CREATEskills

Social Learning for STEM in Primary Education

INNOVATIVE STEM METHODOLOGY

TEACHER'S GUIDE FOR THE IMPLEMENTATION OF THE TOOLKIT "TOOLS TO SOCIALLY LEARN STEM"

www.createskills.eu

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SCIENCE VIEW

MetisBaltic
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1. CREATEskills Project

1.1 Introduction

The CREATEskills project is designed to develop and implement innovative teaching and learning practices, tools and methodologies in EU primary schools for the establishment of STEM studio classrooms, improving the quality and relevance of the learning process in primary education, more specifically regarding the attractiveness of STEM subjects.

This is the main objective of this European project, which has been founded by European Commission under the Key Action "Cooperation for innovation and the exchange of good practices" as strategic partnership for innovation in primary schools. Within the context of the European Union, STEM is the acronym for the knowledge areas of Science, Technology, Engineering and Mathematics. The relevance of this acronym is to focus the interest in knowledge, concepts and practices relative to these areas and how this knowledge can be applied in practice to solve complex questions of real-life. The competences in STEM are considered as one of the skills of the citizenship in 21st century by the European Commission.

Through hands-on activities and based on the logic of the Social Learning Theory, CREATEskills will contribute to the development of the 21st century skills among students. The direct target groups are primary school students (6-12 years of age), teachers, parents and school directors. As indirect target groups, this project also aims to reach out the wider community, namely Science-related Researchers and Organizations, establishing a bridge between schools and work environments.

CREATEskills will develop, test and implement a methodology for STEM Education in primary schools, including a Toolkit with STEM teaching materials for primary school teachers and a Web-Platform with a Virtual "Teachers Room", a Virtual Library for resources and a Photo Gallery with home activities and DIY projects for children and family.

Through these activities, the project will contribute to the current EU school context, by:

- Promoting inter-disciplinary pedagogical approaches, through the collaborative development and implementation of a STEM related methodology for primary students (Toolkit);
- Increasing primary teacher's involvement in experimental education by testing and using the Toolkit and engaging in several activities of the project.
- Promoting critical thinking and 21st century skills at an early childhood education (Toolkit, DIY projects).
- Improving the motivation of European students to scientific culture and professions, as result of the participation in exciting activities with a strong scientific and pedagogical component and contacting professionals that use this knowledge in their day-to-day work.
- Contributing to minimize early school dropout transnationally, as result of the increased motivation for classes and a wider perspective of possible career options, including those connected to scientific fields, with special note to foster gender mainstreaming.

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1.2 The relevance of raising STEM attractiveness

"Education has a leading role in the needs of the future society."

Many OECD studies[1] have shown that Education has a crucial impact on improving social progress and well-being, mainly through the development of competencies and skills. According to the European Commission, around six million young people drop out of school each year (14% of all pupils)[2]. Therefore, there is a need to rethink Education, having in consideration the modern society and the requirements for the future professionals - in order to be capable to respond to the social-economical demanding of the 21st century. STEM subjects are one of Europe's major education domains and in the center of future needs. Improving the appeal of research careers and other related careers to young people is an important contribution to generate a more skilled workforce, capable of facing new technological changes in Europe.

In today's world, information and knowledge are increasing at such an astronomical rate that teaching ideas and facts, without teaching how to use them in real-life settings, is no longer enough. Schools need to adapt and develop new ways of teaching and learning that reflect a changing world. The purpose of school should be to prepare students for success in the labor market, and therefore schools need to prioritize the knowledge and skills that will be in the greatest demand. OECD's publication entitled "Skills for Social Progress: the power of social and emotional skills", shows the importance for children to develop a balanced set of cognitive, social and emotional skills to better face the challenges and obstacles of the 21st century. The research points out that, not only teachers, but also parents, can play a significant role in the development of the children's social and emotional skills through the promotion of strong relationships and real-life hands-on practical learning experiences. An early investment in social and emotional skills can contribute to the achievement of better cognitive skills in the future, and consequently reducing educational, labor market and social disparities. Therefore, the development of cognitive, social and emotional skills at an early age set the basis for the future.

In a world that is becoming increasingly complex, it is more important than ever for our youth to be equipped with the right knowledge and skills to solve complex problems, gather and evaluate evidence, and make sense of information. These are the types of skills that students learn by studying STEM subjects. By introducing these subjects in an early age and making them appealing and interesting to children, can help set the foundation for their future studies and professional field.

Being said, the CREATEskills project is innovative in the following ways:

- By assuming itself as an integrated project, based on the use of an innovative approach to STEM subjects involving the conception of didactical tools, along with training and involvement of primary teachers in a multidisciplinary approach;
- It will produce a STEM Toolkit and a Web-animated Platform which can be used in articulation with EU schools' curricula (interdisciplinarity);
- It develops project activities with active and creative participation of teachers, students and parents with emphasis on EU values and intercultural understanding - direct collaboration between schools, students, parents, science community and general community;

[1] such as *"The Social Outcomes of Learning in 2010"*
[2] http://ec.europa.eu/news/culture/110202_en.htm

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- It addresses relevant topics such as STEM education, 21st century skills, social learning, engagement and involvement of students, teachers and parents at European level, seeking common solutions for mutual problems;
- It proposes a new approach with activities that promote the dissemination and exploitation of results in the EU systems of education. All outputs of the project can be transferred to other schools and countries and will be of free access to anyone. Materials available in English and 4 partners' languages (Portuguese, Spanish, Greek & Lithuanian);
- Social learning approaches (modeling, observation and vicarious learning, self-regulation, and self-efficacy) with expanding roles and definitions of creativity (fluency, flexibility, resilience, elaboration, cross-disciplinary thinking, motivation, and persistence) can also underline the innovative aspect of this project.

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2. Innovative Practices

In this chapter, there are presented the main conclusions about STEM teaching and learning innovative practices based on the state of the art of STEM in Primary Education in Greece, Lithuania, Portugal and Spain.

Regarding STEM in Primary Education, in all four partner countries it is stated by the participants that it is really important to pay attention to subjects such as: introducing innovative methodologies, using new technologies and training teachers with specific courses focused on STEM teaching. Due to it, in this chapter there are included the most innovative approaches to STEM teaching and learning, presenting the best practices from each country. Finally, specific recommendations to improve STEM teaching and learning are included.

2.1. Methodological aspects of teaching STEM

Most of the research that relates STEM to Primary Education focuses on the methodological change that is needed to achieve real transformation in these subjects. A change is needed that motivates students to follow a path that leads to training in science, technology, engineering or mathematics.

It is important to start STEM training from kindergarten due to its applicability in ordinary life and for the student's future. Moreover, STEM subjects promote critical thinking development and the reinforcement of the natural curiosity of children. Despite the fact that the content in STEM is considered really important for the present and future of the students, teachers consider that schools hours are not enough and the way STEM is taught does not motivate students.

To fill that gap and needs in teaching STEM, our analysis showed that:

- ✓ It is very relevant to use active methodologies such as: Research based learning; Project based learning; Problem based learning,
- ✓ Critical thinking and teamwork must be incorporated
- ✓ A major focus on real-settings (experiments, visits etc) needs to be implemented, such as: tasks based on authentic learning; interactive assignments and activities; Cultural visits and excursions.

However, it is necessary to recognize the lack of resources that makes difficult to apply these methodologies in classrooms. In general, the resources (infrastructures, laboratories) are limited. Schools do not have their own spaces to develop STEM subjects with methodologies based on experimentation.

In this sense a key response for the need of effective STEM education is the role of active learning strategies, technology teaching methodologies and social networks.

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2.2. Promote teaching strategies on teachers training

The above brief recommendations imply that there is a need for teachers that will lead these elements in the classroom and engage their students in the STEM subject. In the research that the CREATEskills consortium performed, a gap exists in teachers training on STEM: teachers need to develop more creative and attractive teaching strategies during their training to promote STEM within their students. Teachers need new skills and a different approach to teach STEM in order to reduce the underachievement in this field, which is a priority at European level.

Thus, following are briefly presented the main "pillars" to be adopted:

1. Collaborative lesson planning

Collaborative work is a teaching strategy that works well in large projects, once they are easier to perform among several teachers. Planning according to the same age group teachers enable to deliver cross-curricular learning beyond subject boundaries; to improve the teaching and learning process and to eliminate unnecessary workload around planning and preparation.

To foster co-operation creating new tasks, implementing new teaching methods

2. Interdisciplinary projects

Teachers have indicated that the main drive to learn STEM is its applicability to daily life, an aspect that students often do not perceive. It would be, therefore, interesting to raise experiences and STEM projects that link these disciplines with others. Therefore, it is interesting, not only the collaboration between STEM teachers but also with teachers from other subjects.

To propose a project or an activity where students can work combining various contents: mathematics and art content, or science and music (for example).

3. Teacher training and teacher professional development courses

Primary school teachers are not sufficiently trained to introduce modern teaching approaches in the classrooms and that specific STEM teaching seminars or trainings. Teachers and school professionals are more aware of the modern STEM teaching approaches and concepts introduced not only in the research field but also in aspects of the legislative framework.

Training can be based on teaching approaches such as: inquiry-based learning, game-based learning, creative learning, project-based learning and team-based learning

4. Good practices and ideas to implement in the class.

One of the demands of teachers is continuous learning and professional development. When we talk about teacher training there are different possibilities and not all are related to training courses. A good starting point could be to know what good practices are being carried out in the field of STEM and have concrete proposals that can be carried out in their own classrooms.

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- Group dynamics
- Reflection and debates (in small and large groups)
- Group activities
- Group experiments for scientific work
- Cultural activities

5. ICT: tools to teach and a place to learn

ICT has been mentioned in teachers' results, because of the potential they have to be integrated into teaching, but also because of the potential for the teacher's continuous training.

On the one hand, it would be interesting for teachers to receive training on how they can integrate technologies properly and within the framework of their subject.

It would be positive for teachers to value the possibilities of ICT for their continuing education. Online environments and networked learning communities are good examples with a lot of training offers for them.

6. More connection with students

Many teachers do not really know the perceptions of the students. Following that implication, teachers should ask them about their interests and demands and trying to connect teaching activity to students´ motivation. It supposes, in short, give more importance to students in their learning process.

It can be useful for teachers to carry out activities that involve the students in the design, development, and evaluation of the STEM subjects.

7. Use other spaces for teaching STEM

One of the main teachers´ demands is regarding spaces and infrastructures, because some centres do not have laboratories or specific spaces for experimentation. In addition to the need for suitable spaces (in relation to the importance they can have for the motivation and learning of STEM), there are other possibilities that should be considered:

- To use the space that already teachers have in the classroom. One idea could be to create a corner in the normal classroom called "STEM corner" where students can find resources to experiment (students can use in groups).
- To use other spaces of the school, like the playground or the gym (or other spaces that are available for the development of experiments). Leaving the normal classroom can be motivating for students.
- To use resources for experimentation that we can find easily, like bottles, water, pieces for construction.

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2.3. Innovative approaches to STEM teaching and learning

In all partners' countries, we find some innovative proposals for teaching STEM in Primary Education classrooms. In the case of Spain, a plan is being developed to work on logical-mathematical competences through a program that promotes the incorporation of Information and Communication Technologies (ICT) in schools. Besides, workshops developed by the university are also included in this programme in order to present science and technology in an attractive and motivating way, as well as and a program to foster STEM vocations in the classroom.

In Greece, some of the identified innovative practices regarding STEM teaching and learning include a plan called *My School Garden*, which is being developed to increase interest in gardening and natural science. Also, an educational activity to teach science through theatre - by combining STEM learning with aspects of arts. Some activities are developed in collaboration with the relevant LCPSs (Laboratory Centers of Physical Sciences) and are supported by initiatives (constructions, laboratory teachings, hands-on activities) on the natural sciences and their application in everyday life.

In Lithuania, programs are being developed to promote STEAM by introducing technologies with which students can experiment. Several private initiative programs are also being developed in relation to each of the abbreviations STEAM. And finally, the *MARCH* program - *Make Science Real in Schools* - was developed to help identify good practices and methodologies that combine STEM.

In Portugal, the 1st cycle Primary School Programming Initiative was developed and implemented, which aimed not only to enable students with ICT skills but also to enhance their reading, expression and writing skills. Also, in the current course, a project has been developed to give the centres autonomy in relation to the pedagogical curricula of the same. Finally, a few years ago it was developed a plan to introduce the technology in the centres called *EduLabs Project*.

Together they propose a set of innovative approaches to work STEM in schools, namely:

1. Science fairs

A science fair project is a way for students to raise questions which are interesting for them and through which they must seek out answers to satisfy their own curiosity. Students learn the scientific method to prove their hypothesis or to deny it. Students have the options to work with an expert or mentor to be guided, they can work in groups or also by themselves. The opportunity to choose what to do and how to do it help them to stay focused and motivated.

On science fair, students can find out about STEM from different sides: they learn how chicken breaks out, study the visualization of the brain's work or explore fingerprints. It is a very good way to motivate students towards fascinating science.

2. STEM Olympics

STEM Olympics encourage students' interest in science and engineering practices. It improves the skills and abilities of experimental work and stimulates creativity, autonomy and critical thinking. It promotes STEM content, its application in the classroom and encourages students to understand STEM design and challenges.

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3. STEM (and/or) Science coordinator

STEM/Science Coordinators encourage the implementation of new and more effective teaching practices. They are responsible for providing scientific and pedagogic support and guidance for teachers. They advocate the implementation of innovations in education, undertake initiatives regarding teachers' training and encourage the use of modern educational technology tools.

4. Learning Science through Theatre (LSTT)

In the context of the activity, students create, develop and implement a theatrical performance related to scientific concepts and knowledge from the material being taught in schools, learning science in a creative way. The specific objectives of the activity - which has as a central axis the interdisciplinary interconnection of science with aspects of art, aiming at the enhancement of students' interest in science - involve both students and teachers. More specifically, through this activity, students comprehend scientific concepts and phenomena, develop a spirit of cooperation and teamwork, actively participate in the negotiation of scientific concepts and develop creative and critical thinking skills.

Also, by participating in dissemination activities and entrepreneurial actions for the promotion and support of their theatrical performance, they will contribute in further bridging school with society and, at personal level, developing their social and entrepreneurial skills. At the same time, teachers are engaged in professional development procedures through their cooperation and the exchange of opinions, ideas and teaching material.

5. My School Garden

The main purpose of this innovative activity is to raise interest and sensitize learners of a broad age range in (organic) school gardening experiences and practice on cultivating plants and/or developing a viable ecological culture. It aims to provide children with opportunities to think and act as conscious citizens, within a viable development of a society which lives in harmony with the environment and in respect with contemporary local and global agricultural economies and healthy eating habits.

In other words, incorporating agriculture and organic gardening in the classroom helps learners understand how humans interact with the environment and how food is grown. Furthermore, agriculture and school gardening promote awareness of a healthy lifestyle, helps learners master STE(A)M concepts and exposes citizens to agricultural job opportunities.

6. Course "PHYSICA"

The "PHYSICA" course is developed via laboratory activities and per modules. It aims the emotional development and creative learning through fine arts, in early recognition and empowerment of students with particular inclinations (or, on the contrary, deviations) to STEM teaching subjects. In addition, laboratory activities and constructions with applications of robotics, natural sciences, music, geology - geography and technology - are presented in a festival of natural sciences, open to the public.

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7. Laboratories for Learning

It consists of disseminating methodologies to integrate ICT in the national curricula. There are ambassadors who, required by schools, organize workshops and training sessions for teachers. All training sessions and workshops allow teachers and schools to have the best and more appropriate tools and resources to implement scenarios of Future Classroom Labs.

Schools can develop innovative projects at the European level and submit those to the Directory of Education on the eTwinning platform. Laboratories for learning/Future Classroom labs started to be developed in 2010.

8. Logical-mathematical plan

It consists of developing a plan in primary schools to develop different skills in students related to logic and mathematics, such as mental processes of deduction and induction or problem-solving. Specifically, the Ministry of Education offers a model that schools should fill in which establishes objectives and ways to measure the improvement of mathematical competence.

9. TECHMI program

This program exists with the intention of eliminating gender stereotypes in STEM subjects, showing to boys and girls that science, mathematics, engineering and technology are the most fun and creative of all the technological resources we use today. The project has the collaboration of women engineers between the ages of 22 and 26 to supervise its follow-up in the various schools that participate in the program and help students to develop it.

10. Make & Learn

Make & Learn works on a Project Based Learning approach. It was established with the aim of generating greater interest for STE(A)M areas among young students, stimulating skills such as logical and creative thinking, communication and teamwork, critical analysis and problem-solving. In one hand, the program trains teachers to use innovative methodologies that allow them to make STE(A)M subjects more fun. On the other hand, activities are developed with children from 8 to 12 years old in the classroom and outside it to stimulate their logical and creative thinking with STEAM activities.

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3. Innovative STEM Methodology – Toolkit "Tools to Socially Learn STEM"

The Toolkit "Tools to Socially Learn STEM" presents a set of 41 STEM activities, dynamic exercises, games and experiments to be done in groups, based on an active and participatory methodology for educating using science, that aims to fill the gap and needs identified by teachers' and also provide new ideas / interventions to work this subject with students.

In this chapter you will find a summary of the 41 STEM dynamic activities with a link to the complete description, teaching how to develop it step-by-step.

3.1. Activities to develop and promote attractiveness for STEM

The 41 STEM activities are organized by ages in the following order:

- **6 to 9 years old**: 8 activities, from number 1 to number 8;
- **10-12 years old**: 29 activities, from number 9 to number 37;
- **All ages**: 4 activities, from number 38 to number 41.

3.1.1. Ages 6-9

Number 1	
Name of the Activity	Identifying types of ROCKS
Summary	In the National Curricula for a class science in Primary education, students are asked to study their surroundings/environment and recognize different types of rocks. Students are inspired first with the reading of the story "Journey to the centre of the Earth" by Julio Verne.
Target Group	6-9 years old
Duration	60 min
Link to the resource	https://bit.ly/2IoZJEN

Number 2	
Name of the Activity	Math working model of lines and angles
Summary	To make a work model in class using wooden sticks and playdough to form parallel and perpendicular lines, as well as the three types of angles studied: straight, acute and obtuse.
Target Group	6 - 9 years old
Duration	Session of 45 minutes to 1 hour
Link to the resource	https://bit.ly/2UgGK1e

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Number 3	
Name of the Activity	Self-drawing machine
Summary	In this activity students will make a self-drawing machine. The 12V DC engine is displayed and connected with batteries – students will notice that the engine's leg is rotating. The teacher explains that this rotation of the leg will be essential because it will make the whole device movable and it will draw some shapes. Students will try to find a way to connect the marker to the engine, so that it could move and draw any shapes. One device will draw circles, another – waves, yet another – spirals.
Target Group	6 – 9 years old
Duration	1 h 30 min
Link to the resource	https://bit.ly/2IrUT9H

Number 4	
Name of the Activity	Rounding
Summary	This activity is designed to help students understand the rounding rule.
Target Group	6 – 9 years old
Duration	45 min.
Link to the resource	https://bit.ly/2Z31pcZ

Number 5	
Name of the Activity	Adaptation (of humans, animals, plants)
Summary	At the start of the topic, the students discuss the changes in housing, clothing, lifestyle and how all the changes were highly influenced by the environmental conditions. The existence of plants and animals was also highly influenced by the same markers as the humans.
Target Group	6-9 years old
Duration	The activity could last the whole school day. There is a possibility to go on a school trip to the Zoo or the Botany Gardens.
Link to the resource	https://bit.ly/2ZaXkUf

Number 6	
Name of the Activity	Stages of the water cycle
Summary	Activity to observe and track the characteristics of the water in the different phases of the cycle in an easy way
Target Group	6 - 9 years old
Duration	30 minutes to explain the experience and prepare the material. 2 hours under the sun. 30 minutes to draw the conclusions.
Link to the resource	https://bit.ly/2VGzGg6

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Number 7	
Name of the Activity	Germinating seeds.
Summary	With this activity we want to make little children capable of experimenting with seeds from different plants. From the observation, we will try to introduce them into the scientific method. We will make two examples and they will have to foresee what it is going to happen (hypothesis). Then, we will check it and we will arrive at a conclusion.
Target Group	6 - 9 years old
Duration	5 minutes every five days. Observation for at least 20/30 days.
Link to the resource	https://bit.ly/2GievLX

Number 8	
Name of the Activity	Density of water – sink or float
Summary	A simple experiment about the density of water using some peeled and unpeeled fruits to check whether they float or sink.
Target Group	6 - 9 years old
Duration	One session of 45 minutes-1 hour
Link to the resource	https://bit.ly/2IheSbJ

3.1.2. Ages 10-12

Number 9	
Name of the Activity	Types of Soil
Summary	Students learn and analyse the soil we have in our Planet through a project-based learning question "Which soil is more permeable?". Through a brainstorm activity, students try to define "What is soil?" and after they visualize a Youtube short film in English **https://www.youtube.com/watch?v=uS7zfeK4OTQ**
Target Group	10 – 12 years old
Duration	45 min
Link to the resource	https://bit.ly/2GeEe70

Number 10	
Name of the Activity	The Robot moves
Summary	Students learn in Robotics class to apply coding in everyday activity, using the example of moving the robot. Students are asked to roughly in small groups answer the question "How do I make the robot walk?" Quickly students write sentences describing what they do and each group reads their plan. Teacher shows them that writing a description is not needed, that there is a simpler way called coding using symbols and programming a robot.
Target Group	10 – 12 years old
Duration	45 min
Link to the resource	https://bit.ly/2Glm83h

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Number 11	
Name of the Activity	Types of Minerals
Summary	Reading Chapter XX from the book "Journey to the Centre of the Earth" by Julio Verne
Target Group	10 -12 years old
Duration	60 min
Link to the resource	https://bit.ly/2ItJq9E

Number 12	
Name of the Activity	Calculating distances
Summary	In a Social/History/Maths classes, students are asked to make a route from one point of the village till school (the teacher will give the students names of places in the village, eg. Post office, Restaurant, bus stop, church…) using the local map. They should calculate the distance between places in kilometres. The students will identify the places on Google maps.
Target Group	10 -12 years old
Duration	90 min
Link to the resource	https://bit.ly/2IuqCXR

Number 13	
Name of the Activity	Where does Honey come from?
Summary	Students are asked in a science class, related to the insets in our planet, to discover about the importance of bees. Students will learn how the honey arrives on our tables, about bees and their importance for nature. After the class all students will have a snack during break where they will taste honey.
Target Group	10 – 12 years old
Duration	90 min
Link to the resource	https://bit.ly/2IovldE

Number 14	
Name of the Activity	*Paper Robot*
Summary	The students work in teams of three; they make a paper robot of a packet of milk which reacts to an external stimulus that is already programmed to (the light, the approach or the motion sensor). Through the activity the students will realise how the robots work and that the human brain is the main part of every robotic construction. Learning how to use basic principles of programming using the SCRATCH and the connection among electric circuits is a requirement.
Target Group	It is addressed to 10 - 12 years old No special skills are required, just to respond to their age level as far as the fine motor skill is concerned (the student must be able to use the scissors efficiently).
Duration	Ten (10) – Twenty (20) class periods
Link to the resource	https://bit.ly/2KsAl3l

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Number 15	
Name of the Activity	*A Rally of Diameter*
Summary	The learners work in groups of three and assemble the cars which will take place in a race. Each car has the same engine but different sizes of wheels. Through this activity the students will realize that the size of the wheels, i.e. diameter of the circle, and each turn of the wheel, i.e. the perimeter of the wheel, effect the distance. The cars essentially offer an experimental presentation and visualization of the theory; that the different sizes of the wheels effect the distances each car will reach.
Target Group	The target learning groups in mind are in either, the 6th or 7th grade of school, between 10-12 years of age. The activity can also easily be carried at home by a parent or at school by a teacher. In the latter, the students should be divided into groups of three at best.
Duration	The approximate time required is two (2) teaching session periods.
Link to the resource	https://bit.ly/2GeHjUC

Number 16	
Name of the Activity	Our music box! (The notion of software/firmware...
Summary	The music box is a mechanism that can produce a specific melody that is digitally printed (i.e. pins/absence of pins) on its drum surface. In this activity we use it to explain the students the meaning of the program in its drum. In this specific activity we use this recording to explain the students the meaning of the computer program. The students are helped by the teacher to realize the way the sound is produced while its drum spins/pins. The teacher uses the music box to create the norms for the notions of the "program software", orders/instructions of the program, "firmware" and "digital". Then the students create their own "music box", in other words a program with SCRATCH that will produce their chosen melody.
Target Group	10 - 12 years old
Duration	2-3 teaching sessions
Link to the resource	https://bit.ly/2UV9nW8

Number 17	
Name of the Activity	The young Dieticians attack to the Sports Lab!
Summary	Nutrition and healthy diet in combination with the life-lasting exercise consist the meaningful part of health and secures our daily living and…. coexistence. Every young man's cornerstone of success is the maintenance of his mental and physical health at its best.
Target Group	Parents, Teachers, Society, Students of 10-12 years old
Duration	2 months
Link to the resource	https://bit.ly/2Igclif

Number 18	
Name of the Activity	Dissection and Observation of Tissues within a Chicken Claw
Summary	Before the students enter the classroom, purchase and cook the chicken claws. Leave them to cool. Then, in class, the children will dissect it.
Target Group	10 – 12 years old
Duration	1 session of 45 minutes – 1 hour
Link to the resource	https://bit.ly/2IrPG1K

Number 19	
Name of the Activity	Make a fossil.
Summary	Fossils are the remains of living things that were preserved and transformed into stone over millions of years. Although we cannot reproduce the natural process in the lab, we can make fake fossils using remains of living things as moulds.
Target Group	10 – 12 years old
Duration	Two sessions: 1. A 45 minutes or 1 hour session to make the fossil and, once it dries up 2. A 1 hour session to show fossils and to write a report on the activity.
Link to the resource	https://bit.ly/2KKOB87

Number 20	
Name of the Activity	Working model of an animal cell
Summary	The children will make a working model of an animal cell with a container as the cell outer skin and some food items as cellular organelles.
Target Group	10 - 12 years old
Duration	1 session of 1 hour and a half.
Link to the resource	https://bit.ly/2P5FXPQ

Number 21	
Name of the Activity	Electronic circuit
Summary	The children will make an electronic circuit with a battery, a bulb, a light holder, wires (as needed) and a circuit switch.
Target Group	10 - 12 years old
Duration	2 session of 1 hour 1st session: the students will learn about the characteristics of the materials that constitute the circuit and their function. The students may have the chance to experiment with the different materials and manipulate them. 2nd session: the students assemble the circuit elements and experiment with it, turning on and off, checking whether all the elements make contact properly.
Link to the resource	https://bit.ly/2v0DOLY

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Number 22	
Name of the Activity	Homemade water treatment device
Summary	Making a water treatment device for removing impurities from water. Purifying water consists of applying different methods in order to eliminate residues in waste waters.
Target Group	10 - 12 years old. It is necessary the help of a conductor.
Duration	45 minutes or 1 hour
Link to the resource	https://bit.ly/2Kw0Mp5

Number 23	
Name of the Activity	Homemade rain gauge
Summary	The children will make a homemade rain gauge with a bottle of water as the main element.
Target Group	10 - 12 years old
Duration	1 session of 1 hour and a half.
Link to the resource	https://bit.ly/2UYj8TP

Number 24	
Name of the Activity	Bridge construction of pasta
Summary	Speaking with children about buildings. We are talking about the development of the city and about the construction of its bridges. Students will build a bridge from some material which is not strong itself, so they can concentrate on engineering solutions that help build a bridge that does not collapse.
Target Group	10 – 12 years old
Duration	1,5 h
Link to the resource	https://bit.ly/2v08b5l

Number 25	
Name of the Activity	Trick Dice
Summary	Students discuss the results and probabilities of rolled dice and they make trick dice, which always shows 6.
Target Group	10 - 12 years old
Duration	45 min.
Link to the resource	https://bit.ly/2UYjUjH

Number 26	
Name of the Activity	Shadows of the 3D shapes
Summary	Students learn how to make solid shapes. They use the shapes they've made to find out what 2D shapes cast shadows.
Target Group	10 - 12 years old
Duration	45 min.
Link to the resource	https://bit.ly/2G6bYTQ

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Number 27	
Name of the Activity	Hot Air Balloon
Summary	In this activity students talk about/ discuss properties of materials, air, wind direction or heat. During it they produce a hot air balloon.
Target Group	10-12 years old
Duration	1,5 h
Link to the resource	https://bit.ly/2v2TvCp

Number 28	
Name of the Activity	Is there a place in the world, which is "a thousand miles from any human habitation"?
Summary	Students will analyze situation from Antoine de Saint-Exupéry book "Little Prince". They understand that is not possible to find a place in world, with no humans in 1000 miles radius. They will use scaling and knowledge about maps and radius.
Target Group	10 – 12 years old
Duration	45 min.
Link to the resource	https://bit.ly/2IkYpDN

Number 29	
Name of the Activity	Why some flowers stems bend after blooming and others not?
Summary	This activity is intended to repeat the part of the flower: a blossom and a stem. To analyze the effect of the three criteria: weight, length and the structure the flowers stem stability. Research and assess the effect of the geometric shape on the weight resistance. Findings are used to make the highest and most robust structure.
Target Group	10 - 12 years old
Duration	2 – 3 h.
Link to the resource	https://bit.ly/2X50vL9

Number 30	
Name of the Activity	Travel agency
Summary	Students must plane a trip which is impossible to plan, or it would be irrational, but they must prove it.
Target Group	10 – 12 years old
Duration	The activity should take 5 lessons. (One for reading and analysing a letter, another lesson for writing the letter, the third lesson for rewriting and sending the letter, the fourth lesson for a meeting with the client. A fifth lesson may also be required.)
Link to the resource	https://bit.ly/2KwSQnz

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Number 31	
Name of the Activity	The Christmas Cake
Summary	For Celebrating the Christmas season (in an English Class) students are asked to participate in the group activity "The Christmas cake". Students are divided in small groups (3 per group) and search online for the perfect "Christmas cake" – they analyse the ingredients of the recipe filling in a chart (which ingredients to use, quantities and calories). In groups they still search better ingredients which they can replace to make it a healthier cake. In groups they decide who brings what from home to bake the cake / decide to bake the cake at home and bring it to class for a tasting contest. Cakes are in an exhibition with the list of ingredients available so everyone can vote after tasting it and evaluate the flavour, use of healthier ingredients and overall aspect of the cake.
Target Group	10 - 12 years old
Duration	90 min (with cooking)
Link to the resource	https://bit.ly/2YZvf1Q

Number 32	
Name of the Activity	School Trip to a local quarry
Summary	Getting to know our earth/rocks/minerals – after reading and learning about rocks/sand in the class, students visit a quarry to explore the different minerals they can find.
Target Group	10 - 12 years old
Duration	90 min
Link to the resource	https://bit.ly/2Uv42FL

Number 33	
Name of the Activity	"Come Visit my village!"
Summary	Students will pretend that they are working for a travel agency and they have to come up with the best Touristic leaflet in small groups. Firstly, students will get to know better the village with a field trip and taking photos of what they consider important for the leaflets. If needed they can do a quick interview to local people about the monuments they select. In class each group selects the photos they think are best. They will use Publisher to build their leaflet. In the end their will also create a promotional video using the photos. Each group will show their work to the school community and students, teachers, staff will vote on the best.
Target Group	10 – 12 years old
Duration	180 minutes (two classes of 90 minutes)
Link to the resource	https://bit.ly/2UgYjOF

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Number 34	
Name of the Activity	Multidisciplinary approach of color creation using the microcontroller Arduino
Summary	The students work in groups of 2 or 3. They are going to construct an electric circuit using a light emitting diode (LED) and a microcontroller Arduino. Next, they are going to program the microcontroller to light the diode making the necessary colour mixing creating new colours. The next step is that the students should use temperas to create the similar colours to those created with RGB led in the natural world.
Target Group	It is addressed to six-graders of primary school (10 - 12 years old) It can be applied by Computer Science teachers in the school lab, or any other teacher that cooperates with the Computer Science teacher (co-teaching). The students should be grouped; the best would be groups of two**.**
Duration	Two (2) teaching sessions
Link to the resource	https://bit.ly/2UdRT2T

Number 35	
Name of the Activity	Resolving daily problems
Summary	One of the problems resolved with the learners involved the improvement of the doors of the school which were damaged due to bad weather conditions, (strong winds, storms, etc.). We used simple materials and tools, proposed by the learners in order to make the doors shut easier and stop the squeaking noises. Through the experimental problem-solving, the learners put theory of mathematics, physics and technology into a real-life situation which reinforces learning. Apart from the doors of the school, the learners continued to resolve similar conditions they had at home with the help of their parents. They made use of their knowledge and put theory into practice in their lives and were very successful.
Target Group	This activity is beneficial to the learners and people living in their environment. It can be used by teachers to learners and from learners to learners. It has been designed for learners between 10-12 years of age.
Duration	3-4 days or 10-12 teaching session periods.
Link to the resource	https://bit.ly/2IsP8Zt

Number 36	
Name of the Activity	Sun-Robot: A Robot that gives Energy
Summary	According to data from the U.N., over 1,2 billion people on earth, i.e., 1 out of 5 people don't have access to electricity. This occurs mainly in areas of Africa. In these types of communities, after the sun sets children cannot study and there are also tremendous effects on the economic and social life. How could we help such areas have access to energy? We could construct a robot that would collect energy from the sun as it moves and store it in its battery and then deliver it to the areas in need. In addition to this, the robot itself would supply itself in the same manner and further protect the environment. The basic part of the robot would be a mobile solar panel that always moves towards the direction the sun.
Target Group	The target group are aged 10-12 and are between grade 5 (in primary school) and up to the 9th grade of middle school. It can be implemented at home by a parent or at school by the teacher. In the latter, the students should be divided into groups. The ideal groups consist of 3-4 students each.
Duration	4 teaching session periods
Link to the resource	https://bit.ly/2Z8os60

Number 37

Name of the Activity	Escape the Maze
Summary	In this activity, the students will be able to develop computational thinking skills, especially algorithmic thinking. They will have to create a sequence of steps to solve problems. This activity has three parts, depending on the experience of the students with the programming of robots and even if they have experience, the activity can be done partially or completely. For its design, the following two activities have been reused: - **https://csunplugged.org/en/topics/kidbots/unit-plan/sending-a-rocket-to-mars/** - **https://juegosrobotica.es/retos/reto-mbot-robot-laberinto/**
Target Group	10 – 12 years old
Duration	It is recommended to complete the activity for a week on different days: Step 1: 15' Step 2: 60' Step 3: 60' Step 4: 60' Step 5: 120' (it depends on the previous level of programming of students) Step 6: 60'
Link to the resource	https://bit.ly/2U8PJ4E

3.1.3. All ages

Number 38	
Name of the Activity	Boom! –A Crash test
Summary	Lets construct a car of simple materials and place in it a boiled egg as a driver. Take the necessary safety measurements so the egg will remain safe (not damaged or displaced) after a car collision.
Target Group	All ages
Duration	2 teaching session periods
Link to the resource	https://bit.ly/2UeFBXY

Number 39	
Name of the Activity	Learning Science Through Slowmation
Summary	In LSTS science understanding is based on the use of models, representations and other forms of visualization, in order to explain, clarify and demonstrate complex or abstract phenomena. Teachers create digital narratives using the technique of slowmation (2 photographs per second) and "animate" science concepts and phenomena through inspired heroes and their adventures in scripts that they develop re-contextualizing science teaching and learning. Teachers through the slowmation process introduce to new ways of teaching science to pupils, representing still images, text, sounds, transforming them and connect them through this incorporation process. Students use technology to represent their constructions of science concepts and design and construct narrated slowmation to present their science knowledge. Slowmation integrates features from digital storytelling, claymation, object and stop-motion animation. Slowmation engages students with science concepts in multiple and transformative ways creating links as a semiotic progression. Students can make a narrated slowmation to explain a science concept and through the whole process they create a multimodal representation. They need only two pictures or frames per second (a slow animation called slowmation). Students can create 2-dimentional or 3-dimentional models in a model studio. The materials that students may use are play dough, cartons coloured, pictures, drawings, existing game models, toys, natural and everyday materials, cut outs etc. Students use their

	own still photo camera or mobile phone camera with HD quality to take pictures. They create sounds and produce recordings with their phone recorder or their laptop recorder in order to enhance the explanation of a science concept by adding dialogues, music or natural sounds. Finally, they use their laptops or macs with moviemaker or i-movie software installed to edit the developed digital narrative
Target Group	All ages
Duration	The proposed duration of the LSTT activity is 1-2 months. The students work closely with the teachers in a regular basis during these months (once per week is proposed), following the inquiry framework that will get them all the way to the final video. In any case the duration can be decided by the teacher according to his/her time constraints and classroom's needs
Link to the resource	https://bit.ly/2Gd4K0r

Number 40	
Name of the Activity	Celebrating Tolerance Day
Summary	For Celebrating Tolerance Day, in an English class, students are put up to a task "How do we celebrate Tolerance Day?". In small groups each one will define a Working Plan to implement the activity. They will have 2 classes to do something that will alert the community to the Celebration of "Tolerance Day". Parents are asked to come and see the students work and help if they wish.
Target Group	All ages
Duration	180 min.
Link to the resource	https://bit.ly/2D8ZMB6

Number 41	
Name of the Activity	Learning Science Through Theatre
Summary	LSTT brings together science and art inquiry. Students learn science in a creative way while implementing a theatrical performance related to scientific concepts. In LSTT, students comprehend scientific concepts and phenomena, develop a spirit of cooperation and teamwork, actively participate in the negotiation of scientific concepts and develop creative and critical thinking skills. Furthermore, by participating in dissemination activities and entrepreneurial actions for the promotion and support of their theatrical performance, they contribute to further bridging school with society and develop their own social and entrepreneurial skills.
Target Group	All ages
Duration	The proposed duration of the LSTT activity is 3-5 months which includes the period of preparation and the performance time. The students work closely with the teachers (and/or team leaders) in a regular basis during these months (once per week is proposed), following the inquiry framework that will get them all the way to the final performance. In any case the duration can be decided by the teacher
Link to the resource	https://bit.ly/2X3JIrN

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