

Project Number:
Project Acronym:

KA210-YOU-5C90C2AA
CartoonED
Research Report / Cyprus



Co-funded by
the European Union



Erasmus+ KA2

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 / Cyprus

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	RITE
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Due Date	Saturday, July 1, 2023
Delivered Date	Wednesday, June 28, 2023
Reviewed by	
Contact person EC	

Leading partner	
1.	Association Four Change - Romania

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

Research Phase Report

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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?

STEM education focuses on problem-solving, collaboration, critical thinking, and hands-on learning while integrating Science, Technology, Engineering, and Mathematics. Children need to understand STEM education as it emphasizes the practical application of knowledge by connecting theory with real-world applications. It fosters innovative responses to problems by developing critical thinking and problem-solving abilities. STEM education encourages interdisciplinary learning by combining several disciplines for comprehensive knowledge. Today's technology requires knowledge that, with STEM education, children can acquire to develop the skills they need to succeed in the workforce. Therefore, STEM education provides children with a strong foundation and sets them up for potential careers in engineering, computer science, healthcare, environmental science, and more.

1.2 Analysis of the national situation

In Cyprus, primary and secondary education starts at 6 and ends at 18. It consists of an elementary school (6 to 12), Gymnasium (12-15) and Lyceum (15-18). Students begin to attend Gymnasium after they finish elementary school, at the age of 12. The Gymnasium is a three-year cycle of compulsory education. When students complete three years, at the age of 15, they can move on to upper secondary education (High school), which is not mandatory. The curriculum is specialized and adapted to the spiritual development of children aged 12-15. Students begin to attend Lyceum after they finish Gymnasium (middle school) at 15. The Lyceum is a three-year cycle, and when students complete the three years, at 18, they obtain a certificate called "apolyterion". In addition, secondary technical and vocational education is offered in two streams. A theoretical stream and a Practical stream. Students can undertake Secondary Technical and Vocational Education if they have completed the third year of Gymnasium. The study period is three years, at the end of which the student will receive a school-leaving certificate recognized as the equivalent of the school-leaving certificate received by graduates of Lyceum education.

Science

Regarding STEM education, specifically science, primary education offers the subject of science. For secondary education, the subjects are natural sciences- physics, chemistry and biology. For Technical and Vocational Education, physics and chemistry subjects are offered.

Technology

Concerning technology in STEM education, primary education offers the subject of technology, computer science – Computers. For secondary education, the subject is technology. For Technical and Vocational Education, design subject is provided.

Engineering

Considering engineering, only Technical and Vocational Education provides education with subjects in mechanical, electrical, civic and architectural engineering.

Mathematics

The subject of mathematics is provided in primary and secondary education in Cyprus.

The school study conducted in Cyprus revealed that the students were unfamiliar with the term STEM education and didn't know what the STEM acronym stands for, which was not mentioned in their school. Although a group of students reported that they were taught subjects related to engineering, such as milling, where they had to do mathematical calculations in conjunction with practical work, they couldn't associate this activity with STEM education. The majority of students reported that the subjects related to STEM education taught in their school were mechanical and electrical courses, and some other students mentioned the agriculture subject.

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

Regarding the topics related to STEM in Cyprus, it was revealed that most students struggle to understand and comprehend mathematics and physics. The students expressed their opinion that mathematics and physics are subjects that they are significantly underperforming, and they believed that conventional teaching methods lack visual and practical representations. The traditional methods are based on progressive memorization of the solution rather than understanding the logic behind the answer. In addition, the students reported that psychology impacts their learning process, and many have biased opinions on mathematics and physics, consequently disrupting their understanding. Another critical factor that directly relates to the student's performance mentioned was previous mathematics and physics gaps, making it challenging to overcome. The learning outcome derived from the students was knowledge gaps, prejudice and incomplete of explaining the solutions.

1.4 Solutions and new approaches

Students believed that STEM education could potentially contribute towards helping them understand subjects in a better and more efficient way by teaching them real-world applications. According to the research, students suggested implementing educational video content and real-world practical exercises will enhance their learning experience. Problem-solving exercises directly related to real-world practical applications could enhance students' ability to consolidate mathematics and physics better. A combination of theory and practice is an effective method to engage with students more innovatively, attract the student's interest and provide them with a different perspective, and this will allow better comprehension of the school subjects while keeping the class environment exciting and interacting with real-world materials.

1.5 Proposal of topics to be used for the development phase

In the research conducted via focus groups and interviews, the students expressed their difficulties connecting the theory the schools teach with real-world problems, which reduces their problem-solving abilities. Physics and Mathematics were the most unwelcome subjects where students have the least interest. The conventional teaching methods mainly focus on progressive memorization which leads to frustration and confusion for the students. Having real-world practical applications ensures that students engage more interestingly, giving them a better perspective on how they approach a problem and enabling them to create a solid foundation for problem-solving skills.

According to the national research and student feedback, the proposed topics with development potential are the following:

- Fluid Dynamics (Physics)

Learn about fluid dynamics, including the concepts of pressure, buoyancy, and fluid flow. Applications may include knowing how hydraulic systems operate and how aeroplanes fly.

- Electricity and Magnetism (Physics)

Learn about the basic ideas of electromagnetism, such as electric fields, magnetic fields, and electromagnetic induction, and uses for it such as electric motors and circuits.

- Optics (Physics)

Examine how light behaves and how it interacts with matter. The concepts underlying lenses and optical equipment, as well as reflection, refraction, and diffraction, are all possible topics.

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- **Thermodynamics (Physics)**

Learn about the "heat," "temperature," "energy transfer," and "thermodynamic laws." Students can learn about gases' behaviour, phase changes, and engines.

- **Renewable Energy (Physics)**

Focus on renewable energy sources like solar, wind, and hydroelectricity. They can investigate the environmental effects of various renewable energy generation systems.

2 RESEARCH PHASE 2 – DETERMINING MOST SOCIALLY EXCLUDED YOUTH TYPE

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

In Cyprus, children between the ages of 5 and 15 must receive primary and secondary education. Public schools offer free education from age 5 to 18, but private schools are also available for those who prefer to pay for their education.

Nursery Schools and Kindergartens

In Cyprus, children have the right to free nursery education from the age of 4 years and 8 months. Nursery education aims to support children's development, meet their basic needs, and provide positive experiences for self-realization and a positive self-image. If places are available, children can be registered at public nurseries from age 3. The Selection Committee considers various criteria, including sibling presence, protection status, orphanhood, refugee status, family size, Gypsy or foreign speaker background, and chronological order. Cyprus offers a variety of public, community, and private nursery schools. Free compulsory preschool education was introduced in 2004, with the Ministry of Education & Culture covering operating costs. Community nursery schools often work alongside public nurseries and share facilities. Parents generally pay their children's attendance fees, typically for a morning or afternoon session or extended hours until 2.45 pm.

Pre-primary education

In Cyprus, Pre-Primary education is established at 4 years old and 8 months old and the compulsory Pre-Primary class at 5 years old. The educational programs focus on achieving the following objectives:

- 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.

Primary education

Primary school in Cyprus is compulsory for all children who have reached the age of 5 years and 8 months. This requirement ensures that children receive essential education starting at the appropriate age. Along with the right to free nursery education, this mandate aims to provide a strong foundation for their academic journey. Children who

meet the age criteria must enrol in primary school to fulfil their educational obligations. By making primary education mandatory, Cyprus emphasizes the importance of early learning and lays the groundwork for children's academic development.

Secondary education

Secondary schools in Cyprus provide a six-year education program for students aged 12 to 18. The secondary school system consists of Gymnasium (first three years) and Lyceum (next three years). The Gymnasium focuses on general humanistic education, while Lyceum offers specialized study in various subjects. The purpose of the Gymnasium is to provide a broad educational foundation, while Lyceum allows for more in-depth and specialized learning opportunities. The secondary school system in Cyprus aims to cater to students' academic growth and prepare them for further education or the workforce.

International students at secondary school

Cyprus is known for its inclusive education system that integrates international students into regular classes at secondary schools. The Analytical Teaching Program is designed to help non-fluent Greek language speakers acquire the necessary language skills for the education system. To cater to their language learning needs, courses that may be challenging for non-native speakers, such as Ancient Greek, Religious Studies, and History, are waived for these students. This enables them to focus on developing their Greek language proficiency. The country is committed to supporting and assisting international students in helping them adapt to the curriculum.

Secondary Technical and Vocational Education

In Cyprus, Secondary Technical and Vocational Education present three paths: formal education, apprenticeship scheme, and lifelong education. The education system comprises two streams, Theoretical and Practical, where students who have completed the third year of Gymnasium can choose to pursue this pathway. The program runs for three years, and upon completion, students receive a school-leaving certificate equivalent to the certificate obtained by Lyceum graduates. This education pathway equips students with practical skills and recognized certification, preparing them for technical and vocational careers.

Technical and Vocational Education of the formal education system

Research conducted in Cyprus revealed that students reported instances of social exclusion, where a person is ignored and mistreated, leading them to believe they are inherently flawed. While some students did not witness such behaviour in their school, others acknowledged instances of social exclusion. This difference in responses

highlights the complex nature of social interactions and varying perspectives among students regarding this issue.

Apprenticeship Scheme

In Cyprus, apprenticeship schemes are offered to students who decide not to continue with Lyceum education after Gymnasium and want to concentrate on their careers. Eligible students can apply for apprenticeships once they complete the second year of Gymnasium and turn 15 years old before December 31 of the registration year. Apprenticeships are generally not available to students over 18 years of age. The apprenticeships are two years long and consist of theoretical and practical training. Students work in the industry three days a week and receive a salary for their services. The remaining two days are spent in school, where they learn theoretical aspects and core subjects related to their preferred field.

Education and Training for Special Needs

In Cyprus, the Education and Training of Children with Special Needs Law 1999 ensures that children with special needs receive the support they need to develop in psychological, social, and learning areas. The law also emphasizes training staff members to equip them with the necessary skills to support these children adequately. The Ministry of Education & Culture is committed to creating an inclusive environment in mainstream schools where children with special needs and disabilities can integrate. However, Cyprus also has nine special schools offering specialized education for children with special needs if required. These schools provide additional resources to ensure that all children with diverse needs receive an appropriate education.

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

According to a study in Cyprus, students from different schools or backgrounds often experience social exclusion. This unfortunate phenomenon was reported by students who witnessed it in their schools. Some students found it challenging to accept socially excluded individuals with different views, as they were unfamiliar with them and found it hard to conform. Socially excluded students often suffer from low self-esteem and loneliness. However, the study also highlighted a positive outcome where a group of students helped their socially excluded peers by encouraging them to connect with others and share their feelings. They did this by initiating simple conversations, ultimately leading to significant relationships. To address this issue, many students suggested that teachers should take proactive measures to incentivize student engagement before the start of the school year. This approach could go a long way in breaking down barriers and promoting inclusion.

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

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. By promoting empathy, understanding, and inclusion among viewers, these cartoons could help bridge gaps and encourage positive change.

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.

Within the context of this research work, the existing educational cartoon methodologies and techniques were distinguished, and their overall benefits were highlighted. These methodologies and techniques collectively contribute to the comprehensive benefits of educational cartoons, including increased engagement, improved comprehension, enhanced consolidation of information, and the development of young learners' critical thinking and problem-solving skills. **Tables 1** and **2** present the educational cartoon methodologies and techniques.

Table 1 Educational Cartoon Methodologies

No	Educational Cartoon Methodologies	Overall Benefits
1	Integration of curriculum-based content into the cartoon's narrative	It makes learning more relatable and engaging for children, as educational content is presented within entertaining storylines.
2	Use of visual aids, such as colourful illustrations, animations, and diagrams	Enhances comprehension and retention of educational content through visual stimulation and appealing visuals.
3	Inclusion of interactive elements like quizzes, puzzles, and games	Actively involves children learning, fostering critical thinking skills, problem-solving abilities, and engagement.
4	Incorporation of humour and storytelling techniques to create emotional connections with viewers:	Establishes emotional connections, making the learning experience more enjoyable, relatable, and memorable.
5	Alignment of educational objectives with entertaining storylines and characters	Ensures educational goals are achieved while keeping children engaged and interested in the content.
6	Utilization of characters as relatable role models to facilitate learning	It helps children connect with characters and their experiences, promoting empathy and understanding of various perspectives.

7	Incorporation of real-world examples and scenarios to enhance understanding	Relates educational concepts to real-life situations, enabling children to apply their knowledge in practical contexts.
8	Incorporation of age-appropriate language and vocabulary	Assures the content is accessible and understandable for the target age group, facilitating learning and comprehension.
9	Integration of diverse cultures, perspectives, and inclusivity	Promotes cultural understanding, diversity, and inclusivity among children, fostering a positive and inclusive learning environment.

Table 2 Educational Cartoon Techniques

No	Educational Cartoon Techniques	Characteristics
1	Traditional Animation	Traditional animation, also known as hand-drawn animation, involves the creation of individual frames by hand, resulting in a smooth and classic animation style."
2	2D Animation	2D animation refers to the creation of moving images using two-dimensional techniques, such as drawing and manipulating digital graphics, resulting in flat, cartoon-like visuals
3	3D Animation	3D animation involves computer graphics to create lifelike and dynamic moving images in a three-dimensional virtual environment, adding depth, realism, and visual effects.
4	Stop Motion	Stop motion is a technique where physical objects or models are incrementally moved and captured frame by frame to create the illusion of movement in a sequence of photographs.
5	Motion Graphics	Motion graphics is a digital technique that combines text, graphics, and animation to create visually engaging and dynamic content for various media, including films, advertisements, and user interfaces.

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

Considering the animation software tools used to generate the cartoons, **Table 3** presents the most popular for various applications, including their main features.

Table 3 Popular Animation Software

No	Name	Characteristics
1	Visme	Cloud-based, online design tool for creating animated social media images, infographics presentations, ads, and banners.
2	Adobe Animate	Create interactive vector graphics and 2D animations for videos, ads, games, and television.
3	Adobe Character Animator	Create motion capture to create live animations of your 2D characters. Create a character in Illustrator or Photoshop, and import it into Character Animator.
4	Blender	Programming features for rendering, modelling and creating 3D animations.
5	Autodesk Maya	3D animation, modelling, rendering and simulation tools for realistic characters.
6	Cinema 4D	3D computer animation, modelling, simulation and rendering.
7	OpenToonz	Free and open-source for creating multiple animation styles. 2D animation capabilities.
8	Moho Animation	2D vector animation, robust animation technology and tools.
9	Unity	3D animation, cinematics tool for film, television and gaming. Shared composition, accelerated rendering and non-creating tasks automation.
10	SideFX (Houdini)	3D animation for rigging, modelling, VFX, animation, lighting and rendering of gaming, film and TV.

3.3 Proposal of educational cartoons methodologies and techniques.

Considering the outcome of the research in Cyprus, the most popular cartoons mentioned by the students were the Smurfs, Garfield, Tom and Jerry, Ben Ten, Bob the Builder and HEIDI cartoons. A famous cartoon mentioned in the research phase for addressing social problems was HEIDI, which teaches lessons on bullying and intimidation and inspires marginalized youth and their peers by highlighting the challenges these excluded youth face and showcasing their resilience and strengths. According to the current status, traditional hand-drawn animation 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."

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