Panhellenic STEM & Educational Robotics Competition 2023-24
Open Category
(3rd - 6th grades of Primary School)

Mediterranean Source of Life and Culture

Rules and Scoring

B' Edition (October 2023)

Diligence
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Introduction by the President of WRO Hellas

The big **celebration of STEM and Educational Robotics** is here! This year marks 17 years in the effort to introduce educational robotics as well as STEM methodology into compulsory education. This year's Panhellenic Competition **is organized for the 10th consecutive year** by STEM education with COSMOTE as a Strategic Partner and is under its control **auspices** of **Ministry of Education** and Religions.

The **organization** of a big event like the Panhellenic Educational Robotics Competition requires **experience and expertise** that we have mastered and provide **free** in the educational community

With the competition as a vehicle, we pursue the introduction of educational robotics, as well as the wider **STEM** (Science-Technology-Engineering-Mathematics) methodology in the formal education system. The Panhellenic Competition is a unique way for young students to understand science, programming and automation, learn to think like engineers, develop their problem-solving skills and expand their creativity.

During their preparation for the competition, the students, with the guidance of their teachers-coaches:

- form groups (**teamwork**)
- study the relevant literature and experiment (**critical thinking**)
- explore the science of engineering (**engineer thinking**)
- face challenges and propose solutions (**problem solving**).

By exploring these skills in a hands-on and participatory way, children develop resources that are essential for their **future**, whatever career choice they pursue.

The elements that make up the new competition include the following innovative changes:

- Single theme for all ages
- The introduction of simple machines
- **The introduction of measurements in Primary**.

Overall, the Panhellenic Competition supports STEM as a methodology for compulsory education and defines the ways in which students will acquire the skills of the 21th century. At the end of the competition, the educational community - from Kindergarten to High School - by participating in the competition is invited to respond to the **convergence of Greece with technologically developed countries**.

Good luck

Ioannis Somalakidis

Description of the subject

The Mediterranean is the source of European civilization. It connects with its closed, protected sea three continents, Europe, Asia, Africa.

It condenses all currents of art and philosophy born in its fertile soil over the centuries. She lets them flow and blend through her multiple passages.

It is the model of multiculturalism sculpted by coastal peoples with different religions, values, attitudes and styles, who learned through their travels and colonizations to exchange goods and products of their art and craft to live together in a measure of solidarity and of mutual respect.

«**The Mediterranean is a coexistence of ideas, feelings, cultures, ways of life and creation. It is a crossroads of cultures, a starting point and a destination**» writes the visual artist Giorgos Lazogkas

The Mediterranean is**a transcontinental sea,** extension of the Atlantic. It "separates" Europe from Africa and borders the following states:*Spain, France, Monaco, Italy, Malta, Slovenia, Croatia, Bosnia-Herzegovina, Montenegro, Albania, Greece, Turkey, Cyprus, Syria, Lebanon, Israel, Palestine, Egypt, Libya, Tunisia, Algeria, Monaco, Gibraltar and Morocco*

It covers **2,510,000 Km2** and includes over **10,000 islands**, in which more than 15,000,000 people live. Its name was used for the first time in the 3rd century by the Latins, and in particular Solinus, who characteristically calls it **"Mediterranean Sea"** i.e. sea between two continents. As for the Greek term **"Mediterranean"** comes from the geographer - bishop of Athens Meletius II.

Characteristic of the Mediterranean is its deep blue color, which is due to the non-growth of plants due to the lack of nutrients. This deprivation, however, does not imply a lack of biodiversity, as over 12,000 species can be found in its waters, ⅓ of which are endemic, such as the loggerhead turtle and the Mediterranean seal.

It is not called unjustly **"incubator of Western civilization",** as due to the cultural exchanges that occurred due to trade, some of the greatest civilizations developed on its shores. Thus both the arts and the sciences, such as astronomy and mathematics, experienced a great flourishing.

To this day, the Mediterranean remains an integral part of world trade, shipping and of course tourism. That is why the need to find ways to protect it is imperative

Sources:

- https://el.wikipedia.org/wiki/%CE%9C%CE%B5%CF%83%CF%8C%CE%B3%CE%B5%CE%B9%CE%BF%CF%82_%CE%98%CE%AC%CE%BB%CE%B1%CF%83%CF%83%CE%B1
- https://www.tovima.gr/2008/11/24/opinions/i-mesogeios-twn-politis

The identity of the Competition

- **Panhellenic STEM - Educational Robotics Competition** (October – March)

has the following categories per education level, for students:

- Kindergarten
- Elementary school
- high school

Elementary level includes:

- The **Open Category (STEM)** and
- the Football 2x2

The **Open Category** of the Panhellenic Primary School Competition is divided into two levels for:

- **the grades (1st-3rd) and**
- **the grades (3rd-6th).**

The tender to which this document refers and which will henceforth be referred to as ***Contest*** is:

- **of the Open category,**
- **of the "Last classes (3rd-6th)",**
- **of the Primary School,**
- **of the Panhellenic STEM Educational Robotics Competition,**

The ***Contest***:

- is an educational activity,
- has a subject related to the Mediterranean Sea
- addressed to groups of 3-6 children, who are accompanied and guided by an adult coach (teacher, parent...),
- will be held (the final) live (unless unforeseen) in Attica,
- is announced in October and is completed at the beginning of the next Spring (end of March),
- is organized by STEM Education, with strategic partner COSMOTE,
- offers for coaches, free intensive webinars related to the educational tools listed to the contest
- In general it aims to act as a nursery of students experienced in automation and robotics and to create an active core of educators-coaches trained in the philosophy of STEM.

Participation in ***Competition*** from the first year in 2015 and until before the pandemic was impressive, with participation per year varying between 300 and 360 teams, which implies approximately 1600 children from all over Greece per year.

Due to the large number of participants, the ***Contest*** is conducted in two phases, the regional competitions and the final competition.

- The **Regional Competitions** (in which the teams of each Region of the country participate) are held at the headquarters of each Region, at the end of Winter, approximately 3-4 weeks before the Final Competition. Depending on the total contest participation, (with a quota from each Region and taking into account the number of teams that can be accommodated in the Final Competition) a certain number of teams qualify for the Final Competition.

- The **Final Competition** which is held in Attica (unless unforeseen) and the teams that qualify from the Regional Competitions participate. The first three teams claim the **medals** (gold, silver and copper), while especially **the themed awards** are awarded to a limited number of groups whose projects are distinguished by individual criteria of the competition, e.g. the best codeOrama document, a truly original idea, an impressive mockup, a theatrical presentation, etc.

The philosophy of the Competition

The Competition was designed from the beginning as a nursery for the qualitative upgrading of students' skills in educational robotics, within the context of STEM education.

His goal is to create a numerous **pool of students with the necessary skills**, who in turn will be the pioneers for the introduction of STEM in education.

The philosophy of the Competition is the young and beginner students involved:

- to acquire knowledge through analysis and synthesis when trying to solve problems,
- to accumulate experiences working creatively in various fields such as:
    - the structural construction,
    - the electronic part of automation and
    - programming the simulation with animation,
- to freely develop their imagination in the construction of the model,
- to improve their communication skills when presenting the project,
- to familiarize themselves with teamwork,
- to enjoy the joy of creation,
- to gain confidence in feeling that they are producers of potentially innovative products.

The cognitive background that can be both a prerequisite and a result of participation in ***Competition*** is the solid knowledge of engineering systems development and computer programming (for more see the Appendix paragraph "**The dual nature of educational robotics projects**"). We believe that educational robotics rests on two pillars: **constructions of mechanical systems** and **computer programming**. In this direction, **STEM Education** (https://stem.edu.gr/%ce%bf-stem-education/) has published targeted educational material:

- for the construction part has published the book "**Mechanical Systems - Student's Book**", 449 pages.
- an introduction to identifying gears by categorizing them can be seen in the paper https://www.academia.edu/87241718/%CE%A0%CF%81%CF%8C%CF%84%CE%B1%CF%83%CE%B7_%CE%BA%CE%B1%CF%84%CE%B7%CE%B3%CE%BF%CF%81%CE%B9%CE%BF%CF%80%CE%BF%CE%AF%CE%B7%CF%83%CE%B7%CF%82_%CF%84%CF%89%CE%BD_%CE%B3%CF%81%CE%B1%CE%BD%CE%B1%CE%B6%CE%B9%CF%8E%CE%BD_%CF%83%CF%84%CE%BF_%CF%80%CE%BB%CE%B1%CE%AF%CF%83%CE%B9%CE%BF_%CF%84%CE%B7%CF%82_%CE%B5%CE%BA%CF%80%CE%B1%CE%AF%CE%B4%CE%B5%CF%85%CF%83%CE%B7%CF%82_STEM
- for the programming part the book "**Let's Scratch-3. Teacher's guide**» , 451 pages (https://stem.edu.gr/%ce%b5%ce%ba%cf%80%ce%b1%ce%b9%ce%b4%ce%b5%cf%85%cf%84%ce%b9%ce%ba%cf%8c-%cf%80%ce%b5%cf%81%ce%b9%ce%b5%cf%87%cf%8c%ce%bc%ce%b5%ce%bd%ce%bf/lets-scratch-3/).

The innovations of the Competition

The ***Contest,*** since its creation, has been constantly trying to introduce innovations.

- Since the beginning of the competition (2015), the first innovation was the use of free software MIT **Scratch** for the control of automations, instead of the proposed software of the manufacturers of the used hardware. The use of Scratch environment supported the development of one software **simulation** of the physical automation model on the computer screen using animation. The result was to significantly increase the **complexity of programming** in the students' works. For the pedagogical dimension of Scratch see more in "The pedagogical dimension of Scratch'' in the Appendix.
- The next innovation introduced was the representation of the code using the **CodeOrama**. This was done gradually. In the 2018 contest the demand was optional, from 2019 and then, is mandatory. Every year, students and coaches get more experience with it.
- In 2021 the USB **camera** was introduced as an additional sensor (keeping the same theme of the competition so that the transition was smooth). For the following year (2022) an attempt was made to evolve the way of using the web camera in automation triggering. Web cameras can be used for **image recognition**. The web camera can be integrated in future into activities involving **Machine Learning** and **Artificial Intelligence**. The use of cameras was aided by the synergy of CodeAthon-2021 where students are asked to develop relatively simple programs for **pattern and shape recognition.**
  (https://drive.google.com/file/d/1bti9lkxZvk-RsZlZpR_oWPHre9uI6akf/view)
- The next step in this series of innovations was in 2022 introducing the use of an additional low-cost microcontroller, the BBC **micro:bit.** (https://microbit.org/). The purpose of using the micro:bit is to acquaint Primary School students with the collection and processing of experimental data from **sequence of measurements of physical quantities.** (something absent from Greek compulsory education)
- Following the gradual integration of innovations in the tendering process, in micro:bit automation this year, special emphasis is placed on graphical representation (graph) of the measurements obtained. This is considered essential for students' understanding of the concept of change and the rate of change of a physical quantity.

Recognizing that the accumulation of all previous requirements acts as a disincentive to participate in *Competition,* teams of students and coaches who have no previous experience from this year applies:

- The projects of the groups that **they have all the prerequisites** (provided they qualify from the regional competitions) to compete:
  - For **three contest medals** and
  - the **themed awards** of the final phase of the ***Competition***
- The projects of the Teams that **have less than the prerequisites** can participate in the regional competitions by claiming **themed awards** without advancing to the final stage. Nevertheless **excellent quality projects** which although they do not meet all the prerequisites, by decision of judges, can **Exceptionally** participate in the final phase of the ***Competition*** claiming **the themed awards**.

Suggested **the groups should be composed of students of all ages of the category** so that **expertise** which is acquired by the group's participation in one ***Competition*** to be maintained, diffused and deepened by the participation of the group in posterity ***Contests***, thus ensuring the **Continuity** of the ambitious effort of the children, their team and their school.

As the experience has shown, generally **the achievement of distinctions** in the competition is a result of **long-term participation** of students and coaches.

But "championship" is not the point. The profit for each child from his participation in ***Competition*** is on the one hand the joy **of creation** that he experiences during his involvement in the project and on the other hand **positive memories** of this experience that will accompany him throughout his life after school.

The participation project

The group of students participates in ***Competition*** with one **original work** that has been developed during the preparation period.
The project should:

- be based on a "**innovative idea**" (novel at least for kids),
- be supported by an interesting **"script narration"**,
- to satisfy a need, to propose a **resolution** in a **problem,**
- to choose the **best feasible solution,**
- to describe the **compromises** achieved between the initial design and the final product,
- to present the solution by incorporating the project automations in a **diorama,**
- to document the **programming code implementations**.

The theme of the Competition

One of the **long-term goals** of ***Competition*** is to leave its imprint on the young participants,to teach problem solving via creativity so that they will be receptive when later in their adult lives they are called upon to face real problems. This goal is expressed through the choice of the themes of the ***Competition***. So the combination of wanting to leave an imprint on the young participants with **authentic and interesting Competition themes**, led to choices that raise awareness among children about issues critical to our country and planet, such as:

- in 2015, "*My own city*",
- in 2016, "*Our galaxy*",
- in 2017, "*Vehicles and transport of tomorrow*",
- in 2018, "*Aegean Archipelago: Technology helps develop the islands*",
- in 2019, "*Colonization on Mars*",
- in 2020 & 2021 "*From Archimedes to Da Vinci*"
- in 2022 "The primary sector of agricultural production"
- in 2023 "Smart Cities"

Into this context also fits the choice of the subject of the ***Competition*** **2023-24**. The projects that will participate in the competition should have a topic related to the title:

"The Mediterranean Sea as a Source of Life and Culture"

Works not related to the competition theme will not be evaluated.

The countries that are bathed by the Mediterranean sea, have been developed with it since ancient times in infinite areas.
Now it's our turn to put our «**stone**» at the top of the pile of this evolution and create **innovations** that future generations will find. The Mediterranean always was and is, a helper in everything we do, as long as we take care of it and take advantage of it in the most efficient way, while also taking care of the health of its flora and fauna.
The aim is to improve the quality of life of citizens in the context of sustainable development.

Indicative ideas:

- Combating Mediterranean pollution
- Mechanisms developed by different peoples from ancient times to the present day.
- Means of transport in the Past-Present-Future
- Energy potential of the Mediterranean.
- Potable water potential of the Mediterranean.
- Artificial islands…
- Musical instruments and cultures
- etc

"Mediterranean" needs... SIMPLE, EASY AND AFFORDABLE SOLUTIONS
Innovation begins with a "spark" and forward-looking people.
Are you interested in creating your own Solutions... for your Mediterranean?

The hardware required for the project

For construction can be used:

● **robotic kits with central unit the micro:bit processor**

e.g. Gigo Micro:Bit Compatible Robots, NEZHA Inventor's kit V1 or V2 for micro:bit, 32 in 1 micro:bit Wonder Building Kit

OR / AND

● **the LEGO WeDo robotic kit**

AND

● **the micro:bit microcontroller, with additional optional external sensors**

AND

● **Web Camera**

AND

● **up to two computers.**

The use of other materials (other than those mentioned above) is allowed only for the model and the scenery of the project.

The software required for the project

As software can be used:

● **Scratch-2, to** ensure the operation of existing WeDo 1.0 equipment

Or also

● **Scratch-3,** (https://scratch.mit.edu/)

Or also

● **any MIT Scratch-based environment** such as the **Mind+** environment (http://mindplus.cc/en.html)

Or also

● **Microsoft's Makecode software can also be used in the second automation** (Beta, Beta+ automation).

Automation of projects

The project requires at least 3 automations* of which:

● **The first automation (We will call it Alpha),** uses as hardware the robotic kit WeDo or "My first automations" or a micro:bit based robotic kit. The automation **is necessarily related to its simulation in Scratch environment**. Data from sensors are used to drive at least one physical actuator and the related simulation in Scratch scene.

AND

● **The second automation (We will call it Beta)** uses at least one Micro:bit sensor (internal or external) to **take measurements and plot** one or more basic physical quantities. In addition, **there will be an extension of the automation (We will call it Beta plus)**

AND

● **The third automation (We will call it Gamma) uses a USB camera for image recognition in Scratch environment**. In addition to the web camera, it can also use any other (of the permitted) actuators.

Analytically

Alpha automation

Alpha automation is necessarily related to programming **and animated simulation** in a Scratch environment

● uses as hardware the robotic kit **WeDo** or "Introduction to Automation" or a **micro:bit based robotic kit**

● uses at least one of the **sensors** of the systems mentioned.

● uses the **actuators** who allowed. These actuators are: the motors and leds from the WeDo kit, the built-in micro:bit LED and speaker, actuators or led or motors and Relays that the micro:bit can somehow drive. (LCD and oled displays displays can be used in the project but are not considered actuators)

● Is programmed with **MIT Scratch or scratch like environment** like mind+ software

● In this software, the simulation of the automation is created on the computer screen using animation. (Described below).

● The program that runs the automation and the related simulation on a computer screen is described and presented using the CodeOrma method (described below).

Beta automation

Beta automation is necessarily related to **measuring one of the following physical quantities**: distance, temperature, magnetic field intensity, brightness, sound intensity, conductivity, voltage, velocity, angular velocity, acceleration, pressure.

● uses **micro:bit microcontroller**

• uses at least one of the sensors necessary to measure the permissible physical quantities.

The allowed sensors are the sensors **built into the micro:bit or external sensors** connected to the micro:bit which are suitable for measuring the physical quantities mentioned above,

● uses at least one of the **allowed actuators**.

These actuators are: the motors and leds from the WeDo kit, the micro:bit built-in LED and speaker (loudspeaker), motors, external leds and relays that the micro:bit can somehow drive. (LCD and oled displays can be used in the project but are not considered actuators)

Only in Beta automation the software can be **MIT Scratch and/or scratch like environment** like Mind+ and/or **MakeCode.**

In Beta automation the system will take measurements of one of the previous physical quantities**. The value of the measurement will be compared to a threshold** value that the team will have determined to demonstrate the **activation** of the automation.

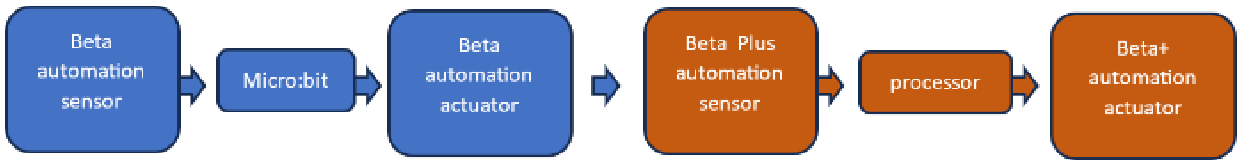
During an automation demonstration, **data collected from the micro:bit, should be displayed graphically, in real time**, on the computer screen (**data graph**).

Beta plus (Beta automation extension)

For the first time this year, the extension of the Beta automation with one more automation (Beta plus) is required.

The Beta plus automation sensor takes as input a stimulus caused by the Beta automation actuator and only then, the Beta plus automation actuator is put into operation.

Both the Beta plus extension automation sensor and its actuator will belong to the permitted sensors and actuators described in the Beta automation. The sequence of automations is also referred to as a chain reaction and over time it will help to create projects with more complex and more fun automations.



Gamma Automation

● It uses **as sensor a USB camera** connected to the computer

● Is programmed with **MIT Scratch or scratch like environment like mind+ software**

● Triggered when the software camera performs some image recognition (described below).

● uses at **least one of the allowed actuators.**

These actuators are: the motors and leds from the Wedo kit, the micro:bit's built-in LED and speaker actuators, or led motors and relays that the micro:bit can somehow drive.

The camera monitors its environment continuously and when it perceives the requested image it activates the automation.

Movement or change of the objects in the camera's field of view (which activates Gama automation) should occur **without human intervention.**

**** 2 of the 3+1 mandatory automations should have a motor as an actuator.**

Recommended materials for the implementation of the automations

Allowed systems for the implementation of the automations are systems that exist in schools and are compatible with the requested automations.

- My first automation (WeDo)
- micro:bit v2 starter:kit
- Primary school measurement and automation package
- Gigo Micro:Bit Compatible Robots
- NEZHA Inventor’s kit for micro:bit
- NEZHA Inventor’s kit V2 for micro:bit
- 32 in 1 micro:bit Wonder Building Kit
- Keyestudio Sensor Shield Module for microbit and compatible sensors
- micro:bit Wukong Expansion Board Adapter
- Octopus sensors compatible to wukong expansion board and Gigo Micro:Bit Compatible Robots
- PlanetX sensors compatible with NEZHA Inventor’s kit

Electronic Automation

Automation is the process by which a real-world stimulus is perceived by an electronic **sensor**, then a **program in the processor** processes the data and gives a command that changes the state **of an electronic actuator**.

Examples of automations:

- Suppose we have an escalator in the subway that works depending on whether passengers are passing and we assume that the detection of passengers is done by a weight sensor.
  - If the weight sensor is simply triggered by the weight of the human (or a dog or a suitcase) THEN that's automation
  - If the weight sensor is a button that the passenger has to press with their foot (manipulation) THEN this is NOT automation (doesn't work with a dog or a suitcase).
- Suppose we have a drone (e.g. a quadcopter) and a tilt sensor on it.
  - If the sensor takes and transmits inclination values to a central processing unit and this unit increases or decreases the power on the corresponding motor to balance the plane, THEN this is automation.
  - Also If we demonstrate the former without flying the drone but holding the drone by hand and tilting it to simulate the flight, THEN that is automation.
  - But if we use the sensor as a joystick to (remote) control the drone THEN that is NOT an automation.

Image recognition

Educational material for creating programs for **image recognition:**
https://drive.google.com/file/d/1bti9lkxZvk-RsZlZpR_oWPHre9uI6akf/view.
The purpose of this automation is to recognize image patterns from camera shots and then give the command for action on an electronic actuator. In Scratch-3 this is achieved by using an (internal or external USB) USB camera (still or moving), the image of which is projected as the background of the Scene. With the "video sensing" feature (found in the "sensing" menu), Scratch can **detect**: movement, speed, color recognition or interaction with roles (sprites) already present in the Scene.
Similar and enhanced features are provided in the Scratch-like software Mind+.

The simulation of automation

In the first automation (Alpha) is required a **simulation of the physical automation on the computer screen using animation.** The physical automation and the simulation have to be synchronised
Specifically during the operation of the automation the input data from the sensor should also be used by the simulation program so that**alongside** with the automation activity being activated**at the same time** the simulated - virtual actuators and their action to be displayed in the form of animation in the Scratch or Mind+ environment.

The CodeVision of the program

At least for them **two automations (Alpha)&(Gamma),** needs to be done **representation of the code** by creating one or more codeVisions.

The**codevision** is a code representation tool whose main goal is to facilitate the teaching of visual programming by allowing the observer to have both an overview of the entire code and access to its details, helping him not get disoriented while immersing himself in the details code. In codeVision, the set of scripts of all the objects of a program is displayed in a two-dimensional table (**code anatomy**) and the modes of communication between them are represented (**code functionality**).

More information about codeVision can be found at the link:https://www.dropbox.com/scl/fi/wl0gmfrabi3eyn9t80nuw/CodeOrama.pdf?rlkey=umc8iv9aemwt0q2d4l1s45i6w&dl=0

The deliverable: Portfolio folder

Each group should submit an electronic file with a portfolio containing:

A. The documents with**parental consent** for the use of their photos or videos featuring their faces (special printable forms to be posted on the STEM Education website).
B. A short**project description** (word document) that will highlight the problem it solves.
C. The file/s with**the program**in Scratch and/or Mind+ or Makecode.
D. A folder (zip) with the files with**photos** where the stages of the construction can be seen and in particular the constructions of the mechanisms.
E. A file (or its link) from at least one**video**where the students will present by describing and showing the operation of the construction, with an emphasis on the automations (zoom-in to see the automation) in operation and its size not to exceed 100MB. (Extremely necessary if the competition is conducted online). Attention: Projects whose video size will exceed 100 MB will not be included in the portfolio evaluation process.
F. The file with the**codevision** (in xls or pdf or png or jpg).

For the above they will create**separate folders named A, B, C, D, E,**and **F** inside**group dropbox** into which the aforementioned required files will be loaded (not compressed all together in one zip).

With**coach's responsibility**the portfolio folder**submitted electronically**and**on time** with a specific date communicated by STEM Education (at least 10 days before their participation in the regional competition of their region).
Projects submitted late it is at the discretion of the Jury to decide whether to participate in the***Competition*** and will be evaluated.

Steps for submitting the portfolio:

- The teams will create a dropbox account that will belong to them and upload the portfolio there. Attention: Access permission should be granted to third parties (competition judges).
- The link to the group's dropbox will be shared with STEM Education. Specifically, the teams will edit their initial registration form and fill in the "Required deliverables" field with the link to their dropbox.
- Teams can find and edit the registration form at any time by checking their inbox, specifically the email with the subject "Participation Confirmation" and from eventora.

The mockup of the project

The project should be supported by a “**script narration**” which will take place in some place. This space will be represented in the project with a**mockup** which will constitute the**scenery** in which the automations will be included.
On the day of the competition, each team will be allocated “**kiosk**” with a space of approximately 150 cm x 150 cm and with a vertical width of approximately 2m. The printed material can be stuck on the back, e.g. the codeVision (if it is large) or to view (with a group projector) the presentation.
There will be at the booth**Workbench** size approx**100cm x 60cm**. In this space, the model should be installed together with the automations. Alternatively, the team can also place their work on the floor, as long as it does not exceed the limits of the booth.
It will be available at the stand**power supply** with power strip.
There will be no wired internet or wifi.
The robotics systems with the possibility of developing free mechanical precision constructions**which exist** in schools for the age group we are referring to is either the Lego type or the GIGO type. Given this, all parts of the construction that contain mechanical automation or mechanical parts moving with motors should be made with plastic LEGO or GIGO building blocks. The remaining parts of the structure can be made of any other material (such as foam, paper, etc.)

The presentation of the project by the students

On the day of its performance***Competition***(Regional or Final) teams must:

- install in the “stand” that will be available to them the model, the automations and the props that are transported**prefabricated** and**pre-assembled**,
- ensure that the facility complies with the regulations,
- demonstrate and present their work to the public (if requested).

For the judgment of the projects it is available**limited time** in each group (arising from a compromise between the number of groups and the total assessment time available). This time may be indicative**seven minutes**, of which a part e.g. five minutes will be for the presentation and the remaining time for questions from the judges.
During the evaluation of their work by the judges, the teams present their work**narrators**their "innovative idea" and their invented script**with** “**theatrical way**". The presentation**it can**to be supported either with**short form** either with **Power Point** in which the main characteristics of the project should be mentioned.
In an atmosphere of teamwork, each member of the team according to the role he playedduring the development of the project takes the floor and:

- states how their work relates to the competition theme,
- narrates the "script" on which the work is based and guides the judges through the mock-up,
- explains how automation solves the requested problem
- performs a demonstration of**operation** of automations
- demonstrates simultaneous simulation during automation operation
- refers to codeVision to explain the automation, simulation, and measurement sequence capture code
- answers potential questions from the judges, related to their project and its development process.

During the evaluation no help of any kind is allowed from the coach or anyone else to his team.

Indicative project evaluation criteria

The manner of conducting it***Competition*** it is a living process that evolves year by year. In particular, the Regional Competition of Attica, due to the very large number of participants that asymmetrically increase the complexity of its management, presents particular problems and is often used as a pilot for the implementation of organizational changes for the Final Competition. Throughout the years of the competition's existence, the procedures that are carried out each time are constantly analyzed, concerns are developed, improvements are proposed, innovations are adopted and after checking if they are feasible, they are tested in practice. The result of this development is the imprint that follows in the appendix "Procedure for conducting the Tender".

In the***Competition***the evaluation of the projects is done by**panels of judges** which as a rule consist of**experienced educators specialized in STEM education and educational robotics**. Each committee consists of 2 to 5 judges who rank the projects of the groups assigned to them. In competitions in which several teams participate in the final stages of the competition, all judged teams are evaluated by the same committee. In such competitions, often in addition to the judging committee that evaluates the medals, there is also another committee that evaluates the individual thematic awards.
In the evaluation for the medals the judges**can be consulted**the following rubric.

Rubric withindicatively evaluation criterias

CATEGORIES CRITERIA GRADES			
Conceived Idea / Project	**TOTAL MARKS: 40**		
	1	Creativity, Research and Idea Development	20
	2	Quality of solving the challenge	20
Educational Robotics/ Automation	**TOTAL MARKS: 90**		
	1	Mechanical Construction, Calesthesia	20
	2	Alpha Automation	20
	3	Automation Beta	20
	4	Automation Beta Plus	10
	5	Gamma automation	20
Program in Scratch	**TOTAL MARKS: 40**		
	1	**Codemap - Visual representation of code**	40
Virtual world	**TOTAL MARKS: 40**		
	1	Correctness of Logic, Complexity of Software and automations	20
	2	Automation simulation with animation, Interface, Aesthetics	20
Presentation	**TOTAL MARKS: 30**		
	1	Assessment of Presentation, Communication Skills and Collaboration	20
	2	Decoration, Videos, Posters	10
MAX SCORE: 240			

Complaints and objections procedure

The "waterfall process" followed in***Competition***it does not allow time delays and because of this**It**

is not feasible to effectively implement an objection process during the competition.
Objections, complaints, objections and suggestions - in written form - are accepted, evaluated and utilized by the scientific and organizational committee of the competition, for the continuous improvement of the following competitions.
In our experience, the few objections to the evaluation arose from a lack of understanding - usually on the part of those who expressed them, perhaps with justification - of the rules of the competition.
Due to the open nature of the competition, the evaluation includes factors that do not allow a weighted and "objective" score for non-quantifiable (but recognizable) qualities of the contestants' works such as originality, aesthetics, presentation, etc. Thus, from the first competition - although a rubric with a quota for the score is indicatively used - it was adopted**"cup" model** which highlights the cup winner with**successive exclusions** instead of the "championship" model where the champion emerges with the points he collects. This “cup” model is adopted in the evaluation phases, in which groups (the groups of teams that each committee will evaluate) are formed. The rubric can act as an advisory for panel judges.
The spatial proximity of groups belonging to different groups and the comparison between them gives rise to complaints of unfair treatment. The random placement of the teams in the various groups is something that objectively cannot be avoided and it is the duty of the team coaches to understand this way of operation and to explain it to the children of their teams and to the parents.

It is important as a personal assessment that each child compares himself with how he was before getting involved in the competition process and what he has conquered on his behalf and how he has evolved through his participation in the competition.

ANNEX

The materials of WeDo 1.0

Allowed materials, sensors and motors from WeDo 1.0:

	708882 Power Functions XL Motor
	LEGO WeDo 1.0 Tilt Sensor
	708881 Power Functions Battery Box
	708871 Power Functions Extension Wire 20”
	708886 Power Functions Extension Cable 8”
	LEGO WeDo 1.0 Motion Sensor
	709670 E-Motor
	LEGO WeDo 1.0 USB Hub
	Power Functions Light
	708883 Power Functions M-Motor

Allowable materials, sensors and motors from WeDo 2.0 or fully compatible:

	**745301 Smart Hub 2 – Interface With PC or Tablet**
	**745303 Medium Motor**
	**745305 Tilt Sensor**
	**745304 SensorMotion**
	**Add-On Power Pack**

Recommended micro:bit compatible materials

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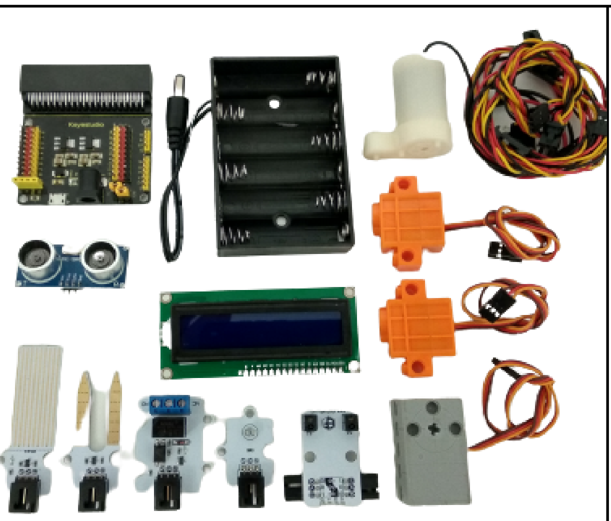
<tr>
<td></td>
<td>777755 Elementary Measurements and Automation Package

This material package has been tested and works perfectly with the proposed materials and software of the competition, and is supported by relevant examples.

Shield for Micro:Bit
Geekservo 2kg 360 Degrees compatible with lego
2x360 servo motors compatible with lego
Base for 6xAA Batteries with Jack 5.5×2.1
LCD 1602 I2C Module
Distance sensor 2-400cm HR-SR04 (digital)
Octopus 1 Channel 3v Relay Module
Octopus light sensor (analog)
Octopus Soil Moisture Sensor (Analog)
Octopus LM35 Analog Temperature
Octopus Water level sensor (analog)
Octopus 2 Channel Tracking Module (digital)
Water pump
Jumper Wires F/F
Jumper Wires M/F</td>
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<tr>
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<td>941269 Gigo Micro:Bit Compatible Robots</td>
</tr>
</table>

	708288 **NEZHA Inventor’s kit for micro:bit**
	708239 32 in 1 micro:bit Wonder Building Kit

Technical clarifications related to WeDo

- THE**connecting the sensors to the computer** done via hub (WeDo) and USB connection.
- In case a group**does not have two hubs**, the first sensor can be placed on the hub to present the first automation, then the first sensor can be removed, the second sensor can be placed to present the second automation. A similar procedure can be followed in the case of use**two engines** and sensor through a hub.

- WeDo 2.0 in the MAC environment works normally.

Technical clarifications related to the micro:bit

Instructions for simultaneous interface micro:bit, WeDo 2.0 and USB camera on mind+

In the proposed procedure Mind+ software (largely compatible with Scratch-3) is used in combination with software version**ScratchLink** to achieve the desired result.
Basic requirements for the bluetooth connection of WeDo to the computer, the computer during the WeDo search process must have Internet. After the bluetooth connection is restored, the Internet is not necessary.In the event that a wireless network is not provided in the area then it is suggested to give the computer a wireless network through a mobile phone.

In the following procedure the Micro:bit is connected to the computer with a USB cable and the camera is the internal computer or external USB.

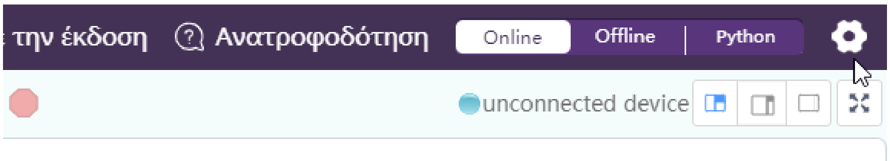
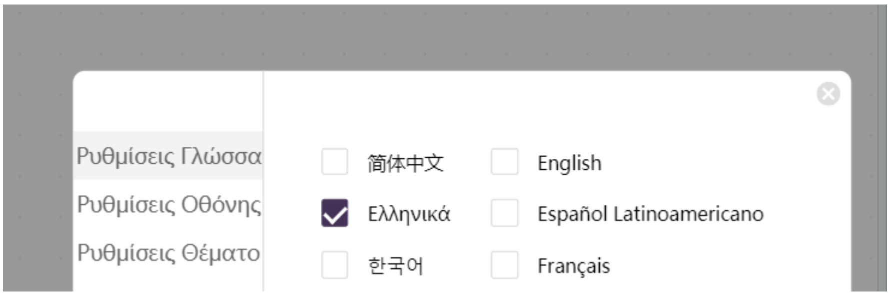
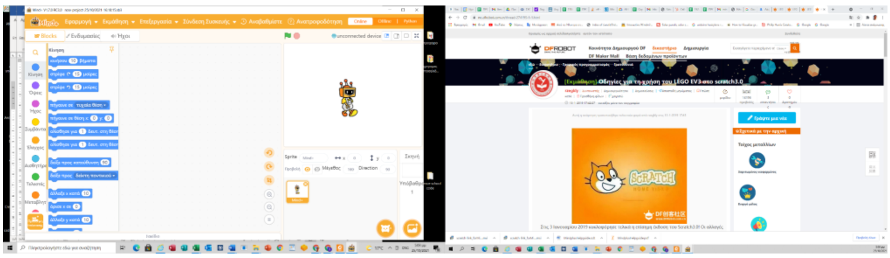
Download and install mind+ software

- Download the software from:http://download3.dfrobot.com.cn/Mind+_Win_V1.7.1_RC2.0.exe
- Run the executable
- Follow the installation process

Download and install a specific version of the Scratch-Link software

- Download the program from the link:Scratch-Link
  http://download3.dfrobot.com.cn/scratch-link_forMindPlus-v1.1.msi
- Follow the installation process.

First launch of mind+ software

<table>
<tr>
<td>At the first launch the program will be in another language, whenever to change it click on the top right gear.</td>
<td>
</td>
</tr>
<tr>
<td>Select Language (Greek).</td>
<td>
</td>
</tr>
<tr>
<td>Select Online mode</td>
<td></td>
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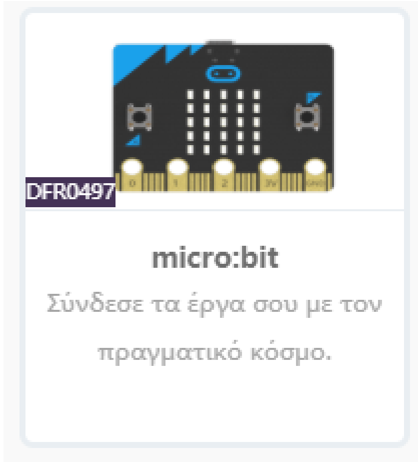
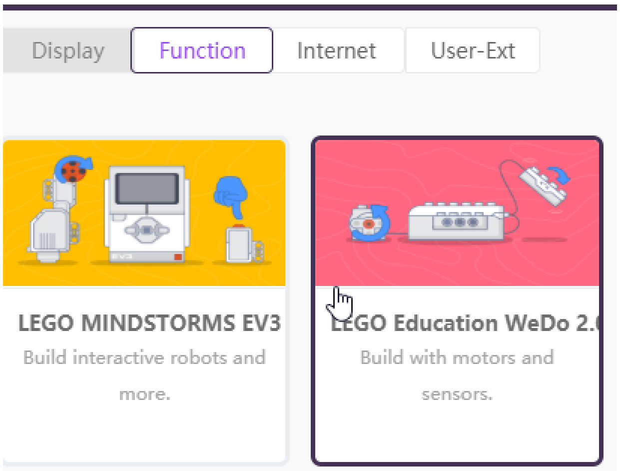
micro:bit connection

● Make sure the Scratch-Link program you installed earlier is running. ● Open the mind+ program. ● Click on the “Add Extension” button at the bottom left of the window. ● Click on the box that says micro:bit. ● Go back and while you have connected the micro:bit board with the USB cable press connect device. ● Select the micro:bit board.	

LEGO WeDo 2.0 Connection

<table>
<tr>
<td>Click on the “Add Extension” button at the bottom left of the window.

Open the “Function” tab and select “LEGO WeDo 2.0”.</td>
<td>
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<tr>
<td>Press the exclamation mark and then connect to the WeDo hub.</td>
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Camera Connection

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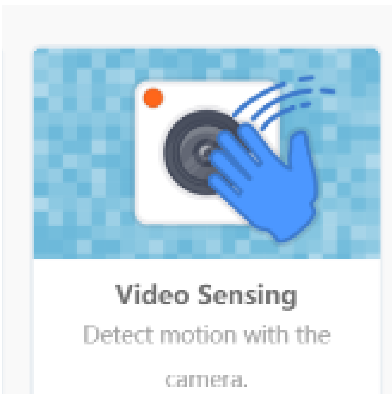
<tr>
<td>Click on the “Add Extension” button at the bottom left of the window.

Open the “Function” tab and select “Video Sensing”.</td>
<td>
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Ideas - Suggestions

As **good practices** from which ideas can be drawn for project development can be considered**collections of notable works** who have participated in***Competition.****Such collections under*they begin:

- It is an online library, openly accessible to all teachers, which hosts original teaching materialsrobotics.

  The scientific committee of STEM Education selects the representative projects from each competition, following the following criteria:
  - to be structurally sound
  - to be programmatically correct
  - to be a model for teaching STEM
  - to be offered for teachers to include in their teaching work.
- in the book "[**LEGO Education WeDo + Scratch Educational Script Repository**]» (ISBN: 978-618-84064-1-4) (https://stem.edu.gr/%CE%B5%CE%BA%CF%80%CE%B1%CE%B9%CE%B4%CE%B5%CF%85%CF%84%CE%B9%CE%BA%CE%AC-%CF%83%CE%B5%CE%BD%CE%AC%CF%81%CE%B9%CE%B1/).

Indicative procedure of conducting it *Competition*

Keywords

Club, **Code** (Team),**Kiosk**, **Awards** (final ranking or Special/Thematic),**Commission** (ranking or special thematic awards),**Group** (groups), (chronological)**Zone**, **Phase** (evaluation).

Indicative schedule of its implementation *Competition*

08:00-09:30	Registration
08:00-10:30	Setting up and completing the preparation of the booths
10:30-13:00	First evaluation phase
13:00-13:30	Intermission for the teams that did not qualify to leave
13:30-15:00	Second evaluation phase
15:00-15:10	Announcement of results
15:10-16:00	Withdrawal of teams

A) Registration

On the day of the competition, the teams come to the reception area (registration) to complete their registration.

After registration, a folder with the contestants' cards and the**group code** which they will have throughout the competition. This code is the team's identifier for the entire duration of the competition and cannot be changed. The children must write this code on their cards in case they are asked.

B) Stand installation

The group code corresponds to**booth number** in which the team will exhibit their work. Any change of position (e.g. for reasons of accessibility for the disabled) must be done with the agreement of the President of the Organizing Committee, who will be contacted by the team coach. The team code will remain the same even if there is a change in the team stand.

Teams have the ability to install their project and do the necessary**settings and tests** until the evaluation process begins.

C) Evaluation process

The evaluation process is carried out according to the indicative criteria described in the relevant announcement of the competition.

The following text refers to the Attica Regional Competition of March 2020 (postponed) and is indicative.

As the exact number of teams that will compete cannot be known in advance, it is assumed that this will be approximately the average of the respective competitors of the last three years (it is estimated that up to 70 teams will compete on any given day) . Also, the number of teams that will qualify from the Attica Regional to the Panhellenic Competition is calculated proportionally to the number of teams in Attica in terms of the number of teams from all over Greece and therefore it is estimated that there will be 22-28 teams.

Thus, for each day in the first evaluation phase, 30 teams qualify from the approximately 70 teams. In the second evaluation phase, from the 30 teams, 11-15 teams qualify to participate in the final of the Panhellenic Competition.

The times of the assessment

A limited amount of time will be allocated to each group for the judging of the projects -

seven minutes as an indication, of which a part (eg five minutes) will be for the presentation by the group and the remaining time for questions from the judges.
The duration:

- for the first assessment phase it is approximately 150 minutes,
- for the second assessment phase it is approximately 90 minutes,

After the completion of the first evaluation phase, the teams that qualify for the next phase are announced and the rest can leave.
The children of one team, after being evaluated by the judging panels, can visit the stands of other teams and see the works presented by their fellow athletes. But there should always be a representative at their booth who can demonstrate their work to visitors.
Children must be in their booth when the next assessment phase begins.

First Evaluation Phase
The teams are numbered (the team code) from 1 to 70. The judges are divided into 7 committees and each committee will see 10 teams. Specifically, committee No. 1 will see all the projects of the groups from 1, adding for each subsequent one 7, i.e. groups 1, 8, 15, 22, etc., committee No. 2 will see all the projects of the groups that have a number group 2, 9, 16, 23 and so on, so we continue for the rest of the committees. In order to avoid overcrowding of the committees, committee No. 1 starts the evaluation from group 1, committee No. 2 starts the evaluation from group 9, committee No. 3 starts the evaluation from group 17, and so on.
A team if it is not ready when the panel comes to assess it, may ask the panel to pass later, provided the panel deems it possible (eg in terms of time).
Each committee prequalifies four of the ten teams it examines, resulting in a total of 28 teams for the next evaluation phase. There is flexibility if some committees consider that they should exceptionally qualify three or five teams, provided that the number of total teams does not change significantly.

Second Evaluation Phase
In the second phase of evaluation, there are four committees and their members result from mixing the members of the committees from the previous phase. So for example the new committee No1 will have members from the previous committees No1, No3 and No5, the new committee No2 will have members from the previous committees No2, No4 and No6 and so on. This is so that almost none of the members of a committee have reviewed the same teams, but also that each member of the committee has a more holistic view of the contestants by seeing as many teams as possible. Each committee will see six or seven teams from which they will advance three. Thus, 11-15 teams qualify for the final of the Panhellenic Competition.

The dual nature of educational robotics projects*

According to Komis (Komis et al. 2017), central concepts of educational robotics are the "construction" and "programming" of robots. These concepts are part of the pedagogical stream of Constructivism, which claims that learning consists in the organization of the internal representations and experiences of the individual (Piaget, 1974). The ideas "Learning by making" and "Learning about making" gave the impetus to the foundation of Papert's "Constructionism" approach (Papert, 2000), which aims to form a framework for utilizing ICT in the educational process , capable of causing substantial changes in the way teachers teach and students learn (Ackermann, 2001), as the student from a passive receiver of information becomes an active subject, who investigates and processes what he perceives with his senses and creates knowledge (Frangou, 2005).
The artificial structure created by the students leverages a set of building materials, having sensors to capture events, an actuator that sets the whole structure or a part of it in motion. But the operation of the structure is based on the software that determines the behaviors of the structure such as detecting a stimulus and reacting by activating a motor. So in the process of developing the physical structure and its control program, there is a two-way relationship. The design of a physical structure (hardware) as well as its mode of operation (software) presupposes the interconnection of these processes. It is considered particularly effective that on the one hand the students with the role of programmers have understood the development model of the construction and on the other hand the students with the role of builders are involved to have built the mental model of the operation of the construction. This dialectical relationship between the development of the construction and the programming of its operation will lead to constructions (at least in the initial stage) that will be possible to program effectively considering that "the programming of robotic constructions has a peculiarity with respect to the programming in other conditions or situations. It is identified with the performance of behavior in an artificial construction" (Tsovolas & Komis, 2008).

* excerpt from the book«[LEGO Education WeDo + Scratch Educational Script Repository]» (ISBN: 978-618-84064-1-4)

The pedagogical dimension of Scratch

The**Scratch** (http://scratch.mit.edu), created by the Lifelong Kindergarten Group at**WITH**, as a multimedia-rich system for novice developers. She is one**visual programming language** which allows users to program via graphics instead of text and is integrated into a dedicated programming environment. This allows the user-programmer to see the results of executing a program immediately, while at the same time overcoming the limitation of syntax difficulties that exist in traditional programming languages.

A common one**didactic metaphor** used to understand developing a project in Scratch is that of producing one**theatrical work**. There they need:

- a play**scene** which is the space where the play takes place and in Scratch there is a 2D space corresponding to the scene at**background** of which various static scenery is shown,
- **actors** (objects) which are dressed differently**clothing**,
- **clock** (sprites) which the actors play when they appear on stage,
- **scenario** followed by the roles. In Scratch the**behavior** of roles is defined by pieces of code called**scenarios**. THE**director** and**screenwriter** coexist in**developer** of Scratch and
- **audience** which in Scratch correspond to the users of the program.

In Scratch o**event-driven programming** and implemented**combining command-tiles** (a metaphor from the Lego bricks) that fit together, to define the behavior of the roles (sprites) of two-dimensional objects that "live" in a specific space (scene-stage). A command-tile in Scratch follows a**color coding** which refers to / corresponds to the class of commands to which it belongs. Developing programming in Scratch allows students to create and develop programs related to**animation, narratives and games**, which can broaden the understanding of**computational concepts** as well as of**computing practices**.

Scratch as a programming language is the medium**communication** between intelligent entities, of**man with the computing machine**. Communication takes place at the level of the lower mental entity, the task of the higher entity is to understand the "culture" of the other entity, analyze its thinking and simplify it. According to Papert “to get the computer to do something, you have to describe the relevant process with enough precision that it can be executed by the machine…**by teaching the computer how to think, children embark on an exploration of their own way of thinking** and thinking about thinking makes the child an epistemologist.'

For teaching programming, they can be used**microcosms** which are environments suitable for learning programming. As microcosms are considered small but relatively complete subsets of representation of the "real" environment, which represent a part of the theoretical "world" and can be understood in an observational, experiential and exploratory way. Although microcosms are directly aimed at skill development**problem solving** and algorithmic way**(convergent) thinking**, under conditions can be used as educational tools for development**creative (divergent) thinking**. In such environments it may no longer seem contradictory to ask children to work creatively by addressing them in non-creative ways. A programming environment is one**nursery of potential innovations**, in which the student can accumulate experience cultivating his algorithmic thinking. Under scaffolding conditions the teacher can guide the student to think creatively outside the box and produce something "innovative" for him.

Scratch supports a variety**programming styles** such as serial programming (with elements**structured / departmental and hierarchical programming**), The**parallel programming**, event-driven programming (**event driven programming**) and object-oriented programming (**object based programming**), while using clones features object-oriented elements (**object oriented programming**) programming. In Scratch, the possibility of visual programming with tiles combined with the variety of programming styles it can support and in light of the pedagogical approach of "**emerging literacy**", making it an ideal tool for novice developers with limited programming background, offering them an accessible starting point for learning.