEM Self Evaluation App

The STEM App works in a very similar way, allowing the users to self-evaluate their skills in the 26 competences of The Global STEM Alliance (GSA) STEM Education Framework. Users can browse all the competences in the framework and select the skill they have for that competence, choosing between Exemplary, Developing, Basic or Undeveloped.



Different views of the STEM self-evaluation app

As in the EntreComp app, users can save the progress at any time and continue with the evaluation later on. Users can create multiple evaluations, but only one at a time. They need to finish the previous one before creating a new one.



Progress of the evaluation (left) and private control panel.

Reviewers also have a private Control Panel that allow them to view all the created evaluations and send resources to help users to improve their skills.

14 Feedback and evaluation

14.1 Project Evaluation Tools

The two courses (one face-to-face, and the other online) will be evaluated vía questionnaires developed using online tools (e.g., survey monkey,) analysis and through focus group interviews during the training events. We will assess the quality of the event as a whole (planning, timing, activities, quality and impact of the tools, methodology and contents) as well as the CPD course contents. During the training event we will assess the quality of the event as a whole, including organizational aspects as well as the quality and satisfaction with the CPD course.

The project coordinator will discuss the results of the evaluation at the planned online meetings about the tools used, and it must include assure an excellent communication to work remotely will evaluate the 4 CPS each group of two classes implements during each year. Students will find during the activity and innovative solution to CPS. In this activity they will present their research work and conclusions to a class. This will be evaluated by other two classes and students will do self-assessment (rubrics, answer, questions), the teacher and university lecturer will assess it too, and also the ePortfolio in which some partners have wide experience.

The CPS will be evaluated by Westcountry Schools Trust but all partners will participate.

The four Intellectual Outputs of the project:

- CPD Course.
- Piloting.
- Multimedia Guide.
- APP For Teachers skills.

A face-to-face CPD course for teachers to explore digital technology and remote teaching across the project topics. Teachers will be able to design CPS on four basic areas in order to help learners to acquire knowledge, skills, working in classes two by two.

Another virtual course will be implemented in May, the 2nd year, CPD explore digital technology and remote teaching across the project topics, The two courses once tested will then be developed into "open online course" on the project website.

To evaluate course will do questionnaires online, interview to teachers, field notes, analyse the products… the project coordinators will discuss the results of the evaluation in a virtual meeting after the piloting to take decisions for the 2nd year.

The Multimedia Guide with resources any teacher can use in their classes, an App including all skills a teacher must archive. Each output will be evaluated differently and will make use of a wide range of methods like video cases, questionnaires, number of teachers that are interested in the tools,…

eTwinning: the activities that students and teachers share in eTwinnig were not successful due to the change in the platform.

The project evaluated the website and the platform for teacher training.

The project management was also assessed, to do that Westcountry Schools Trust will design a quality plan and report.

Partners evaluated the planned meetings, face-to-face and online .

15 Evaluation of the piloting

DTiCEQT Erasmus Project. CPS Evaluation for September 2022.

I. CPS modules.

- Peace Pigeon: b.nieto.ou@gmail.com or migilfr@gmail.com
- Podcast – vicentemh@gmail.com
- Partners - DTICEQT PROJECT

II. Purpose.

The project aim is to implement a global and sustainable plan for distance learning strategies between schools; Two classes from different countries, interactively, deal with collaborative problem solving (CPS) which have been previously designed by the teachers of both classes. Students though videoconference will explain how problems have been solved in each country.

The project aim is nourished by the three interconnected terms: **Imagination, Creativity, Innovation**; creativity being the centre of all disciplines.

Schools implement CPS on peace, robotics, and podcast creation

III. Design/methodology/approach.

The nature and duration of this short project lends itself to an evaluative model based on qualitative data (Shadish et al, 1991). The methods used to collect data include focus groups, observations, formative self-evaluative elements and student voice and as the project is focusing on digital skills some digital evaluations have been included. A mixed method approach has been chosen to gather as much information as possible to enable reasonable insights to be drawn.

This evaluation used qualitative methods of data collection in the form of Teacher questionnaires and student voice. The data collection method analysed online CPS Teacher forms from both the Peace Pigeon and Podcast project using simple questions to assess teacher's views and opinion of CPS and the Erasmus Project in general rather than each CPS specifically. In addition, an online videoconference was arranged for students of

the Peace project and Podcast project the students were facilitated by their teachers and interviewed by Dan Rogerson of the Learning Institute, West country Schools Trust. Students were asked questions in English the intention and purpose of the questions were aimed at establishing views from the students in relation to using the Collaborative Problem Solving (CPS) approach (Cohen, 1994). In addition to the above mentioned collection of data, a second set of questions were designed and sent out to CEIP PLURILINGÜE RÍA DO BURGO and in order to gather some additional data regarding the selection and procedure of the sample used for the Peace Pigeon and Podcast, gratefully responses from RCP PADRE FEIJOO-ZORELLE were received.

Throughout the Erasmus+ Digital Technology, Imagination, Creativity and Entrepreneurship for a High Quality Teaching (DTiCEQT) project, the Learning Institute WeST (Westcountry Schools Trust), offers protection, security, confidentiality and anonymity at all times in accordance to BERA, 2018 (British Education Research Association) guidelines, alongside this adherence and procedures implement the General Data Protection Regulation (GDPR UK) relating directly to the collection, storage and use of personal data used for the purpose of this project.

IV. Abbreviations.

Data has been collected from two out of four schools involved within the project these being RCP PADRE FEIJOO-ZORELLE and CEIP PLURILINGÜE RÍA DO BURGO. Throughout this evaluation when discussing individual school's acronyms will be used for each, RCP PADRE FEIJOO-ZORELLE School will be referred to as PFZ and CEIP PLURILINGÜE RÍA DO BURGO School as PdB. The children who were involved within the project will be addressed as students throughout the report. Evidence from Teacher questionnaires and student voice will use italics and quotations to indicate the use of data.

V. Evaluation.

Across both schools the students who engaged in the project, were aged between 10 -13 years of age. This is an appropriate **project** for the **age** of these students during their adolescent's stage of development, if Erikson (1982) Identity vs Role stages of development are to be considered, in that, this is a time when children are becoming more independent, and begin to look at the future in terms of career, relationships,

families and how 'they' as individuals want to **belong to a society and fit in**, whilst searching for a **sense of self and personal identity**, through an intense exploration of personal values, beliefs, and goals. With the analysis of the **data** collected, evidence seems to suggest that the podcast and the peace pigeon project have been successful given the words of the students and teacher feedback…

*'The children felt that they had learned about how to **work in groups** and about their **fellow students**' ways of working together (PFZ)"Students who worked on the Podcast felt that they had learnt how to **plan** and create a **business**, they felt that they **learned new skills** in doing so (RdB).'*

*'For Peace Pigeon students, by exploring their knowledge of **Peace Day** teachers felt that students developed their understanding of why it was so important as '**humans**' to have this day.'*

*'For Podcast students, it was felt that the use of virtual reality was felt to be a valuable asset in providing students with the **opportunity** to appreciate their cultural heritage.'*

The duration of project was 4 weeks long and the sample size of a least 4 students for the podcast and peace pigeon project was comparable for both schools, whilst it is known to be advantages to work amongst a group and promote **agency** (Bandura 1989) **belonging** to a group as in this case for four weeks, is also described as valuable in having a '**core social motive**' in that children seek to form and maintain bonds as actively engaging in the world around them, it involves thinking about how children do this and in particular, how they construct themselves as subjects in a way in which exerts **influence** on the world around them, both **individually** and **collectively**. Data in the form of student's voice from evaluations, highlights a sense of **agency within the students** and the effectiveness and benefit from the **collaborative problem-solving (CPS)** approach used within the projects, in accordance with the OECD, (2013) who highlight the benefits of CPS having the capacity for children to effectively engage in a process whereby two or more agents attempt to solve a problem by sharing the understanding and effort required to come to a solution and pooling their knowledge, skills and efforts to reach that solution…

'In using the CPS approach in general, participants felt that it improved their ability to work together, increased confidence with digital equipment, gave them the chance to use online project management approaches so that people could contribute at different times' (PFZ).

'They gained skills in using some software and also gained increased confidence in talking in public.'

Students enjoyed researching information to be enjoyable, but they found it difficult to determine what to use when they encountered conflicting evidence.

When asked how successful the project had been and for ideas on how it could be improved, they said that they felt it was very successful, they were happy with their work. (RdB)

While successful the project would have been better if it had been extended and that more powerful computers would have made it easier. (PFZ)

A subtle difference from the analysis of data from the schools appeared in how often student's attended their activity, the PRBS students met once a week for an hour and a half whilst the students from PFZS meet three times a week in the morning and had open access online any time of day. This **freedom**, **flexibility** and **opportunity** for students to make choices and direct their own learning, aligns with the goals of the DTiCEQT programme, in that an intension was to try to promote **innovative** and efficient learning for students based on **creative** and **active pedagogies** (Prilleltensky, 2010), **implementing digital technologies** in each curricular area in a creative way, creating creative and playful learning environments that foster imaginative solutions, collaboration, innovation and entrepreneurship facilitated by technologies by **discovering a problem, looking for evidence, and selecting innovative solutions thus** encouraging students to be **protagonists** of their own learning using software and modern technologies thus minimising school failure, something that has been revealed an essential goal for schools after the health crisis of COVID-19. In addition to students being protagonist, autonomy plays a part with these projects, the data highlights this… as

*'Both CPS focuses included work on **establishing** a business' and the "Peace Pigeon" project saw children creating a **product**.*

*'They looked at **costs**, **budgeting** and working with **partners**.*

*They found this to be **fun** and **interesting** as they had not encountered this in their school career before (PFZ).*

*In **recording** and **editing** their podcasts, students used recording equipment, editing software and experienced a studio environment (RdB and PFZ).*

In other **CPS work** on virtual reality, both schools had made use of related technology including virtual spaces, virtual libraries and virtual reality robotics.

And finally, analysing data evidence via the school's creation of online platforms, such a Twitter, Instagram a YOU-Tube channel and Facebook, it is clear within both project that students have shared ideas and produced a final article with the production and the process of using **PCS** to establish this. To my mind this is an excellent example of shared **Social capital** (Putnam, 1993, 2000) (Savage and Kanazawa 2002, 2004) (Bourdieu,1992) amongst the students. Within the process of **bonding, bridging and linking social capital**, which refers to relationships within or between homogeneous groups to establish **collaboration**, the process has involved the effective functioning of social groups in this case the students, who have, through interpersonal relationships demonstrated a **shared sense of identity, shared understanding, shared norms, shared values, trust, cooperation, and reciprocity** (Bandura 1989). Social capital is a measure of the value of these resources, both tangible (the product) and intangible (the emotional and social benefit) to students, and the impact that ideal creators have on the **resources involved in each relationship, and on larger groups** in this case the school communities and education organisation in training teachers to facilitate **digital skills** and promote **new** innovative methods of student collaboration using a **CPS** model. Students narrative highlight the benefits of this…

'Students understood that there had been a science and technology focus. They found designing their product and using the 3D printer to be very interesting (PFZ).'

'In recording and editing their podcasts, students used recording equipment, editing software and experienced a studio environment (RdB and PFZ).'

'In other CPS work on virtual reality, both schools had made use of related technology including virtual spaces, virtual libraries and virtual reality robotics.'

Building social capital has positive consequences on the lives of our students and school communities. It is increasingly imperative that we concentrate on relationship-building in our school environments. The efforts schools make to form and strengthen relationships will help all students, regardless of race or social emotional status, flourish throughout their academic careers and beyond. In addition, **Well-being** (Ryffs 2018) factors consist of having **positive emotion, being engaged** in an activity having **good relationships** with other people, finding **meaning** in one life and a **sense of accomplishment** in the pursuit of one's **goals self-efficacy goal representation anticipated outcomes, confidence and a sense of self**, again data highlights this contribution…

'Other children felt that their learning had given them a greater understanding of mental health issues and made them feel greater empathy for others (RdB)'.

'Learning in one project covered monuments around the world and the lives of some famous women including Marie Curie and first women in space (RdB)'

'There was research and discussion about cultures across Europe. One student reflected that current culture is often focused around the use of digital technology and that this is future cultural heritage in the making (PFZ)'

In contrast, students with low social capital may not even know how to try out for a team or when a club or activity meets. Which highlights a slight difference within the data collected whereby one school included a child with SEND and another did not, if we are

to have true representation of equality and inclusion as the DTiCEQT project aim intends diversity and inclusion is necessary so all students can participate and engage with projects. As mental health problems are a major risk factor for early social exclusion (Bäckman and Nilsson 2011).

Students with low social capital are considered by some as lower achieving. They can be mistaken for those who keep to themselves and show more signs that resemble depression. When they encounter a challenge, they are afraid to ask for help, exert less effort, and give up more quickly than their classmates who have stronger social capital Prilleltensky, (2010).

"Unless we care about the fate of the collective, the necessary structures to promote personal and relational wellness will not be in place" (Prilleltensky 2010: 240)

VI. Limitations and suggests for future projects.

- The inclusion of more schools undertaking part in the project.
- Consider a measurement of impact before and after engagement in project.
- Inclusion of student's voice regarding impact upon personal wellbeing.
- Include a diverse and inclusive sample.

16 Conclusions and recommendations

- A Multimedia Guide for good practice examples and guidelines on implementation "Promoting a holistic education of young people through creative and innovative CPS".
- Partners will produce a guide which will include project results and lessons learnt.
- The Guide will include conclusions on how to enhance innovations from experimentation.

- Creating a problem-solving culture in a classroom means to encourage and prompt students to think a little differently and systematically, in order to generate the problem's solution.
- Activities which reinforce and complement the cooperation with virtual mobility (provides powerful opportunities for international collaboration) between schools and other institutions (universities and experts, ...) turning schools into broader learning communities in order to implement education and training of professionals to meet challenges of excellence, equity, diversity and inclusion in the school environment.
- The project is focused on four areas Personal Skills, Cultural heritage, STEM and Economy.
- "Personal" area (Development, Autonomy, Creativity, Citizenship, Civic, ...) is at the centre of all activities. The didactic proposals stimulate students to be creative putting their imagination into practice, offering them opportunities to find intelligent solutions. The student, while achieve knowledge, acquire skills of self-directed and self-disciplined learners, fosters personal autonomy; within the process of human growth, we will promote behaviours or customs that directly affect optimal personal development as a citizen. The project also prepares students to acquire public speaking skills with the conviction that effective communication makes any activity easier; this competence is also achievable through practice; speaking in public is considered a relevant competence nowadays.
- Teachers will make didactic proposals based on collaborative solving problems (CPS) where the subjects will be interconnected; once the subject has been agreed upon by university researchers; The teachers two by two (one class from each country) will give you the most innovative approach they consider. The CPS will be piloted in two classes that will interact through video conference: Asking questions, looking for imaginative solutions together, ... Once the (CPS) is completed, the teachers analyse together with the evaluators how it can be improved.

- To work cultural heritage students use Virtual Reality and Augmented Reality. It involves getting students to do a significant amount of research and data collection, organize the information they gathered, and decide how to best present it in narrated or written format, video, VR... The final product is a good way for students to achieve in their learning they will have the opportunity to communicate innovative results, what they have learn... Communication results are a fun and easy way to get students to connect to the material studied in class, in any grade or area ,... all this to show what they have achieve during the learning process.

- STEM: We, will follow the eight Science Framework for K-12 Science Education identifies as essential: asking questions and defining problems, Developing and using models, Planning and carrying out investigations, Analysing and interpreting data, Engaging in argument from evidence, We plan to do prototypes using 3D printing and do scientific investigation based on a question, students do research works to problem solving.

- The project aims are students to explore and acquire a culture based on entrepreneurship and economic-financial because of the multiplier effect that education has in these ages, a financial education in secondary school is positive for society. Different international organizations, such as the OECD, the IMF or the World Bank, have long recommended the introduction and promotion of economy subjects in schools. Create playful environments that foster creativity, collaboration and entrepreneurship will prepare our students to better cope with a life in which markets play an essential role will prepare our students for this e. g. simulation where participants play the role of sailors / shipowners, with buying and selling and building boats, deciding where to fish considering the application of permits or quotas the activity is not purely business decisions, it is an opportunity to work on the sustainable management of resources.

- The project is also complementary to other projects ICT go Girls; Key competences to prepare our students for an entrepreneurial mindset, Teachers' Continuing Professional Development: Qualified Teachers = Successful Learners.

- So, a well prepared teachers and make observations at the own school between teachers and between schools will lead to innovation.

- The project leads to improve innovative solutions to implement the use of innovative CPS. To work four basic areas Personal, Cultural heritage, STEM and Economy. The area "Personal" (Development, Autonomy, Creativity, Citizenship, Civics that will be work transversally...) is at hart of all activities. The student, while they learn build self-improvement, self-driven and self-disciplined learners, encourage personal autonomy, creativity are working cultural heritage, STEM or Economy. The assignments stimulate students to be creative, putting their imagination to work, provide opportunities for them to finding intelligent solutions. The project is focused on social entrepreneurship; problems arise in the local community and students seek Innovative solutions that can lead to improvements through small changes.

16.1 Impact

16.1.1 At universities

Collaborate with schools let universities have first-hand information about schools do, which methods and tools they use, how they integrate them in the curricula. As in the project participates the faculty of Sciences Education the project will also have a big impact in students to be teachers.

Universities do a lot of research work promote innovative methods evaluate teach her digital competencies and also entrepreneurship and STEM competences of teachers and students. They produced the apps for mobile devices so lecturers felt the need to provide teachers with new tools based in European frameworks of competences and also The Global STEM Alliance (GSA) STEM Education Framework. STEM App is based in it.

16.1.2 At the schools

The project has a lasting impact on the way we currently use technology across the school. This has been a whole school focus and has meant that we are able to adapt our curriculum to incorporate aspects of the project particularly aspects that pupils thoroughly enjoyed. We will now continue as a school to ensure that we are able to implement further similar projects into our curriculum ensuring that our curriculum remains well rounded.

The impact in our school was much better than expected. It made almost all the teachers get involved in the project and work together collaborating with each other.

The project improves internationalization of schools offers a unique opportunity to learn and improve one's own teaching methodologies and the organization of the school.

I. In teachers.

- European projects are a challenge for teachers and, in this case, the CPS methodology is very much in line with the idea of competence teaching that we have at school, which is why it was well received by all the participants
- As teachers we could improve our skills in different areas and learn how to use new digital tools. That was a very enriching experience.
- The Teachers have had the opportunity to collaborate with like-minded individuals across the project. They have been able to share and trail ideas alongside other teachers whilst comparing outcomes. The project comparisons between the groups have allowed for vital insights and in-depth evaluation. As a result, this has allowed Teachers to guide pupils on improving the quality of outcomes across each project. Teachers have also grown in confidence in regard to the implementation of technology within the classroom and across subject areas. The guides have been a vital resource for ensuring that steps can be easily by teachers as well as easily distributed.

II. In classes.

- The impact on pupils has been profound. All pupils have had the opportunity to engage in a new way of using technology and understand the importance of review, evaluation, and improvement. This has had an impact across the curriculum where the children have now begun to apply this methodology to their work. The children have loved communicating with pupils from across the world and become excited at the concept of learning new methods and concepts as well as new ideas gained from the different cultural experiences. The project has also allowed for increased interactivity and class engagement due to the practical nature and competitive element between the schools In Students. Classes turned out to be more active and funnier, so students got really involved

in the tasks and it was very motivating Students felt really motivated when working with the CPS model and they also learn how to work in teams collaboratively.

- Working with a technological and collaborative approach meant changes in some classes that had a less innovative approach. In the classrooms there is greater receptivity to this methodological commitment and the changes, although moderate, make us optimistic towards greater changes.
- The CPS methodology was proposed, students had to move from an individualistic level to collaborative work, which required them to consider the opinions of others and modify their stance for the good of the group, if necessary.

III. How does the project improve the quality and innovation in teaching?

- The project improves the quality and innovation in teaching as it introduces the use of new digital tools in the classroom such as virtual reality developing children's skills in technology which is a very important area nowadays.
- We have always had more innovative teachers and others who use traditional methods, but the truth is that, currently, all the teachers involved are adopting some of the tools developed in the project in their daily work; in those in which they feel more comfortable, which lays the foundations for greater changes in the near future.

IV. Does the project improve e use of digital tools?

- Of course. Robotics, Podcast, … are tools we already used, but virtual reality or the digital newspaper as educational tools are new to us to us and now, we integrate them in the curricula of the students. in the project students learn to use VR, Apps, prototypes, Lego WE DO …

V. Does the project improved the use of innovative teaching methods?

- As we have indicated before, exposing our work to other schools is a unique opportunity to evaluate our methodology and organization in a real context. This provides quick and valuable information that allows us, in a positive way, to improve our teaching practice. Practice observation is not very common at Spanish schools, only the education authorities select few schools to observe the way of

teaching in other community and both benefit from the activity and also promote the observation at the own school. It´s so important that a teacher in own school observe other teacher teaching and evaluates them, and gives feedback and also both exchange knowledge.

- Today's society requires creative, entrepreneurial, critical, and competent individuals in digital technologies. Partners have designed a global and sustainable plan to implement distance learning at schools and between schools in order to promote innovation, creativity and efficiency in the use of ICT in order to offer our students a quality education in accordance with the needs of the 21st century students, the aim is offering innovative and quality education and minimizing school failure.

- Teacher training acts as a catalyst for the quality of teaching. Learning is most effective when teachers and students work together to achieve a goal. The teacher helps to create a common context of experiences within the classroom to promote inclusive education.

- The learning process must be based on solid basic competencies and skills such as reading, writing, numeracy and science knowledge that remain challenging today. Schools must ensure that all their students have solid basic competencies, essential to promote inclusion and social cohesion. The project implemented digital technologies and active learning.

- Digital skills are a matter of basic literacy, we propose equipping students and teachers with the basic skills to make the use of digital technology in a meaningful way and adding value to the learning process; The teacher inspires students' interests in the learning, which then leads them to solve problems on their own creatively. The covid situation has shown that active teaching models, self-regulation of students, their ability to work flexibly remotely are essential. We will promote the use of emerging technologies such as VR / AR, 3D designs, APPS...it aims at transforming the project students from passive users to creative and conscious creators of knowledge and information, they become architects of their own learning.

Our project intends use the three interconnected terms:

Imagination – creativity – innovation.

Creativity must be at the centre of all disciplines and disciplines must be interconnected with each other. Schools must work together with other schools in a broader learning community.

Activities which reinforce and complement the cooperation with virtual mobility (provides powerful opportunities for international collaboration) between schools and other institutions (universities and experts, ...) turning schools into broader learning communities in order to implement education and training of professionals to meet challenges of excellence, equity, diversity and inclusion in the school environment.

A face-to-face CPD course in the 1st year. Once tested the course, teachers were able to design CPS on four basic areas Personal, Cultural heritage, STEM and Economy, analyse and develop innovative pedagogy and assessment approaches and methods to support these diverse collaborative learning pathways.

The project is focused on four areas: Personal ´Cultural heritage, STEM and Economy

- "Personal" area (Development, Autonomy, Creativity, Citizenship, Civic, ...) is at the centre of all activities. The didactic proposals stimulate students to be creative putting their imagination into practice, offering them opportunities to find intelligent solutions. The student, while achieve knowledge, acquire skills of self-directed and self-disciplined learners, fosters personal autonomy; within the process of human growth, we will promote behaviours or customs that directly affect optimal personal development as a citizen. The project also prepares students to acquire public speaking skills with the conviction that effective communication makes any activity easier; this competence is also achievable through practice; speaking in public is considered a relevant competence nowadays.
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that will interact through video conference: Asking questions, looking for imaginative solutions together, … Once the (CPS) is completed, the teachers analysed together with the evaluators how it can be improved and elaborated a final proposal that will be included in the Multimedia Guide.

- The impact it was measured through the results, how digital technology can be integrated in the 4 basic areas. The activities will focus in Cultural Heritage (local, national European using VR/ RA/ Apps,….) and Personal development, while they learn build self-improvement, self-driven and self-disciplined learners, encourage personal autonomy will also lead to students be active citizens and willing and able to participate fully in the local community, as well as to enhance European identity and youth participation in democratic life and processes in Europe, and improve the knowledge of European institutions., They explored STEAM (science, technology, engineering, arts and maths)using prototypes , research works, and the areas personal development skills and economy. Key components of the competence profile of an entrepreneur: Using simulations to learn economy, students achieved leadership and motivation, strategic vision, change management, …
- The methodology was active learning. The teacher presents students a question and the have to show through research work the evidences found and how the lead to conclusions.
- The project is also complementary to other projects ICT go Girls; Key competences to prepare our students for an entrepreneurial mindset, Teachers' Continuing Professional Development: Qualified Teachers = Successful Learning.

Digital Technology
Imagination
Creativity and
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