SUNRAISE - Stem UNlimited Raise thanks to Arts at School in Europe

Project Nr: 2021-1-IT02-KA220-SCH-000032579

PR1: Analysis of the achievement of STEM skills in EU and the need for a more interactive approach

NATIONAL REPORT
GREECE

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Abstract

This initial Desk Survey aims to provide a general overview of the current developments in STEM education internationally so that it sets a framework and an element of comparison to the current situation of STEM education in Greece.

The study will remain in progress until its final stage due by December 2022, where a National Report will be submitted that will include data and results from Online Questionnaires and Focus Groups, which will be conducted based on structured questionnaires to provide more insight from the educational field on the STEM education its development, progress and any possible challenges that need to be addressed.

THEAMA, in its role in the project as a cultural operator, will focus greatly on the perspective of '*adding the A to the STEM',* thus incorporating performing arts within the STEM educational practices and introduce **STEAM** as a viable option that benefits the overall educational targets.

1. International context and practices

Definitions of STEM and its educational benefits are numerous, we are here quoting two that provide an accurate description

- *STEM is defined as an approach to teaching the STEM content of two or more STEM fields, bound by STEM practices within an authentic context that aims to connect these subjects in order to improve student learning,* (Kelley & Knowles, 2016*).*

- *STEM education is an attempt to combine some or all of the disciplines of Science, Technology, Engineering, and Mathematics into a class, unit, or course based on the connections between these subjects and real-world problems* (Moore, Stohlmann, Wang, Tank, Glancy, & Roehrig, 2014*).*

- *STEM education is an interdisciplinary approach to learning where rigorous academic concepts are presented in conjunction with real-world problems. An approach where learners apply Science, Technology, Engineering and Mathematics to highlight the connections between school, community, work and global initiative, enabling the development of STEM literacy and with it the ability to compete in the new economy* (Tsupros, Kohler & Hallinen, 2009*).*

STEM is an educational methodology, which was essentially developed to promote knowledge and skills that were missing from the conventional curriculum. The so-called 7Cs Skills of the 21st century are abilities and skills that are necessary for a person to cope with the added challenges.

The 7Cs are: Critical thinking, Creativity, Collaboration, Communication, information, and media literacy, Computing and ICT literacy, Cross-cultural understanding, and Career and learning self-reliance.

Therefore, in order to meet the specifications and characteristics of an interdisciplinary STEM approach, teaching should be designed based on strategies based on solving everyday problems, through activities that actively involve students. Those teaching strategies that fit such an approach should be structured around the three "Ps":

- Project-Based,
- Place-Based και
- Problem-Based

, that is, project-based, site-specific and real-world problem-based teaching (Mayes & Gallant, 2018).

Equally important is the teaching method based on Inquiry Based Learning, as mentioned by Erdogan & Stuessy (2015).

The importance of STEM educational methods worldwide is prominent, and it is gaining momentum within the educational community, Indicatively, in the USA President Obama launched a campaign on 13/03/2015 'Educate to Innovate' dedicating 1 billion dollars to the cause of applying STEM methods in the educational system

Within the European Union a Digital Education Action Plan (2021-2027) has been introduced by the European Commission, to address the challenges of the digital age and the COVID19 situation. (source: https://education.ec.europa.eu/focus-topics/digital-education/action-plan)

In Europe, an important STEM programme is **Scientix**, born in 2010 at the initiative of the European Commission, and European Schoolnet has coordinated the project since its first launch. This Brussels-based consortium of 34 Ministries of Education in Europe is an innovation driver in teaching and learning and fosters pan-European collaboration between schools and teachers.

In its first phase (2009-2012), Scientix built an online portal to collect and present European STEM education projects and their results and organised several teacher workshops. The main networking event was the Scientix conference, held in May 2011 in Brussels.

The goal of the second stage (2013 – 2015) was to expand this community to the national level. Through a network of National Contact Points (NCPs), the project reached out to national teacher communities and contributed to the development of national strategies for wider uptake of inquiry-based and other innovative approaches to science and maths education.

This activity was continued in the third stage of Scientix (2016-2019), which was also funded by the Horizon 2020 programme of the European Union for research and innovation.

Currently running the fourth stage of the programme Scientix 4, from January 2020 to December 2022.

SCIENTIX WORLD MAP OF STEM AMBASSADORS, source http://www.scientix.eu/in-your-country/scientix-4-teacher-panel##GR

Studies funded by the European Commission or conducted by Science, Technology, Engineering and Mathematics (STEM) communities such as the STEM Alliance have highlighted major issues regarding the situation of STEM in European education systems: the low attractiveness of STEM studies and careers, or the unmet labour-market needs in STEM-related sectors that are expected to grow in the future, full document available here - European Schoolnet (2018). Science, Technology, Engineering and Mathematics Education Policies in Europe. Scientix Observatory report, October 2018, European Schoolnet, Brussels., (source http://www.scientix.eu/observatory/stem-education-practices-europe).

SCIENTIX AMBASSADORS 2022 are members of the teachers' panel from 2022. They help share Scientix activities at national level and play an active role in supporting innovation in STEM education in their countries. Their work is essential for expanding and consolidating a community whose core values reside in sharing of good classroom practice, especially in the area of STEM, and making sure that students are equipped with the skills needed to become successful adults.

Scientix Ambassadors:

- Disseminate Scientix at national level via social media and face to face presentations.
- Help the exchange of knowledge and good practices in the area of Science Education.
- Support and improve science education in general.

(source: http://www.scientix.eu/in-your-country/scientix-4-teacher-panel

THEAMA solicited the participation of the Scientix Ambassadors in Greece for the purposes of the SUNRAISE project and for PR1 – Online Questionnaires and Focus Groups.

2. STEAM vs. STEM model

In the last decades of the 20th century, the STEAM (Science, Technology, Engineering, Arts and Mathematics) model seems to have emerged, a model that includes the Arts in the "traditional" STEM model.

The importance of Arts is outlined by the NCBI- National Centre for Biotechnology Information USA, publication *The Integration of the Humanities and Arts with Sciences, Engineering, and Medicine in Higher Education: Branches from the Same Tree* (2018) (source: https://www.ncbi.nlm.nih.gov/books/NBK513040/?term=STEAM%20education) where the necessity to add the "A" to STEM is explained and scientifically justified. In a nutshell it states that, "*While the demand for a strong STEM workforce continues to grow, there are challenges that threaten our ability to recruit, train, and retain such a workforce in a way that is effective and sustainable and fosters innovation. One way in which we are meeting this challenge is through the use of the arts in the training of scientists.*"

Adding art into the lessons is not just for the fun of it, or just to make a program look good. There is so much added value by incorporating art into the Science, Math, Engineering, or Technology curriculum.

- Activating the "artistic" parts of the brain stimulates more creative problem-solving strategies.
- Students who are more involved in art show more social awareness, flexibility, and collaboration.
- Activities that require use of the WHOLE brain (the logical/analytical left brain and the emotional/creative right brain) help students build better mental connections while developing a well-rounded child.
- Students who are engaged in STEAM are able to think about their choices, weigh the risks involved, and persist in creative problem solving.
- Using STEAM lessons builds a focus on inquiry, process-based learning, collaboration, and hands-on exploration.

Great initiatives have started in the USA (world leader in STEM education) and theatre companies are cooperating with schools to introduce Arts into the curriculum.
https://howlround.com/using-theatre-teach-stem-classes-youth

https://villagetheatre.org/youth-education/stem/

3. Greek Statistics -Educational System STEM/STEAM in the Greek Educational System

According to the 2021 National Census the population of those residing permanently in Greece is 10. 432.481, where 5.075.249 (48,6 %) are males, and 5.357.232 (51,4 %) are females.

Education is divided in 3 tiers primary, secondary, and tertiary education, with an additional post-secondary level in which vocational education is provided. Church operated Middle and High Schools are part of the latter. In addition, Second Chance Schools, for adult students are high schools for adults and belong to Secondary General Education. Education in Greece is free, so are all school textbooks for primary and secondary education. It is compulsory from the age of four to fifteen. The Ministry of Education and Religion is the responsible authority for the exercise of control in all educational units levels, divided into local Directorates of Primary and Secondary Education. The Institute of Educational Policy is a staff advisory body of the Ministry. The national budget for education for the year 2021 provided an expenditure of 4.895.100.000 euros.

YEAR 2020-2021 STATISTICS			
TYPE	NUMBER OF SCHOOLS	STAFF EMPLOYED	STUDENTS
KINDERGARTENS	5,626	17,938	175,108
PRIMARY	4,402	74,673	606,400
MIDDLE SCHOOLS -TOTAL	1,825	41,067	328,582
MIDDLE SCHOOLS - PUBLIC	1,727	38,559	311,111
MIDDLE SCHOOLS - PRIVATE	98	2,508	17,471
HIGH SCHOOLS	1,355	24,353	230,295
HIGH SCHOOLS - PUBLIC	1,262	22,216	215,182
HIGH SCHOOLS - PRIVATE	93	2,137	15,113
CHURCH OPERATED MIDDLE SCHOOLS	7	168	244
CHURCH OPERATED HIGH SCHOOLS	10		482
ADULT EDUCATION	13- DAY 86 - EVENING	1,144	6,194
VOCATIONAL HIGH SCHOOLS	467	13,991116,571	
TERTIARY EDUCATION		15,992	236,520

NB. The Region of Attica, which includes the capital city of Athens, represents 34.8% of the Middle School population, and 37.4% of the High School population.

The National Curriculum for Middle School education in Greece as stipulated by the Ministry of Education is outlined in the below Table:

Διδακτικό Αντικείμενο/Μάθημα		Τάξεις		
		Α΄	Β΄	Γ΄
Νεοελληνική Γλώσσα και Γραμματεία	Γλωσσική Διδασκαλία	3	2	2
	Νεοελληνική Λογοτεχνία	2	2	2
Αρχαία Ελληνική Γλώσσα και Γραμματεία	Αρχαία Ελληνική Γλώσσα	2	2	2
	Αρχαία Ελληνικά Κείμενα από Μετάφραση	2	2	2
Μαθηματικά		4	4	4
Φυσική		1	2	2
Χημεία		-	1	1
Βιολογία		1	1	1
Γεωλογία - Γεωγραφία		1	2	-
Ιστορία		2	2	2
Θρησκευτικά		2	2	2
Αγγλικά		2	2	2
2η Ξένη Γλώσσα (Γαλλικά/Γερμανικά/Ιταλικά)*		2	2	2
Κοινωνική και Πολιτική Αγωγή		-	-	3
Οικιακή Οικονομία		1	-	-
Φυσική Αγωγή		2	2	2
Τεχνολογία και Πληροφορική	Τεχνολογία	1	1	1
	Πληροφορική	2	1	1
Πολιτισμός και Δραστηριότητες	Μουσική	1	1	1
	Καλλιτεχνικά	1	1	1
Εργαστήρια Δεξιοτήτων		1	1	1
Σύνολο ωρών		33	33	34

In the first column the subjects listed are – Modern Greek, Classical Greek, Mathematics, Physics, Chemistry, Biology, Geology/Geography, History, Religion, English, 2nd Foreign Language (choice of French, or German, or Italian), Social Studies, Home Economics, Sports, ICT (Technology, Computer Science), Cultural Studies/Activities (Music, Arts), Skills Workshops. In the next 3 columns the weekly hours are given for each of the 3 Middle School Grades.

STEM education has been hesitantly incorporated in public Greek educational system in more than one way. Generally, it is promoted under the supervision of the Ministry of Education through competitions and programs carried out within the school program and timetable. Trying to categorise them is nearly impossible, but there are some sources and evidence that could paint a safe and adequate picture of STEM education nowadays. Besides, the Ministry of Education on 16/3/2022 with a formal newsletter called the schools and teachers that have already completed or elaborate STEM or STEAM programs to upload on its website their educational results and work.

First of all, in the Institute of Educational Policy (IEP), there is Scientific Unit of Natural Sciences, Technology and Mathematics (includes Physics, Chemistry, Biology, Geography, Geology as well as Information Technology, Information and Communication Technologies, Technology and Mathematics). The unit offers consultation on all matters relating to its fields of study for primary and secondary education with emphasis on curriculum development and design. Additionally, it organizes seminars, workshops, conferences in collaboration with other Units and Offices of IEP and promotes issues within its field of competence related to the ongoing reform and the optimum implementation of educational policy. Institute of Educational Policy implements the Action "Training of Teachers in Skills through Workshops" (11/03/2021- 31/03/2023) in synergy with the Action entitled: "Upgrading the Study Programs and Creation of Educational Materials for Primary and Secondary Education" and is co-financed by Greece and the European Union within the Operational Program "Human Resource Development, Education and Lifelong Learning 2014-2020". The Skills Workshops are an innovative didactic and educational activity, which aims to add new thematic circles to the Kindergarten, the Elementary and High School timetables utilizing investigative discovery learning methods. In this Skills Workshops, one of the four main categories is "I Create and Innovate – Creative Thinking and Initiative" and its main field of interest is to promote STEM through Educational Robotics. Skills Workshops were applied on a trial basis during the school year 2020-2021 in some selected schools, while from the school year 2021-2022 they were included in the National Analytical School Timetable for Kindergarten, Elementary Schools and Secondary Schools (Gymnasiums).

Secondly, over the last few years there are a lot of competitions held under the supervision of the Ministry of Education, on the field of STEM or Educational Robotics. Such competitions are:

- "STEM Stars Greece", regarding STEM innovative programs for school pupils aged 14-18. (since 2020)

- "Panhellenic Educational Robotics Competition" and "Educational Robotics Olympiad" organized by the non – profit organization WRO Hellas under the supervision of the Ministry of Education for Primary, Secondary and High School students. (since 2017)

Last but not least, there are numerus Erasmus K+ and e-twinning programs which have been completed or are implemented by schools as partners on the field of STEM education.

In Greece, STEM practices include since 2008, ELLAK (free software/open-source software) that has offered the opportunity for several teachers to train and implement appropriate interventions in the classroom. In collaboration with the Harokopio University, they have built a robot that, with a 3D printer, the students at each school can build it themselves, but also program it afterwards (https://ellak.gr/)

Since 2009, WRO Hellas (World Robot Olympiad) (https://wrohellas.gr/) has been organizing robotics competitions in Greece with the aim of selecting a representative for local and global level. This particular company is private, but works with public schools mainly, while at the same time providing them with the learning kit for free so that they can start experimenting in practice.

WRO started in 2009 and until 2022 it continues solidly in its objectives. From their report of the year 2021-2022 we quote the following:

In parallel with the competitions, we also conduct several webinars in Greek for teachers who are involved in order to be able to cope with the difficulties of implementing new subjects. This year alone, for example 34 webinars were conducted.

Additionally, STEM Education Organization for Educational Robotics, Science, Technology & Mathematics (https://stem.edu.gr/) with the co-financing of Greece and the European Union, develops integrated educational programs of annual duration for all levels of education. The educational content is based on programs of some of the most valid universities in the world (MIT, Carnegie Mellon, Tufts) as well as renowned teachers who make up their scientific team. Since 2015, it has been developing educational programs and conducting educational activities with the aim of introducing STEM into education, either in its formal or informal form.

Public education has also started since 2008 free ICT training (Information and Communication Technologies) at all levels of education and in all specialties.

Seminars on STEM educational activities with Arduino, Raspberry Pi and educational robotics have been held in recent years either by the IEP or by education districts or universities, but also individually by every teacher who is interested in attending online seminars outside of Greece.

There are webinars for STEM training on the European Schoolnet Academy, they are simply in English and are definitely adapted to learning environments of foreign schools.

In Greece there are several teachers who teach Mathematics, Natural Sciences, Technology, Informatics, but there are not many who can combine the teaching of the above courses. The teacher who will teach STEM should know Mathematics, Physics and Informatics or should the mathematician who knows physics or the physicist who knows mathematics have a good cooperation with the teacher of Informatics in a school. Of course, apart from STEM, while in the previous decade collaborative and interdisciplinary education at the level of teachers was missing or ignored, in recent years their application has often been observed in public schools as well as in private schools.

Researcher Ms. Despina Mitsiadi, appointed by THEAMA specific to the project adds, quote, *'In 2017, at the music school in Ioannina, following a communication I had with WRO Hellas (World Robotics Olympiad), they sent us a basic equipment kit and in the one year I taught there, I created a group of children that would enter the competition. This minimal experience with robotics highlighted the difficulties I faced both in finding time to engage the children and in teaching programming which is a prerequisite in robotics'*.

Project-based teaching and learning in the school environment of the Greek classroom is inhospitable in most public schools, yet not impossible, however, in experimental or private schools it is much more common as there are both the logistical means and the hours they devote to groups after end of the school program.

As to the introduction of Arts principles in the Greek STEM practices and specifically theatre there have been records of several mathematics sessions and lesson presentations involving performing arts, either with ready-made plays or with the children's creation of the text.

The local organisation Thales & Friends (https://thalesandfriends.org/el/), a private initiative to promote Mathematics, inspires and supports the creation of reading clubs, as well as other activities that promote reflection, knowledge and dialogue, such as the production of plays for participation in pan-European competitions or literary texts.

In addition, the Panhellenic Network for Theater in Education (https://theatroedu.gr/) has trained many teachers of various specialties in recent years so that they can apply their ideas in the classroom in regular schools and not just for the private, experimental, or artistic schools.

Public schools in Greece, with artistic direction curriculum, are nine as of 2022 (4 in Athens, 1 in Heraklion, Crete, 1 in Thessaloniki, 1 in Messolonghi, 1 in Argolis and 1 in Kozani) where STEAM can be easily applied, involving not only mathematics but also other specialties since they employ teachers specialised as playwrights, actors, musicians, filmmakers and dancers.

4. Out-of-school national or regional activities / projects supporting STEM education

In the context of extracurricular activities various organized and non-organized activities with the STEM methodology are carried out by private or/and public schools, particularly widespread in Greece for children aged 4-15 years.

In the context of exploratory learning and the STEM philosophy, educational robotics courses are organized by various certified private centres. These courses are usually structured around WRO's (World Robot Olympiad) educational robotics courses (building with Lego, using appropriate and compatible computer programs and using appropriate sensors). However, there are other programs structured by other agencies such as the

Educational Robotics program of the University of Macedonia that trains and guides instructors in private centres.

In addition, within the framework of private or public schools/organizations, activities in the STEM methodology are organized on an annual basis or ad hoc and of short duration. Examples of such activities are the following: -

- Museum visits coordinated between schools and Museum authorities with relevant STEM activities are organised in Athens and in other regions. For example, the Heraklion Museum organizes activities with a core of science, interdisciplinarity and exploratory learning. Another example is the Museum of Experiments. that organizes related activities either for visits from schools or for private visits.
- Several institutions organize activities for limited groups of children in various age groups or/and relevant competitions. Such an example is the Eugenides Foundation that organized projects in the field of applied engineering as well as interdisciplinary approaches.
- Activities with an environmental label - which fall under the category of STEM philosophy - are also organized by the Education Centres for the Environment and Sustainability (KEPEA) throughout Greece. Each local/regional KPEA organizes its own programs, seminars and actions depending on its location.
- In addition, the Hellenic Scout Corps organizes activities and seminars for its members within the framework of its objectives and mode of operation, which include investigation and finding a solution with a combination of engineering, science, and mathematics. After all, this philosophy also includes the main goals of scouting, which are getting to know nature, ecology, and sustainable development.

In conclusion, there is a multitude of private and public entities that conduct extracurricular activities, seminars or actions based on the interdisciplinary nature and philosophy of STEM education. It must be also noted that these are mainly addressed to Primary/Middle-School tiers of education and do not usually address students in High School (grades 10-12) as the national curriculum does not leave margins for extra curricular activities and students are geared towards the University Entrance process of examinations and qualifications needed.

5. STEM/STEAM in the Greek Special Education System

On a general note, Special Education in Greece is inadequate in terms of quantity and quality, falls behind the directives set by the European Union and in essence is a minor part of the education system of our country. Usually the various regulations, declarations, legislative provisions or the planning of analytic programs and books made by the Ministry of Education, concern the general population of children, not including students with special needs. The Ministry remembers these students when the various plans have been completed and the related projects have been implemented. The result of this practice

often resembles charity - they give what is left over, not what the children are entitled to - is the failure to provide appropriate and equitable special education to children who need it.

The statistics available on Special Education are given below and are based on figures of the years 2018/2019

Educational Level	Number of schools	Number of students	Number of educators
Kindergarten	114	673	241
Primary	180	4,250	1,750
Middle School	8	238	105
Middle School - Vocational	52	3,168	1,367
High School	5	110	44
High School - Vocational	39	995	47

There are no directives and inadequate amount of data as to the use of STEM in the Greek Special Education system. It is the initiative of individual educators to introduce and employ STEM methods in their classrooms. There are sporadic recorded instances of the inclusion of educational robotics and STEM activities in education which have significant benefits in mobilisation, participation, sociability, communication and in general in the cognitive field for people with learning difficulties, ADHD and Autism. By comparing the levels of education, it is apparent, to a small extent, of course, that the benefits are greater for special education students in the primary level of education in relation to secondary education. This may be due to the fact that secondary school subjects present increasing degree of complexity. It must also be noted that Special Education in Greece applies the biomedical model of disability- looks at the effects of being ill- symptoms, infirmities and treatment, in contrast to the updated and widely accepted social model of disability- which addresses the environmental and social factors that inhibit the functionality of disabled persons/students.

Through the contacts we had with educators, particularly through the Focus Groups, it became apparent that STEM methods, though not routinely applied in special education classrooms, are nevertheless a very useful and adequate tool particularly, as they direct the focus of students through setting goals and objectives and group work.

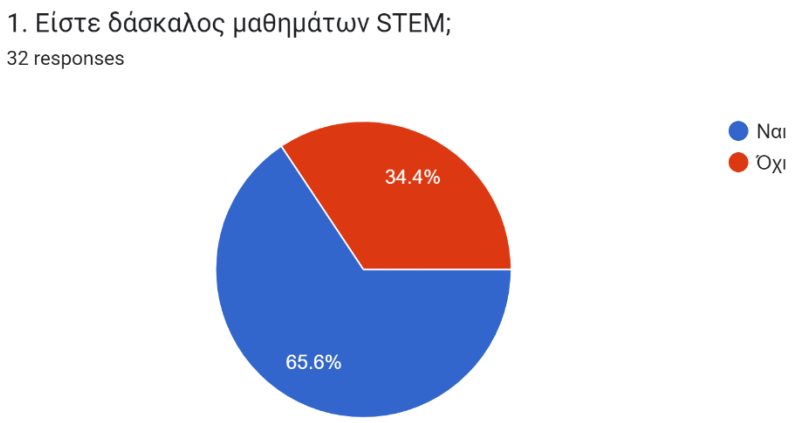
Adding the Arts within an interdisciplinary framework in special education enhances the students' learning experience. The freedom it provides for individual disabled students to freely express themselves in the classroom is an essential element in special education. It also broadens the parameters within which the educator can manoeuvre and personalize the educational process to match individual skills and abilities.

6. Online Questionnaires – process, demographics, and findings

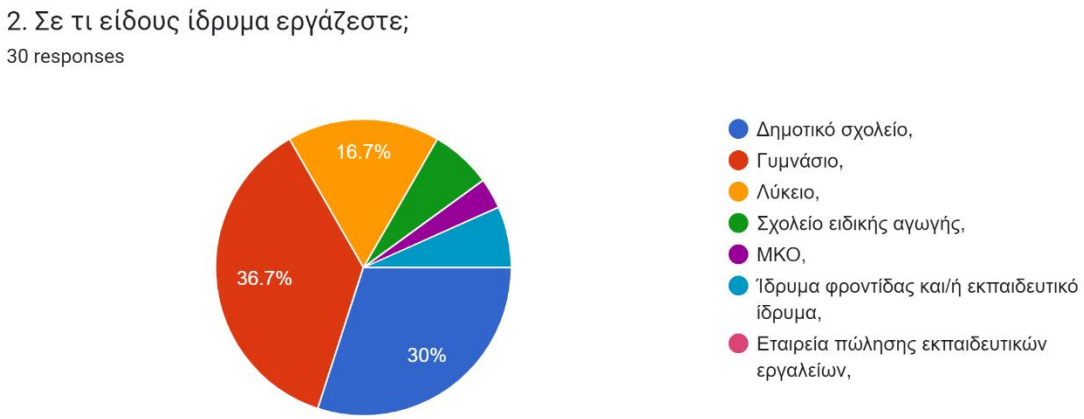
Once the final document of the Questionnaire was produced and uploaded, it was translated into Greek by the project partners from Cyprus and on 21 September 2022 it was disseminated through email to educators. Access to the document was closed on 15 October 2022 after collecting 32 responses.

The email was disseminated to approximately 135 addressees in total, with reminders sent out seeking their participation in the first week of October, as the 32 replies received is at 24% response rate which is rather low, particularly as the audience targeted were specifically educators, 104 of which are enlisted as STEM Ambassadors within the Scientix.eu community.

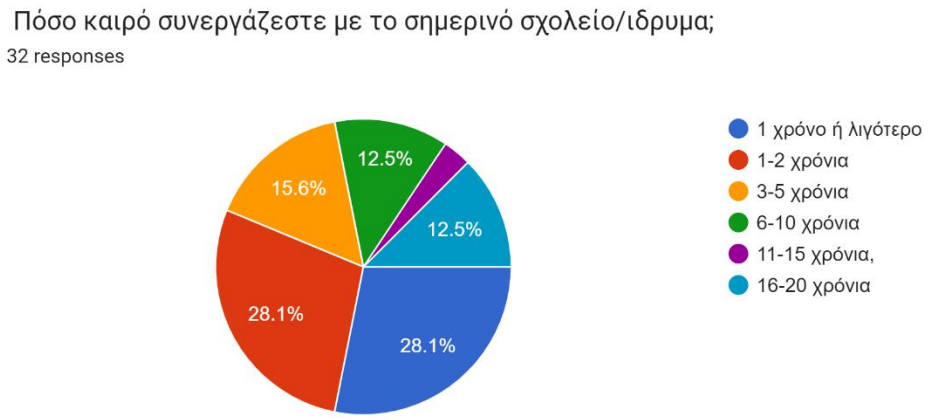
Participants were a mix of educators that either have or have not adequate STEM experience



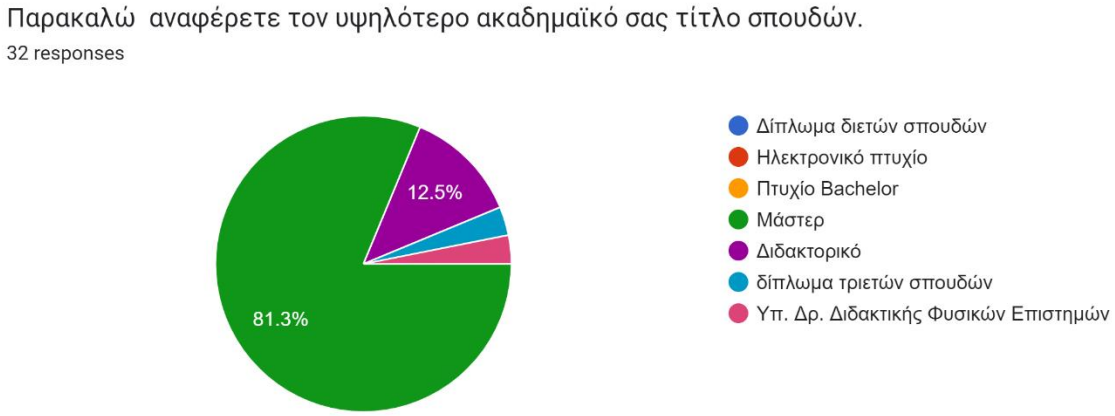
They work in a variety of educational levels and different establishments, the majority though work for either Middle Schools 30.7% and Special Education 30%.



Their years of experience varies –



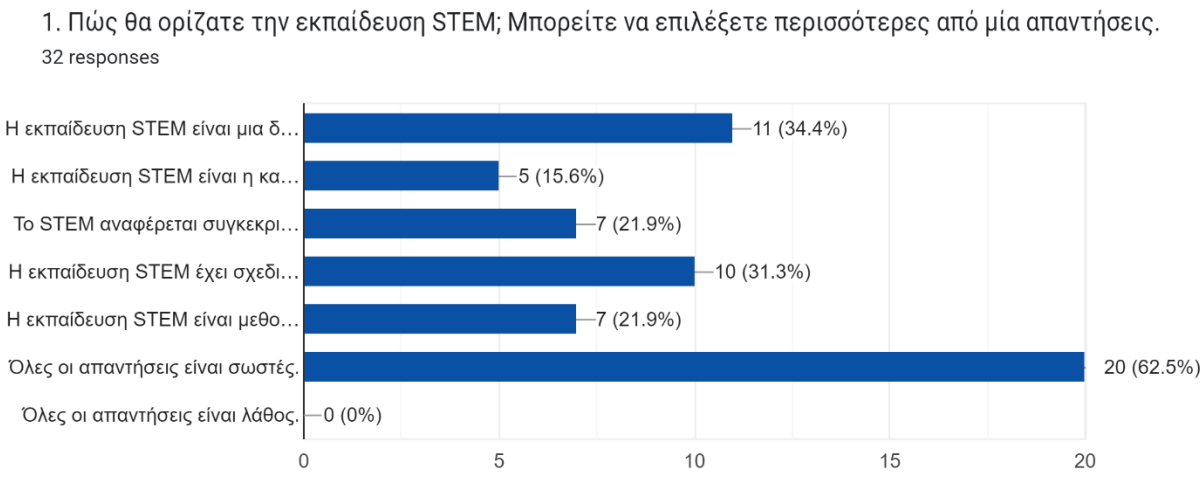
Their academic qualifications are by the majority of 81.3 % at postgraduate level.



The low response from the targeted population can also be attributed to the length of the questionnaire, probably quite long to solicit immediate and straight forward responses from the participants. On the plus side the responses received were from all the geographical and administrative Regions of Greece offering a wider perspective on the use of STEM methodology within the education system. The statistical information of the report was uploaded in the project's drive on 18 October 2022 - see link here.

Detailed results are as follows:

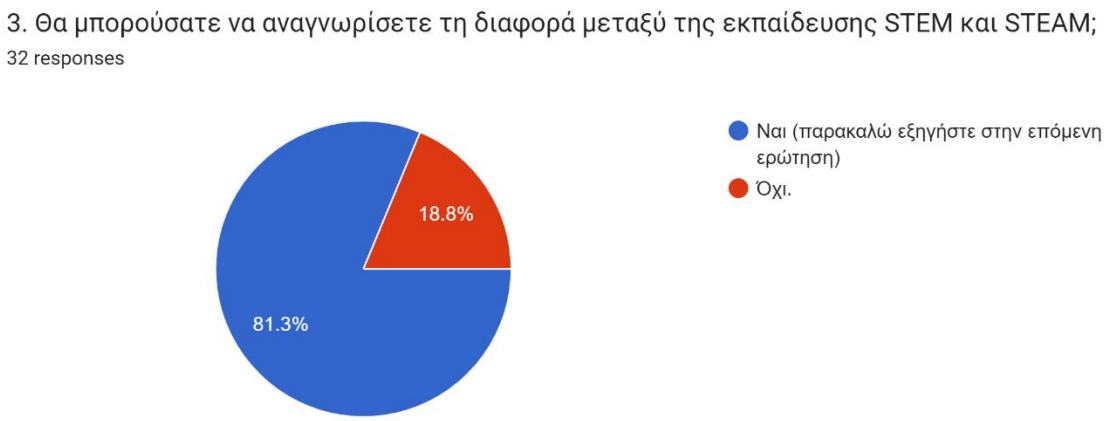
QUESTION 1



QUESTION 2

All 32 responses correct

QUESTION 3



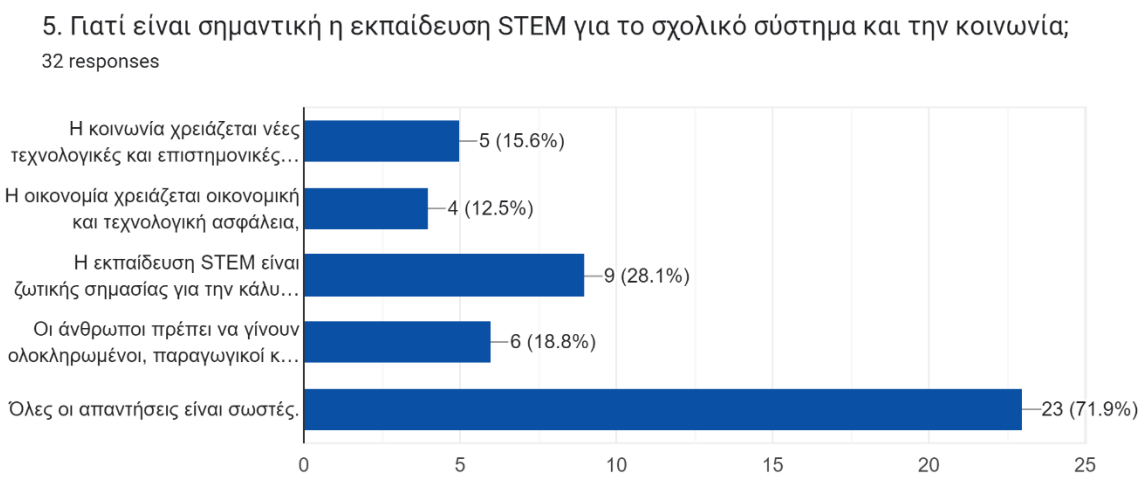
QUESTION 3a

26 responses correctly defining A in STEAM as Art – and one response defining A as All Disciplines, an approach propagated by the Scientix Ambassadors.

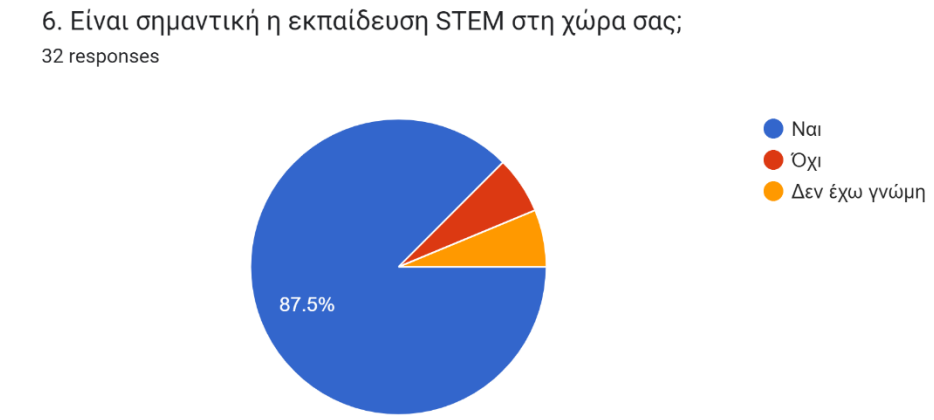
QUESTION 4

32 responses listing the STEM subjects

QUESTION 5



QUESTION 6



The answers on the importance of STEM education were supported by comments, listing factors of importance as:

- Creative approach to educational concepts
- Promoting critical thinking and creativity
- Promoting use of technology
- Constructivism, collaboration, exploratory learning are promoted and emphasis is placed on research and interdisciplinary work and activities.
- It leads to professions critical for the modern technologically developed era but also it provides abilities and skills to the citizen to deal with modern challenges, problematic situations of everyday life
- It cultivates skills that help the development of the individual and society as well as their harmonization with current developments
- As in all countries, it is very important to develop skills in students that will keep up with the 21st century providing them with the necessary education to cope with the

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4th Industrial revolution that has prevailed in the labor market, with the ultimate goal of industrial / economic development of Greece.

- It provides a comprehensive approach to subjects taught and an interdisciplinary approach to them.
- It is important in Greece to develop skills such as critical thinking and perception. The sterile parrot-learning practiced by previous generations is finally coming to an end.
- Recent emphasis on STEM education, although the implementation still requires more steps and efforts to be considered complete
- STEM education is important in every country. Students are exposed to inquiry learning.
- It enables students to work collaborate and create in groups
- In the context of modern and technologically developed societies, the school should respond to the developments and needs of the children and the society as a whole.
- It propagates applied knowledge, although in Greece the term is abused or misused even by academics, referring mostly to IT
- It fills a big gap in science education, especially at younger ages, and introduces students to it in a way that effectively connects scientific knowledge with the needs of everyday life.
- Mainly to cultivate critical ability, interdisciplinary approach, collaboration, problem analysis.
- It is a way of experiential learning
- Involves students in activities where all the required 21st century skills are combined
- It best serves learning through holistic problem solving and can be considered more effective for preparing workers in the field of technology and science.
- Inadequate support for the public schools by the Ministry of Education. Only teachers, out of personal efforts and initiative promote the STEM methods, without substantial help.-

QUESTION 7

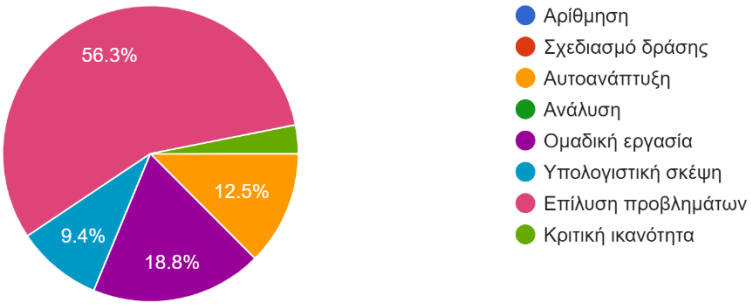
7. Η έμφαση στην εκπαίδευση STEM στη χώρα σας δίνεται κυρίως σε:

31 responses

QUESTION 8

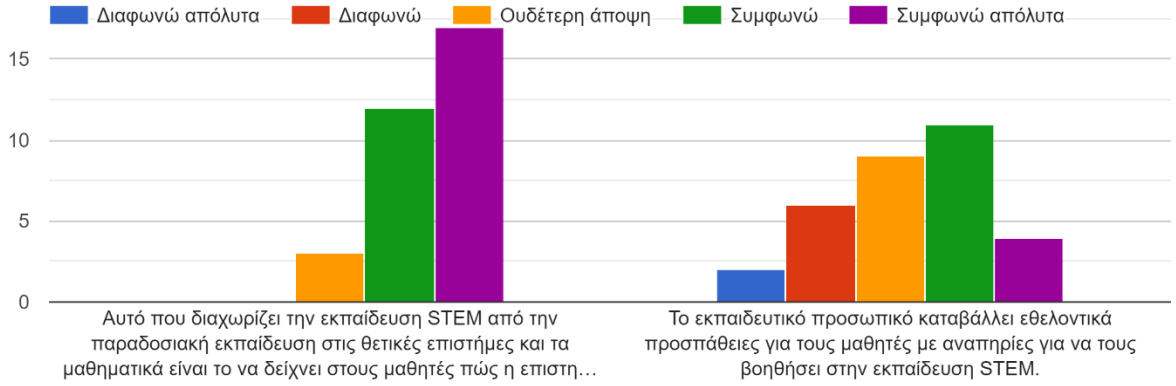
8. Τι είδους δεξιότητες των μαθητών είναι οι πιο σημαντικές στην εκπαίδευση STEM (Παρακαλώ επιλέξτε μια απάντηση):

32 responses



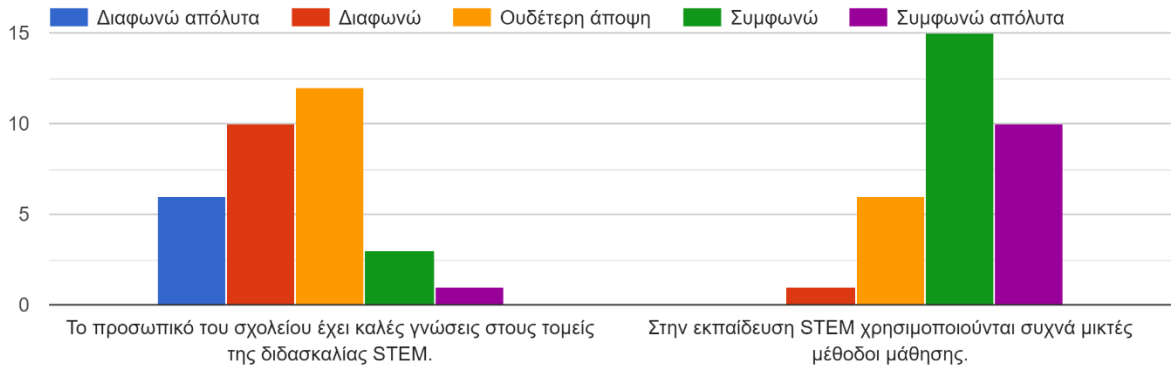
QUESTION 9

9. Δηλώστε το βαθμό συμφωνίας σας για τις ακόλουθες δηλώσεις:



Seven of the participants further elaborated on the above stating that lack of resources, material and educational are a serious obstacle in the implementation of STEM

Δηλώστε το βαθμό συμφωνίας σας για τις ακόλουθες δηλώσεις:



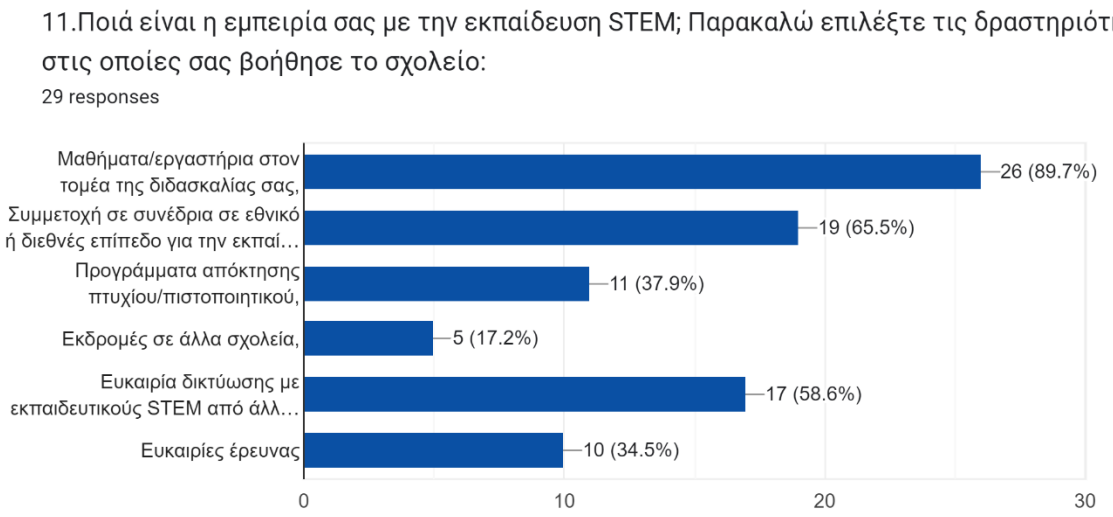
QUESTION 10

20 participants responded summarizing their comments as follows:

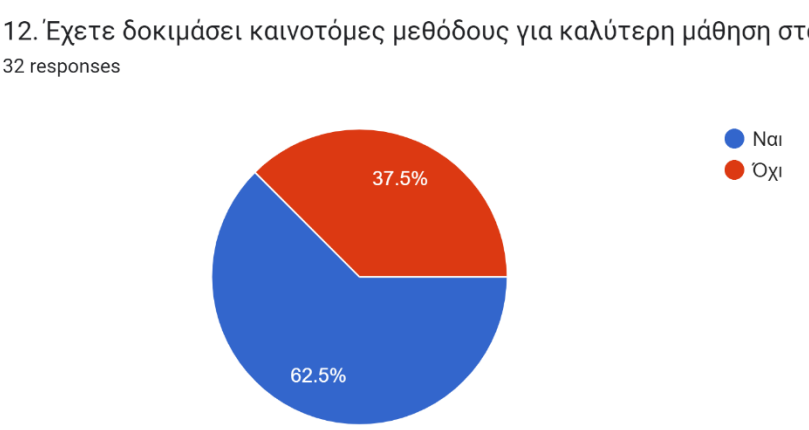
- Methodology not currently organised and streamlined centrally, it all depends on the educators' knowledge and initiative. It should be incorporated centrally, by The Ministry in the national curricula of the schools.
- The level that implements, even without knowing it, the philosophy of STEAM programs is Kindergarten and Primary educational level. However, it needs enormous support for teachers to be able to say that it is implemented on a large scale and correctly. e.g. the use of bee bot by itself is not a STEM method, simply because it is a robot.

- Many educators do not associate it with experiential learning and innovative teaching methods, e.g. project based learning and organization of the learning environment, e.g. working in groups
- Educate the educators, provide them with necessary tools and emphasize in an holistic interdisciplinary approach.

QUESTION 11



QUESTION 12



15 participants commented on the innovative methods, as follows:

- Robotics, radio programs on the European Schools Network radio.
- Participation in eTwinning projects
- project based learning
- Problem based learning, Engineering Design
- STEM in Sports education

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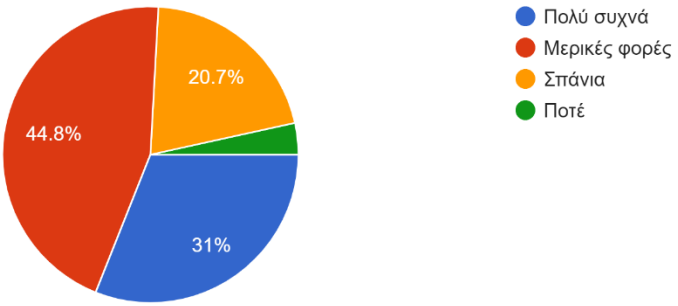
Project Nr: 2021-1-IT02-KA220-SCH-000032579
Project title: SUNRAISE - Stem UNlimited Raise thanks to Arts at School in Europe

- Reverse method of teaching
- AI, 3-dimensional printer
- Experiential learning, use of technological aids, experiment, constructions (electrical circuit, propeller) to teach concepts
- Augmented reality, robotics, problem solving challenges with the use of engineering design.
- SDGs (Sustainable Development Goals)
- Use of computer programs in geometry

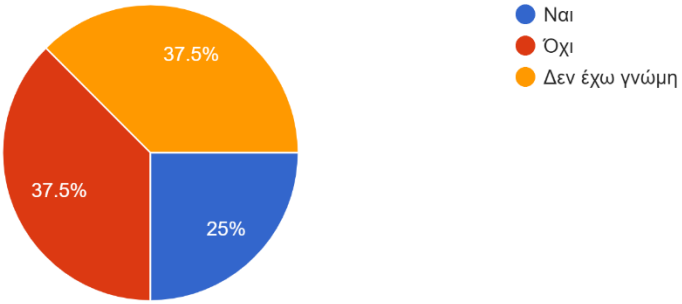
QUESTION 13

13. Πόσο συχνά χρησιμοποιείτε καινοτόμες μεθόδους για την διδασκαλία STEM μαθημάτων στην τάξη;
29 responses



QUESTION 14

14. Κατά τη γνώμη σας, συμφωνείτε ότι οι κυβερνητικές πολιτικές είχαν θετικό αντίκτυπο στην ανάπτυξη της εκπαίδευσης STEM στη χώρα σας
32 responses



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7.FOCUS GROUPS – process, and findings

As planned two Focus Groups sessions were scheduled for 2/11/2022 and 09/11/2022, via ZOOM platform, at 20:30-22:00 in the evening as educators were not otherwise available.

The participants were solicited through e-mails sent out on 24/10/2022 and through the personal contacts of the educators collaborating with the project as Researchers/Trainers. A document was sent to all -Information and Consent for participation in the Focus Groups – to sign, as well as the Agenda of the meeting that included the questions to be asked translated into Greek. (links to the drive here and here).

Both sessions were recorded on video and their links are available here

Group A (02/11/2022) – 5 coordinators from THEAMA, and 7 participants, 6 Middle-School teachers and 1 scientix.eu STEM Ambassador, all graduates and post-graduates in Mathematics, Engineering, Physics working in a variety of public schools (regional minority middle-school, arts middle-school, inter-cultural middle school, and Special Ed middle school).

Group B (09/11/2022) – 5 coordinators from THEAMA and 7 participants, all Middle School teachers, graduates and post-graduates in Mathematics, Biology, Physics and IT working in a variety of public schools (regional minority middle-school, arts middle-school, inter-cultural middle school, and Special Ed middle school).

The recorded video sessions, 90 minutes each, are uploaded in the Project's shared drive here.

Cumulatively, the replies to the given Questionnaire can be summarised as follows:

1. Is STEM education important for the school you work for or cooperate with? Which are the methods of STEM teaching generally used in the school you work for or cooperate with?

With the exception of one participant, who was a Scientix STEM Ambassadors, the remaining participants have not applied STEM methods in a structured manner, as the methodology is not part of the national curriculum.

2. What is your experience with STEM education teaching? Are there any activities that the school helped you with developing your teaching skills, e.g. course/workshops in your area of teaching, field trips to other schools, opportunity to network with STEM teachers from other schools, research opportunities?

Individuals' initiatives are commonly accepted as the only attempt to STEM methods. All educators/participants agreed upon the STEM advantages in education, however, no organised and structured methods are applied.

3. Do you have the freedom to try innovative methods for better learning in STEM?

Lack of freedom, due to the restrictions imposed by the National Curriculum and the material to be covered within the academic year was a common consensus among participants.

4. What kind of students' skills are the most important in STEM education?

STEM method activates the imagination, critical thinking, offers opportunities to experiment, sets the seeds for innovation, and triggers the students' imagination. Those were commonly accepted as skills acquired by the STEM methodology.

5. What is your experience in teaching STEM in an inclusive way? (If you have any experiences with students with disabilities, SEN, socio economic problems. etc)

From both groups, the participants involved in Special Education were only 5, and they all agreed that STEM methods are particularly beneficial to special education and inclusive practices, as clear targets are set, learning is accomplished by trial-and-error methods, it directly involves the students with disabilities into the learning process as active, juxtaposed to passive, participants. The flexible learning approach of STEM can be well applied in special education.

6. Does teaching staff in your school/ institution put some additional/ voluntary efforts to work with students with disabilities, SEN etc to help them in STEM education?

In the present curriculum even for special education STEM is not a part of the learning process. Any effort to apply STEM is clearly the individual educator's.

7. What is your experience with incorporating Arts and artistic practices in the STEM education teaching?

From all 14 participants, none had a conscientious planned instance where Arts were purposefully incorporated in a lesson. However, all participants had resorted to art techniques at some time to enhance their lessons – instances are described in Question 9/10/11.

8. What is your personal opinion, STEAM or STEM? What do you think about the idea of incorporating artistic practices in the STEM education teaching for students with disabilities?

here SWOT analysis can be used (strengths – weaknesses – threats – opportunities)

All participants agreed that the A – whether applied as Arts or as All Disciplines – is beneficial. An interdisciplinary approach is an essential element of the STEM educational approach.

Arts, as in performing arts, with their elements of improvisation is very useful in special education, it triggers the thinking process and offers a free and open approach for the students to express themselves.

Experiential and interactive approaches, supported by adequate classroom tools and resources are essential to include Arts in the daily school routine.

A clear obstacle, commonly faced by all participants, is the size of a classroom. Crowded classrooms with the number of students exceeding 25-27 are not fertile ground for experimentation and innovation.

9. Have you personally used arts as an educational tool within the STEM concept? If yes, what exactly did you implement? How was it received by your students, and did it facilitate the learning process?

None had applied a planned method to incorporate arts, but instead, arts were incorporated inadvertently to enhance the teaching/learning experience.

Those were very positive experiences for the students who reacted with enthusiasm and an increased zest for learning through the arts.

10. How would you propose to incorporate specifically arts (dance, theatre, music, drawing, photography etc) into a STEM/STEAM curriculum?

Instances reported by the participants:

a) Role-playing techniques to teach mathematics through painting.
b) Create a board game, involving IT, Engineering and Language teaching disciplines.
c) Students constructed ramps for the disabled students, wheel-chair users.
d) Visit a Museum, observing and studying ancient mechanisms and recreate them in classroom.
e) Robotics and Mathematics collaborated to create a game based on ancient theatre, like recording voices and sounds, giving the coordinates for seating arrangements, experimentation with the Chorus.
f) Using theatre techniques to teach Mathematics and Chemistry.
g) Reversing student-teacher roles, through theatre improvisation techniques.
h) Every classroom is a potential theatre stage, where the teacher and the students are performers.
i) Engineering applications, where safety procedures were taught via improvisation techniques.
j) Performing arts are a gift to education, in the occasion of a national competition 'Science through Theatre', the class studied 'inertia' both as a social phenomenon and a law of physics.
k) Relation between human rights, human freedoms and free-source, open-source and closed-source programming code.
l) Biodiversity in nature, particularly its complicated terminology, can be easily taught by adopting artistic techniques.

11. Are there any good practises/experiences in STEM education with artistic practices in your school/ workplace or in your country that you were impressed in and would like to implement?

This is a superfluous question, replied in 9/10 above.

7. SUMMARY / SUGGESTIONS – to support STEM education with artistic methods and techniques

STEM" [Science, Technology, Engineering and Mathematics] is an acronym solely used to refer to an educational method in the specific fields it represents. STEM aims to transform the traditional teacher-centred teaching that was predominant in the educational systems, and it emphasizes on an inquisitive method of acquiring knowledge, by strongly propagating research and interdisciplinary tasks and activities. We will notice that reference is made to the term STEAM where A translates to Art.

What is the importance of Art?

Arts are capable to teach people the value of creativity, innovation, communication, reflection and of course the stimulation of personal motivation. Arts provide creative solutions to problems and draw different perspectives that can be useful and often unique in concept. The function of Arts in the accessibility of information content is also important as they develop ingenuity at all levels, provide the skills and confidence to create ingenious ideas.

What is the role of Art in STEM?

The primary and operational goal of Arts in STEM education methods is to **integrate** learners into the educational process. Arts help students develop essential tools like, creativity, inventiveness, communication, and performance skills that will help them throughout their education and employment opportunities.
So far, the majority of scientists and researchers agree that Science and Technology cannot be separated from the Arts, and in general from the Human Sciences educational approach in all its aspects. Arts are extremely broad and diverse, covering everything from painting and photography to dance, history, and architecture. This, however, helps educators to incorporate elements of the Arts into their lessons with pure productive and educational value. In essence, Arts offer the **means to encourage** teaching in all areas to be more engaging and comprehensive.

What methods can THEAMA apply that can enhance STEAM?

Art can undoubtedly be an important teaching tool. THEAMA, through the many years of experience and specialized training of its instructors in theater and dance,

can share in this project effective practices for the creative and voluntary integration of students in the educational process with an inclusive approach at the same time.

More specifically, using **dance**, as a way of expression, creation, and communication, we aim to assimilate knowledge with practical and creative approaches. Mainly by employing:

A. **Kinesiology improvisations**, a tool often used in dance, the student enters a more productive way of thinking as he is called upon to create something new, a movement, a personal and unique movement. The value and recognition of one's unique traits and skills stimulate personal motivation. At the same time, improvisations can also work in groups in order to achieve the team spirit of cooperation.
B. Through the **sound stimulus**, depending on the sound stimulus the body reacts to it and allows the student to imagine an image, thus achieving critical thinking and spontaneity.

Theater also provides a wide array of practical methods, such as:

A. **Theatrical improvisation**, which can focus i) on the mirroring of the act to understand the function or design in everything and ii) on the free personal expression developed for a specific theme or concept, i.e. on targeted improvisation that develops personal critical thinking.
B. The **visual stimulus**, which may be able to intersperse the spontaneity and free expression of the development of a methodology through individual intake, understanding and execution. This particular method meets in many (common) points the already known method of STEM "Learning by Doing".
C. The **theatrical game**, which is the basis for building each time a new dialogue between the participants that can be easily transferred to the creative process. A method that comes from the art of theater but at the same time is almost similar to another already existing method in STEM, like gamification.

References/Bibliography:

- Kelley, T.R., & Knowles, G.J. (2016). *A conceptual framework for integrated STEM education*. International Journal of STEM Education, 3:11. https://doi: 10.1186/s40594016-0046-z
- Moore, T. J., Stohlmann, M. S., Wang, H. H., Tank, K. M., Glancy, A. W., & Roehrig, G. H. (2014). *Implementation and integration of engineering in K-12 STEM education*. In S. Purzer, J. Strobel, & M. Cardella (Eds.), Engineering in Pre-College Settings: Synthesizing Research, Policy, and Practices (pp. 35-60). Purdue University Press.

- Tsupros, N., Kohler, R., & J.Hallinen. (2009). *STEM education: A project to identify the missing components.* Retrieved August 5, 2020 from https://www.plt.org/stuff/contentmgr/files/1/cfd595ddb67c6c78ff30f24f19e5b3d3/files/h ow_plt_supports_stem___jan_15.pdf
- *The Integration of the Humanities and Arts with Sciences, Engineering, and Medicine in Higher Education: Branches from the Same Tree*. National Academies of Sciences, Engineering, and Medicine; Policy and Global Affairs; Board on Higher Education and Workforce; Committee on Integrating Higher Education in the Arts, Humanities, Sciences, Engineering, and Medicine; Bear A, Skorton D, editors.Washington (DC): National Academies Press (US); 2018 May 7.

Sources :

https://edu-gate.minedu.gov.gr/

https://STEMstarsgreece.athens-science-festival.gr/

http://iep.edu.gr/en/psifiako-apothetirio/skill-labs

https://wrohellas.gr/

https://ellak.gr/

https://wrohellas.gr

https://stem.edu.gr/

https://thalesandfriends.org/el/

https://theatroedu.gr/