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KA210-YOU – Small-scale partnerships in youth

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Start date of project: January 1 2023

Duration: 16 months

WP2A1 - Research Phase Report

FOSTERING STEM EDUCATION FOR YOUTH EDUCATIONAL CARTOONS METHODOLOGIES AND E-LEARNING TECHNOLOGIES



Work Package details	
Work Package Title	Research Phase
Deliverable Number	WP2A1
Revision Number	
Responsible Organization	Four Change Association
Author(s)	Mariana Oancea

Leading partner	
1.	Association Four Change - Romania

Participating partners	
1.	OneYouth - Croatia
2.	RITE – Cyprus

The conclusion of the research – a comparative analysis

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1 RESEARCH PHASE 1- DETERMINING UNDERACHIEVED SCHOOL SUBJECTS IN STEM FIELD

1.1 What is STEM education, and why is it important for children – principles and advantages?

ROMANIA	CROATIA	CYPRUS
Definition of the STEM education		
STEM education is a learning approach that combines science, technology, engineering and maths	STEM education is an approach to learning that focuses on integrating the disciplines of science, technology, engineering, and mathematics.	STEM education focuses on problem-solving, collaboration, critical thinking, and hands-on learning while integrating Science, Technology, Engineering, and Mathematics.
Conclusion: There is a common understanding regarding the concept of STEM and what disciplines are learned under STEM umbrella, in the education systems of the Partner countries		
Principles and advantages of STEM education		
<ul style="list-style-type: none"> ✓ Quality and rigour ✓ Relevance and applicability in daily life ✓ Co-sharing the responsibility of learning ✓ Meeting the needs of an ever-changing world ✓ Offers opportunity to innovate and challenge their knowledge ✓ Encourages the development of the soft skills: problem solving, Creativity, critical thinking, initiative 	<ul style="list-style-type: none"> ✓ Integration of disciplines ✓ Hands-on and problem or project based learning ✓ Real-world relevance ✓ Future job opportunities 	<ul style="list-style-type: none"> ✓ emphasizes the practical application of knowledge ✓ connecting theory with real-world applications ✓ developing critical thinking and problem-solving abilities ✓ creates a strong foundation and sets them up for potential careers in engineering, computer science, healthcare, environmental science, and more.
Conclusion: From all the research, similar principles and advantages of STEM education emerged: integrates disciplines for better understanding of the world, meets the needs of this changing world, prepares youth for future jobs with both strong knowledge and soft skills		

1.2 Analysis of the national situation

ROMANIA	CROATIA	CYPRUS
STEM in national education system		
<ul style="list-style-type: none"> ✓ early education (0-6 years), consisting of: pre-school level (0-3 years) and pre-school education (3-6 years) Science domain is taught since pre-school education (environment, natural phenomena), Maths (numbers, measurement units) ✓ primary education (6-10 years, grades grades I-IV) -mathematics is taught within a discipline named Mathematics and Nature Sciences ✓ Lower secondary education/ gymnasium (10-14years, grades V-VIII) – are taught disciplines from Science (Biology - 5th-8th grade, Physics - 6th-8th grade, Chemistry - 7th-8th grade, Technological Education and Practical Applications, Informatics and ICT - 5th-8th grade). Maths is a compulsory for the graduation of the gymnasium cycle 	<ul style="list-style-type: none"> ✓ primary school (children aged 6/7 to 14/15) - Science is taught through the following subjects at primary school- Nature and Society (includes topics like biology, geography, and history- as a social science), Technology is taught through two subjects - IT and Technology (accoring with the primary curriculum, but also robotics and coding within extra-curricular activities); Engineering - concepts are not explicitly taught, but students encouraged to apply their knowledge of science and mathematics to design and construct simple models or structures to understand basical engineering priciples. Maths- numbers, operations, geometry, algebra measurement, and data analysis ✓ secondary school- students aged 15 to 18)/General 	<ul style="list-style-type: none"> ✓ elementary school (6 to 12) Science- offers diferent subject of science Technology - computer science – Computers Mathematics – is compulsory ✓ Gymnasium (12-15) Science - the subjects are natural sciences-physics, chemistry and biology. Technology - different subjects are taught Mathematics ✓ Lyceum (15-18)& vocational & technical Science - physics and chemistry Technology- different subjects are taught & design for vocational/technical schools Engineering- only Technical and Vocational Education provides education with subjects in mechanical, electrical, civic and architectural engineering. Mathematics - is taught through its own subject

<p>✓ Upper secondary education can be: secondary education (classes IX-XII/XIII, with theoretical, vocational and technological profiles) – Maths it a compulsory discipline regardless of the profile of the highschool or vocational school; the other ones under STEM umbrella are taught as a part of the school units profile</p> <p>✓ STEM –as a project based approach - is learned in isolated public/privat units – during either extra-curriculum activities either non-formal activities</p>	<p>Gymnasium (grammar school) & vocational schools</p> <p>Science – are introduced new disciplines (Physics - Grade 7 , Chemistry - Grade 7, Biology - Grade 7)</p> <p>Technology - digital literacy, computer skills, (software applications, and the internet for research, communication, and creativity)</p> <p>Engineering – based upon specialized tracks students (technical or vocational track) students are familiarised with subjects as electrical engineering, mechanical engineering, or civil engineering.</p> <p>Maths – is a compulsory also at this this level of education.</p> <p>✓ Subject of science are taught also during extra-curriculum activities:</p> <ol style="list-style-type: none">1. Science and Technology Clubs2. Environmental Clubs3. Gardening and Agriculture Clubs	
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	4. Astronomy Clubs	
<p>Conclusion: Although the disciplines under the STEM umbrella are taught starting with elementary school up to the completion of secondary studies, the interdisciplinary STEM approach is not carried out at an institutional level, but rather is isolated applied by centers/clubs/specialized or vocational schools from public or private education system.</p>		

1.3 Obstacles and challenges at the national level – underachieved STEM subjects

ROMANIA	CROATIA	CYPRUS
Obstacles & challenges		
<ul style="list-style-type: none"> ✓ lack of financial and material resources ✓ Inadequate and inaccessible training for teachers ✓ congested curricula ✓ teachers and parents attitude regarding STEM <p>Problematic disciplines: mathematics, physics, chemistry, biology, IT.</p>	<ul style="list-style-type: none"> ✓ Funding and resources ✓ Teacher Training ✓ Curriculum Integration <p>Problematic disciplines: maths, chemistry and physics</p>	<ul style="list-style-type: none"> ✓ conventional teaching methods, based on memorization of the solution not on the logic behind ✓ previous mathematics and physics gaps are difficult to be overcome based upon the same teaching methods <p>Problematic disciplines: maths and physics</p>
<p>Conclusions:</p> <ul style="list-style-type: none"> ✓ At the level of the 3 countries, it seems that here also there is a similarity of system problems: insufficient funding and resources (human & materials) to teach STEM, in a proper manner; outdated teaching methods; insufficient reorganized curriculum (not about content, rather about the facilitation of interdisciplinarity and application to real world). 		

✓ At the level at the 3 countries, based on the researches and focus-groups, the top 3 of the most challenging fields under the STEM umbrella are: mathematics, physics and chemistry

1.4 Solutions and new approaches

ROMANIA	CROATIA	CYPRUS
<ul style="list-style-type: none"> ✓ adapted curricula to the new reality of the moment ✓ introduction of the new methods for teaching in many units as possible ✓ better promotion of the STEM/STEAM centers at all educational levels (from pre-schools up to university),, but also at the geographical levels (local, regional, national, international) ✓ ensuring a proper funding for both endowment of the schools and teacher staff ✓ encouraging public-private partnership for a better development of the research and innovation fields ✓ better correlation between STEM/STEAM learning units, business environment and labour market 	<ul style="list-style-type: none"> ✓ the use of technological means for teaching subjects under the STEM umbrella ✓ creating a favorable environment for the introduction of STEM interdisciplinarity into the learning process ✓ using of interesting ways of connecting STEM learning with creative outlets such as drawing and play-acting 	<ul style="list-style-type: none"> ✓ implementing educational video content and real-world practical exercises ✓ to use the learning methods that combine theory and practice in ordere to ensure a better comprehension of STEM subjects in a funny, interactive environment with real-world materials.

Conclusion: The common core of the new solutions and approaches in the national education systems presented above is the introduction of alternative and interactive methods of interdisciplinary presentation of STEM areas, by using technological tools and means connected to the real world.

1.5 Proposal of topics to be used for the development phase

ROMANIA	CROATIA	CYPRUS
STEM problematic areas and proposal of topics		
<ul style="list-style-type: none"> ✓ Due to the lack of the applied component and the connection of the mathematics with life, teachers should show to the students more often why is needed of maths in daily life ✓ All the major mathematics branches (geometry, algebra, trigonometry, probability) have direct application to the real world...just look around! 	<ul style="list-style-type: none"> ✓ The three hardest STEM subjects for children to understand have been identified as maths, chemistry, and physics ✓ Proposed lessons <ul style="list-style-type: none"> -Linear equations (Maths) -Pythagorean lesson (Maths) -Volume (Physics) -Vectors (Maths) -Bonds between molecules (Chemistry) -Temperature (Chemistry) -Compounds of matter (Chemistry) -Newton's laws (Physics) -Motion (Physics) -Light (Physics) 	<ul style="list-style-type: none"> ✓ Having real-world practical applications ensures that students engage more interestingly and develop their problem-solving skills ✓ The proposed topics with development potential are the following: <ul style="list-style-type: none"> -Fluid Dynamics (Physics) -Electricity and Magnetism (Physics) -Optics (Physics) -Thermodynamics (Physics) -Renewable Energy (Physics)
<p>Conclusion: Based on research and focus groups, each of the three countries has proposed to focus on one field from the STEM sphere for which it will develop the training design applicable to young people. Romania proposed mathematics, Croatia at chemistry, and Cyprus at physics.</p>		

2 RESEARCH PHASE 2 – DETERMINING MOST SOCIALLY EXCLUDED YOUTH TYPE

2.1 Overview of the national education system: structure and present situation

ROMANIA	CROATIA	CYPRUS
Overview of the national education system		

<p>✓ The structure of the Romanian educational system is as follows:</p> <ul style="list-style-type: none"> -early education (0-6 years): pre-school level (0-3 years) and pre-school education (3-6 years) -primary education comprises preparatory class and grades I-IV. -lower secondary education or secondary education comprises grades V-VIII. This cycle ends with a national level examination -upper secondary education can be: secondary education (classes IX-XII/XIII, with theoretical, vocational and technological profiles), 3-year vocational education, or vocational and technical education. -non-university tertiary education includes post-secondary education. -higher education is organised in universities, academies of studies, institutes, schools of higher education, called higher education institutions or universities, provisionally authorised or accredited. <p>✓ Special and special integrated education - offers all students SEN educational programs adapted to the degree of disability and their developmental needs</p>	<p>✓ Preschool Education -there is no curriculum and kindergartens and nurseries truly range in quality, especially when it comes to preparing the children for primary education.</p> <p>✓ Primary Education - is divided into two stages: lower primary (grades 1 to 4) and upper primary (grades 5 to 8);</p> <p>-weekly testing puts a lot of stress on children to cram and study - the lack of standardization of the test for finalizing this cycle</p> <p>✓ There are efforts made by the government to implement standardized tests of the end of primary schools</p> <p>✓ Secondary education is compulsory and is attended by students aged 15 to 18 (grammar schools & vocational)</p> <p>✓ Grammar schools -it can be the most demanding to get into and maintain strong grades, but students are then best prepared for their standardized tests at the end of it.</p> <p>✓ Vocational Schools-in different regions of the country there are</p>	<p>✓ Nursery Schools and Kindergartens- since 2004, there is free compulsory preschool education</p> <p>✓ Pre-primary education is aim to:</p> <ul style="list-style-type: none"> ✓ Encouraging creativity and critical thinking ✓ Preparing children for primary school and improving their potential for academic success ✓ Enhancing personality traits like initiative, persistence, self-confidence, and optimism. <p>✓ Primary education - in Cyprus is compulsory for all children who have reached the age of 5 years and 8 months</p> <p>✓ Primary education -along with the right to free nursery education, this mandate aims to provide a strong foundation for their academic journey.</p> <p>✓ Secondary education- six-year education program for students aged 12 to 18</p> <p>- The Gymnasium (first three years) focuses on general humanistic education</p>
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<p>✓ It is organized at all levels of pre-university education, depending on the type and degree of disability, as follows: mental, hearing, sight, locomotive, associated.</p> <p>✓ The educational system in Romania still faces problems at the level of ensuring the quality and equity of education to different vulnerable groups:</p> <ul style="list-style-type: none"> - low participation and inadequate infrastructure to provide early childhood education and care (ECEC) - exposure of VET graduates to work-based learning - Romania's tertiary education attainment rate remains the lowest of all EU countries <p>✓ But, there are visible efforts made by the government and civil society to balance the inclusive educational system</p>	<p>schools for practical trainings into specific professions (eg.stonemasonry); alongside specific subjects, students continue to study a general curriculum in case they hope to undertake standardised tests at the end</p> <p>✓ The Croatian education system has undergone several reforms in recent years to improve its quality and align with European standards.</p> <p>✓ To improve the quality of education some efforts were taken to modernize teaching methods, enhance educational resources.</p>	<p>- Lyceum allows for more in-depth and specialized learning opportunities</p> <p>✓ International students at secondary school - the study of non-Greek speaking foreign students is encouraged; in this respect, the curriculum is adapted, Ancient Greek, Religious Studies, and History, are waived for these students.</p> <p>✓ Secondary Technical and Vocational Education</p> <p>✓ Formal education, apprenticeship scheme, and lifelong education - the necessary condition to attend these schools is that the student had been completed those 3 years of Gymnasium</p> <p>✓ Education and Training for Special Needs – There are 9 special schools offering specialized education for children with special needs if required.</p> <p>✓ The Ministry of Education & Culture is committed to creating an inclusive environment in</p>
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		mainstream schools where children with special needs and disabilities can integrate.
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Conclusions:

- ✓ At the level of the three countries, there is a similarity regarding the structuring of the educational systems.
- ✓ All three educational systems ensure access to students from the earliest ages.
- ✓ It is clear that there are shortcomings of the systems that must be improved, in order to ensure a quality and fair education for all children, regardless of the socio-economic background, the special needs they face.
- ✓ At the governmental level, all three countries make efforts to improve the quality of education and provide equal opportunities for access to education for all children, including those from vulnerable groups.

2.2 Children excluded from the education system: causes, typologies, solution implemented so far.

ROMANIA	CROATIA	CYPRUS
Children excluded from the education system:		
<ul style="list-style-type: none"> ✓ The main categories of children more exposed to social and educational exclusion are: <ul style="list-style-type: none"> - children from families affected by poverty; - children with parents that went to work in other countries; - children with special needs; - Roma children. ✓ There are recent national strategies and programs and other public policies that 	<ul style="list-style-type: none"> ✓ There are certain groups that are more excluded than others including: <ul style="list-style-type: none"> ✓ children with disabilities; ✓ roma children; ✓ children from socioeconomically disadvantaged backgrounds; ✓ migrant and refugee children ✓ There are a number of outreach programs with the Roma community to try to counteract the social exclusion of Roma children 	<ul style="list-style-type: none"> ✓ According to a study in Cyprus, students from different schools or backgrounds (such as refugees or those from low-income families) often experience social exclusion ✓ Students suggested that teachers should take proactive measures to incentivize student engagement before the start of the school year.

<p>stipulates measures for a better inclusive education</p>	<ul style="list-style-type: none"> ✓ There are few specific measures for social-economic disadvantaged children aimed at alleviating this by the government, as the usual access to the welfare state for financial and practical support. ✓ Many nonprofits organizations offer to them some programs as free homework clubs ✓ Schools also try to offer support for purchasing school materials and offering one on one tuition ✓ Croatian schools are now mandated to offer Croatian language courses and provide migrant or refugee children with extra support for a better integration into the school education system. 	
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Conclusions:

- ✓ Also, at the level of the categories of students who face social exclusion, there are similarities between the three countries.
- ✓ There are solutions proposed by governments and civil societies to improve the inclusive education.
- ✓ What is needed next is for Governments to ensure the implementation of these measures/solutions through adequate financing.

2.3 Proposal of the most excluded types of youth from the education national system, to be used as characters of the educational cartoons.

ROMANIA	CROATIA	CYPRUS
Proposal of the excluded type of youth from education as a main character of the cartoon		

<ul style="list-style-type: none"> ✓ students from different backgrounds face different degrees of social exclusion ✓ the proposal of the excluded youth as a main character of the cartoon is youth with SEN (with physical disability) 	<ul style="list-style-type: none"> ✓ from the focus group and interviews it emerged that those from the neurodivergent community, those from the autism spectrum are often exposed to social and educational exclusion 	<ul style="list-style-type: none"> ✓ Based on research reports, it appears that many young people from a variety of backgrounds in Cyprus experience varying degrees of social exclusion. ✓ To help empower these marginalized groups, educational cartoons featuring characters from diverse backgrounds, such as refugees from low-income families, could be a helpful tool.
<p>Conclusion:</p> <ul style="list-style-type: none"> ✓ Educational cartoons are a useful solution for promoting empathy, for better understanding of the children/youth from different vulnerable groups and better inclusion of them into a proper education system. 		

3 RESEARCH PHASE 3 – SELECTION OF THE EDUCATIONAL CARTOONS METHODOLOGIES AND TECHNIQUES

3.1 Analysis of the existing educational cartoons methodologies and techniques- overall benefits of these methods.

ROMANIA	CROATIA	CYPRUS
Analysis of the educational cartoons methodologies and techniques & benefits		
<ul style="list-style-type: none"> ✓ There are conventional and modern techniques of producing animation, either 2D either 3D: <ul style="list-style-type: none"> - stop-motion animation - cutout animation - rotoscoping 	<ul style="list-style-type: none"> ✓ To create a good cartoon, we need to start with scriptwriting and storyboarding. ✓ There are several storyboarding software 	<ul style="list-style-type: none"> ✓ There are certain methods of making educational animations with certain benefits: <ul style="list-style-type: none"> - Integration of curriculum-based content into the cartoon's narrative

<ul style="list-style-type: none"> - Cel animation - 3D CGI(Computer Generated Imagery animation - Flash animation <p>✓ Using cartoon as an educational tool has some benefits:</p> <ul style="list-style-type: none"> - it helps the child's development on several levels: linguistic, cognitive, socio-emotional and physical; - images and sensorial experiences stimulate and help them to train their imagination; - problem solving skills are developed and working memory improves; - can be discover new passions and talents, which they can later train in many other contexts; - It trains critical and analytical thinking. 	<p>that can be used in this process, for example:</p> <ul style="list-style-type: none"> - Storyboarder - Toon Boom Storyboard Pro - Adobe Photoshop - Storyboard Fountain <p>✓ Storyboarding has several benefits, including:</p> <ul style="list-style-type: none"> - Saving time in the making and editing process - Maintaining the continuity of the story in the editing process - Making it easy to communicate creative visual ideas to the public <p>✓ There are several 2d and 3D conventional and modern technique to produce animation, or combined techniques of animations (cutout & drawing) using different softwares or movie editor.</p> <p>✓ The benefits of these kinds of video making are more time spent on the story and less on the animation, making it easier to make for amateurs.</p> <p>✓ There are several free online tools for making cartoons that</p>	<p>makes learning more relatable and engaging for children;</p> <ul style="list-style-type: none"> - use of visual aids, such as colourful illustrations, animations, and diagrams enhances comprehension and retention of educational content - inclusion of interactive elements like quizzes, puzzles, and games involves children's active learning, promoting critical thinking skills, problem solving skills - incorporation of humour and storytelling techniques establishes emotional connections, making the learning experience more enjoyable and memorable. - alignment of educational objectives with entertaining storylines and characters keeps children engaged and interested in the content - incorporation of real-world examples and scenarios enables children to apply their
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	make their production easily accessible.	<p>knowledge in practical contexts;</p> <ul style="list-style-type: none">- incorporation of age-appropriate language and vocabulary facilitates learning and comprehension;- integration of diverse cultures, perspectives, and inclusivity fosters a positive and inclusive learning environment. <p>✓ There are exemplified several educational cartoon techniques:</p> <ul style="list-style-type: none">- traditional animation;- 2D and 3D animation;- stop motion- motion graphics
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Conclusions:

- ✓ At the level of the three countries, similar methods and techniques for making educational animations were exemplified.
- ✓ The research carried out in the 3 partner countries showed the importance of using educational cartoons and the benefits that this method has among children, parents and teachers.
- ✓ Thus, cartoons are not simple visual elements inserted into the educational process to make it more appealing, but represent an educational method that facilitates: logical learning, application of knowledge in day-to-day life, changes attitudes about things or situation that are not fully understood or for which there are prejudices, and, finally, behavioral changes.
- ✓ When students resonate and empathize with their favorite cartoon character, positive behavioral changes will appear sooner or later.
- ✓ After all, education presented in this applied and attractive manner fulfills its major dimensions, both informative (contents, knowledge) and formative (competencies, skills, attitudes, behaviors).

3.2 Possible online tools, software and generators capable of creating the cartoons and their components.

ROMANIA	CROATIA	CYPRUS
Tools & software		
<p>✓ There are at least 10 software for creating 2D and 3D animation:</p> <ul style="list-style-type: none"> - Toontastic 3D - FlipaClip - Pencil 2D Animation - Mango Animate Whiteboard Animation Video Maker - MotionBook - Synfig Animation Studio - Cartoon Animator4 - Animation Desk - Scratch - Animatron 	<p>✓ Hereby a list of all the cartoon/animation making software preferred by youth:</p> <ul style="list-style-type: none"> - Flipaclip - Cartoon Animator 4 - Moho - Toon Boom Harmony - Synfig Studio - Animaker - Procreate - Blender - Pencil2D - Toonz - PowToon - Autodesk Sketchbook - DaVinci Resolve 	<p>✓ There are exemplified at least 10 popular animation software 2D and 3D with more or less similar features</p> <ul style="list-style-type: none"> - Visme - Adobe Animate - Adobe Character Animator - Blender - Autodesk Maya - Cinema 4D - OpenToonz - Moho Animation - Unity - SideFX (Houdini)
Conclusion:		
<p>✓ There are at least 10 free software per each country for creating 2D and 3D cartoons which are easy to access by both beginners or professionals</p>		

3.3 Proposal of educational cartoons methodologies and techniques.

ROMANIA	CROATIA	CYPRUS
Proposal of educational cartoons & techniques		
<p>✓ It is recommended to use the 2D- digital & traditional techniques for the creation of a cartoon</p>	<p>✓ For storyboarding & generating images based upon a script for video it</p>	<p>✓ According to the current status, traditional hand-drawn animation</p>

<p>that deals with real world problems that can be solved through both STEM approach and social inclusion educational approach.</p>	<p>will be used The Sketchbook app.</p> <ul style="list-style-type: none">✓ For recording and audio editing it will be used Audacity✓ For movie- editing there are many choices for software that can be used, but the best free one is DaVinci Resolve.	<p>and stop motion are the most common and widely used techniques for creating animation. Based on the nature of this project and the current practices, it is suggested the use of the 2D technique for the creation of the cartoon based on the methodologies of "Incorporation of real-world examples and scenarios to enhance understanding" and "Integration of diverse cultures, perspectives, and inclusivity.</p>
<p>Conclusion:</p> <ul style="list-style-type: none">✓ Various accessible techniques can be used for free by students to create their scenarios, characters and problem-situations for which they have to find and express creative solutions.		

[An overview of the researches carried out in the three partner countries within this project](#)

The three phases of research carried out in the project underline several things:

- ✓ At the level of each country, there is a concern among the decision-makers for the improvement of pre-university education.
- ✓ The STEM approach remains a desideratum, in the sense that it is NOT yet implemented at the system level as an integrated approach, but is applied in isolation, where teachers are connected to the current, attractive teaching methods, which emphasize the training of the necessary skills and competencies in daily personal, social and professional life.
- ✓ This is a fact proven not only by the analysis of official national, European and international statistics, but also by the "grassroots analysis" carried out by the 3 organizations through focus groups.
- ✓ Educational policies and government decisions tend to :
 - formalize/recognize the benefits of the STEM/STEAM approach;
 - propose financial mechanisms to support this approach;
 - facilitate access to a quality and inclusive education for vulnerable socio-economic groups
- ✓ Innovative and attractive teaching tools and materials - such as animation - ensure memorable and thorough educational experiences that promote love for knowledge and science, stimulate curiosity and facilitate social cohesion among different groups, including those facing different vulnerable situations, preparing the students for the wider world.

Contact



Programme Coordinator:

FOUR CHANGE ASSOCIATION

Calea Calarasi 178, BI C60, sc A, et 4, ap
20, Bucharest, Romania,



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**Co-funded by
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