

Sustainable development as an education tool for primary school students through SCRATCH code

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Abstract. The concept of sustainable development is not only a scientific term but an essential way of changing the way of life for modern man. The cultivation of the values recommended by the UN through the 17 goals must become a pedagogical tool at all levels of education in order to achieve the most basic component of environmental education and sustainable development in the context of ESG, which is the process of recognizing values and clarifying concepts to develop the skills and attitudes necessary for understanding and appreciating the interrelationship of man, culture and the Biophysical environment. The project focus: a) on principles of software programming and pedagogical issues and b) on eco-social contextualization & dynamiting activities that can be applied with the students in order to create a pedagogical model through the use of Scratch code so that students can master knowledge through STEM methods.

1 Introduction

More and more the idea to use computers programming in order to improve student's skills, it is getting part of the educational procedure [1]. Using sustainable development as an educational tool for primary school students through SCRATCH code, is a creative and engaging way to introduce young learners to important concepts related to environmental and social responsibility. SCRATCH is a visual programming language that is widely used in educational settings to teach coding and problem-solving skills [2].

What Scratch is? Scratch is a free programming language developed by MIT that makes it easy to create interactive stories, animations, games, music, and art, and share your creations on the web.

Scratch can run from within a modern web browser or downloaded as an app and it is designed to be fun, educational, and easy to learn [3].

The main advance of Scratch in primary schools

Scratch promotes: computational thinking and problem-solving skills, creative teaching and learning, self-expression and collaboration, and equity in computing.

Students learn: To think creatively, Reason systematically, work collaboratively, Scratch is always free and is available in more than 70 languages.



Fig. 1. The Scratch logo by MIT

Some of the most important benefits for the teachers is: 1) They plan the didactic proposals to be carried out with the students, focus: (SEP) a) Preparation, design and testing of a Scratch game, (SEP) b) Creation Observatory SDG and definition objectives of the observatory and action [4].

The project idea is a proposal for educational use in primary education which focus on a specific pedagogical idea on how it can integrate sustainable development concepts into SCRATCH projects for primary school students starting with Selecting Sustainable Development Goals (SDGs) that are suitable for the age group and relevant students' context, throw creation of interactive stories that revolve around environmental challenges and solutions, Developing simulation games that highlight the impact of certain actions on the environment.

The next step must create a coding Concepts to Integrate in order to teach students about coding logic

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using conditional statements, to introduce the concept of variables to track progress, and show to the students how to use event-driven programming to make characters or objects respond to different interactions by utilize animations to visually represent the effects of sustainable actions.

By combining coding skills with sustainability education through SCRATCH, you can inspire young students to become environmentally conscious and socially responsible citizens while developing their computational thinking abilities.

2 Methodology

The main objective of the program is to create a pedagogical proposal with direct application in the field of environmental education, the basic methodology follows the basic principles of environmental education adapted to the concept of the program. These methodological principles are: 1. Awareness within the 4 dimensions of the projects a) Programming SCRATCH, b) focus on the topic environmental and sustainable life, c) Social ecosystem involvement and, d) take care in inclusion and social concern. 2. Development of skills by scratching and eco-socialising. 3) Participation by a) Observatory Sustainable Goals (SDG, b) Creation of a “world café”, c) the SDG Matrix which will relate students with schools. 4. The evaluation of what actions did the schools achieve today as part of the project.

2.1 The principal idea of the project

In the framework of the Erasmus+ program in 2021, the proposal entitled: EcoSocial I-City Technology fostering ecosocial Education was submitted. The proposal had as main horizontal objectives 1: Addressing digital transformation through development of digital readiness, resilience and capacity 2: Environment and fight against climate change. In the part of school education, he had to aim at a series of pedagogical issues that would work multiplying in the part of education. That was: Supporting teachers, school leaders and other teaching professions [4].

The topics he raised for discussion included issues that concern the modern education community and related to: Environment and climate change, Digital skills and competences but also the European identity, citizenship and values [5].

2.2 The 6 partnerships

Partners of the project included a company, a university institution and 4 schools from four southern Mediterranean countries, specifically Primary schools from Turkey, Greece, Italy and Spain. They may have been bodies and institutions from different countries, but they had the same philosophy of thought and the common cultural tradition of the peoples of the Mediterranean, which allowed for a friendlier climate of cooperation, which was also demonstrated in the transnational meetings. More specifically the project partners were: The

Ahmet Yesevi Ikokulu primary school from Adana, Turkey, a large school with more than 430 students and 20 teachers, the Fomento de Centros de Enseñanza school an educational institution promoted by a group of parents and teachers who promoted the creation of schools, in which the cooperation of families is considered essential with about 180 students in primary education, Palekastro Primary School from Crete (Greece), a small provincial school in a village of about 1,500 people with about 80 students and 7 teachers, the Italian school Istituto Comprensivo Don Roberto Angeli from Livorno with 1000 students and 100 teachers in 7 schools 3 kindergartens, 2 elementary and 2 high schools. The partnership involved the Department of Nutrition and Dietetics of the Hellenic Mediterranean University from Sitia, Crete, which deals beyond the issues of nutrition and dietetics, with food production, environmental resources and the management of food waste. Finally, one more company participated in the program from Spain and the city of Valencia, Associació Meraki Projectes de València Who offers training and advice to educative centers and other entities for their transition to a more digital environment and in internationalization matters (European projects). Unfortunately, during the project, the Istituto Comprensivo Don Roberto Angeli withdrew from the project partnership without bringing the agreed results.

2.3 The 4 Dimensions of the Projects.

The project starts its meetings having as an orientation 4 different dimensions on the mater trying to comprise the 17 different goals of sustainable development:

Dimension 1 Programming SCRATCH and Classroom Pilot Design. 3 of the partners took the responsibility to run some values on the project was the school of Fomento Vilavella to Scratch with eco- social topics, the Ahmet Yesevi Ikokulu to software programming and STEAM and the Association Meraki to introduce to the methodologies but also to transfer and interact with the students' groups.

Dimension 2 had focus on the topics Environment and Sustainable Life. Responsible for the action was the Palekastro Primary School on the topic school & natural environment. It was important to get this topic, because Palekastro is in the meddle of Sitia UNESCO Global Geopark and a part of school life is the relation of the school environment to nature.

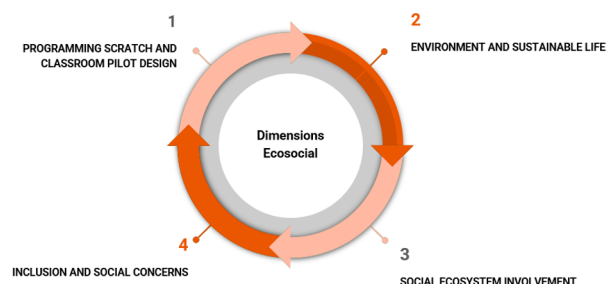


Fig. 2 Dimensions of Ecosocial

The Hellenic Mediterranean University organise the

topic: healthy life and consuming local products in Mediterranean diet. Mediterranean diet is part of Cretan Diet and the department of Nutrition and Dietetic Sciences, has a savvier background on local food production, promote the healthy life and connect food with health and environment. The Association Meraki get the topics of sustainability and natural environment management, climate change mitigation and adaptation, because they have specialists with knowledge on environmental engineering and management.

Dimension 3 with the general title: Social Ecosystem Involvement. In this dimension, identifying some of the topics we can approach with the students are mobility, food, health, air, water, social concerns, climate change, waste, local products, health, Mapping problems, public lighting, energy, diversity, multiculturality, etc.

Istituto Comprensivo Don Roberto Angeli get the Network of entities linked to the school aims.

Palekastro primary school take the responsibility for the collaboration with entities because of the big network of cooperation that school have and the department of Nutrition and Dietetic Sciences to advice in broader networks as a university institution with access to environmental networks and cooperation with other universities institutions all over Europe.



Fig. 3. The 17 Sustainable Development Goals

Dimension 4 take care on Inclusion and Social Concerns the Ahmet Yesevi Ikokulu, already use the Montessori and inclusive teaching, as well as programming and it was able to pass on its expertise to the rest of the team.

The Istituto Comprensivo Don Roberto Angeli decided to organise the Multicultural centre and the Meraki association the participatory processes like collective mapping, focus groups, as well as in accessibility issues.

The basic reasoning in the program was to adhere to

the basic principles of environmental education, a methodological model, a proposal is to structure the teaching in four axes: a) Information - Awareness, b) Behaviour - Attitudes Values, c) Skills, d) Participation. This allows and encourages the participation of students in creative action, reflection, the ability to discuss, the cultivation of creative thinking but above all the process of learning and acting [5].

1. Compendium of didactic proposals made in each of the different participating centres in the eTwinning platform.
2. Integration of the didactic proposals developed in this project in the official training given in the participating centres.
3. At least four applications developed in Scratch to raise awareness about the SDG (at least 1 per school).
4. Four SDG observatory groups composed of at least 5 students (one per school).
5. Environmental analysis reports in each of the participating centres (developed by the SDG observatory groups).
6. Involvement of the educational community and other relevant agents and stakeholders in the development of the project.
7. Improvement of the Eco-social and programming skills in more than 100 students of Primary Education involved in Scratch and/or SDG observatory
8. Increase of the sensibility and interest in the SDG and in European cooperation.
Ideation: teachers training and management.

2.4 Scratching & Eco-socialising. Ecosocial I-City.

2.4.1 Introduction activities

Present the project to three different groups:

- ▶ For the school staff: Selection of the teaching staff that will participate in the project
- ▶ For the students: Identify the student's groups and levels to develop the project
- ▶ For the school community: Identify potential contributors-collaborators among the community (parents, municipality, associations, other education centres, local commerce, etc.) This group can be included in any initiative, task or activity that you consider useful.

2.4.2 Working with the didactic proposal Students

Students in each school had to choose 4 of the 17 sustainable development goals and create a Scratch game on at least one of them. As simple as it sounds, it requires a very good collaboration between the IT teacher and the classroom teacher. For a secondary school student, it is easier to understand the process of Scratch code but for a primary school student the first difficulty is to create a login account, thus the participation of the parent to use an email address that will be able to check the inbox and also to exercise a meaningful parental control. All Scratch code is supported and linked to the website

scratch.mit.edu which means that it is guaranteed by the Massachusetts Institute of Technology, but it is still an interactive medium. This means that the student should have boundaries which the teacher should be a part of even from a distance.

The important thing for the program is that through the Scratch 3.0 version and also the familiarity that the students acquired during the coronavirus pandemic, there was the possibility of using a tablet, which allows the use of the version of the program. This was an element that the program took into account in order to use the game even from a mobile phone.

2.5 Observatory Sustainable Development Goals (SDG)

a. Presentation of the SDG and the Observatory. In 2000, UN member countries adopted 8 Millennium Development Goals, according to which they committed to make significant progress towards ending poverty and achieving a range of other development goals by 2015. UN members recognized the multidimensional nature of development and poverty alleviation, which requires much more than simply raising the incomes of the poor. Of course, the very setting of 2015 as the final date for achieving the goals discouraged rather than encouraged international aid, to the extent that its achievement was deemed unattainable. For this reason, the need to define the objectives through a more general framework of 17 general principles with 169 objectives of the SDG, where through 232 indicators that are regularly calculated with the aim of monitoring progress, was raised again. The UN already issues annual SDG reports noting their achievement, as well as the challenges they face [5].



Fig. 4. SDG Observatory

b. Observatory constitution. Students are not able to create reports like those of the UN but it has been observed that many of the criticisms found in the Millennium Goals have led to changes in the design and implementation of the SDG. With the same logic and sense of "Think Global Act local" students can become observers of the SDG [5].

c. Participative process to identify the main needs or things to change at the school.

- d. *Initial Open questionnaire online: Design, preparation and dissemination in Google Forms.*
 - Awareness level/knowledge about the SDG.

- Do you have any ideas about how we can improve water, energy, green, air, food, ... at school?

- Main concerns, main interests about sustainability and the SDG

- e. Results: report, presentation of the observatory group to the school with the results.
- f. Choose the SDG-s to work with during the school year.
- g. Initial checklist of the school regarding the SDG-s chosen and Goals that we want to achieve with our report.
- h. Design of the Observatory activities.
- i. *Final questionnaire :*

- Level of Awareness/knowledge about the SDG.

Final report and recommendations for the future improvements

The didactic proposal on SDG observatory.

1. Improvement of the following skills in more than 100 students of Primary and Secondary Education
2. Four applications developed in Scratch to raise awareness about the SDG.
3. Four SDG observatory groups composed of at least 5 students (one per partner).
4. Environmental analysis reports in each of the participating centres (developed by the SDG observatory groups).
5. Involvement of the educational community and other relevant agents and stakeholders in the development of the project.
6. Integration of the didactic proposals developed in this project in the official training given in the participating centres.
7. Increase of the sensibility and interest in the SDG and in European cooperation.

To work the ecosocial issues with the students and, at the same time, to identify those topics that are closer to their concerns as well as to those of the school community [6].

To do so, we can use a couple of participative tools:

World Cafe: students and other participants (this can also be applied with e.g. teaching staff) are grouped in 5 small tables (one per topic – colours in the image below).

They have 2 materials to work: the image below, and a white paper with 2 columns (one per round)

We have 2 rounds:

ONE to answer "WHAT NEEDS WE HAVE? What we want to change?";

SECOND to answer "HOW we can achieve it?"

Each round is 20min maximum long.

SDG Matrix: Work with the SDG to know them and relate them to our school. The idea is to classify the SDG in this axis, the closer to the school, the more relevant is to it. Each quarter of the matrix is related also to a general topic. Below, you can see a couple of examples. On the left, a proposal for topics. On the right, an example of a matrix prepared for the Construction sector [8].

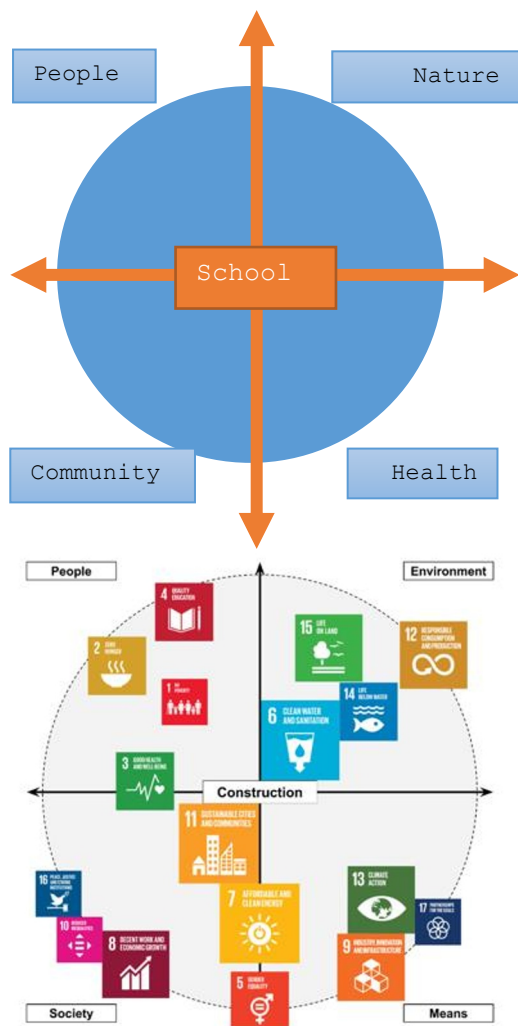


Fig. 5. The SDG axis

Teaching staff role

Training multiplier: replication of the project training to your colleagues



Fig. 6. Ideas for the observatory's Topics for the school report on SDG:

- Materials: presentations, and some tutorial or video
- Sessions and meetings to start and run the didactic projects
- Certificates for the participants
- Finalize the specific design of the didactic proposal [9]

2.7 "How to live in an EcoSocial I-City":

Disseminate and transference

1. The EcoSocial I-city project made to create a Collection of didactic proposals on Scratch and SDG.
1. Make to inspire more than 100 students to participate in actions for SGD and improving their skills in computers technologies [1][SEP]
2. It has Organise the school communities with skills to become Observatories on SDG.
3. It has created 36 Eco-social reports written by students.
4. Disseminations results with a logo, [1][SEP] a brochure, posters and a website.
6. Training program for teachers in Scratch and in SDG and co-creative work.
2. 12 teachers trained in Scratch and 12 teachers trained in SDG and co- creative work.

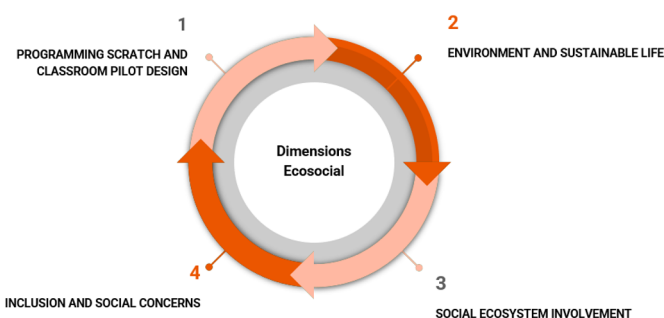


Fig. 7. Dimensions of the didactic proposal

3 What actions did the schools achieve today as part of the program?

Perhaps the most important action of the program was the functioning of the pedagogical action through examples. The EcoSocial I-City program could not be considered a success if it had not been able to work through the example [5] [6]. As much as we covered the theory, the students had to see the program in action. This is how the action Environment and school: (pedagogical intro + examples) was implemented in all 3 schools where I stayed in the program as well as in the Department of Nutrition and Dietetics.

In the framework of the action

- a) school environment (create vertical garden Food, flower bees - green walls)
- b) natural environment (Natural park & Natura 2000 - activities outdoor), field visit: Palekastro Vai palm forest, Antalya Kursunlu Waterfalls, Spain Albufera Natural park, HMU Gorge of Samaria.
- b) Healthy life: nutrition and sustainable life. Trying to eliminate single-use plastic cups at school and bottled water, through the use of water jugs from home.
- a) Healthy life and consuming local products. Increase of local products of local production in school and university canteens. At the same time, more locally produced and seasonal fruits as dietary options.

c) Diet, environment and health. Collaboration of schools with the department through online meetings.

- SDG (eco and social). 65 student observation reports from all schools and an effort to create a booklet that will give feedback for future use.
- Food and healthy life: calculate food print. Students record once a week where in the world the food they consume comes from. A new action is currently being prepared entitled: Globalization of food production and consumption: what we can learn from product labels about tonicity, nutritional value and energy burden.
- Climate change and sustainability: Fridays For Future - similar movements and initiatives. Every Friday students participate in a half-hour activity for the best image of the school. Participation is voluntary and includes taking care of the greenery at the school and actions for a clean yard. It has been observed that the courtyard is cleaner free of garbage previously created by the students, mainly from the food packaging they consumed [10].
- Game backgammon

4 Conclusions

The EcoSocial I-city program starts from a purely theoretical basis, but then through a process of strengthening the technological skills of students through the SDG that tries to make active citizens through the ability to see problems in the implementation of the goals, and with their observations to think globally but act locally.

Because of the scratch code, the cooperation of the class teacher with the IT teacher and the parents is required. It is a cooperative process that, through a game, tries to change situations and behaviours and to socialize children in an era that increasingly distances them from communality.

Program participants act as multipliers. Both teachers and learners, through the "act by example" actions, but also by inviting through the Scratch code in the game even more teachers and students to know the necessity of the SDGs to achieve their goals for the betterment of society in which obviously also belongs to the school.

However, the range of challenges for sustainable development, ending social inequalities and protecting the environment, remains enormous. Participatory growth and the path to improving goals is not a linear path that follows a linear trend. It is a dynamic course that must be strengthened with even greater participation. The use of new technologies has the ability to unite different trends and cultural references as in the case of EcoSocial I-city where teachers from different countries, different levels of education collaborated and gave suggestions in the context of this course.

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