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Learn STEM

Innovative Model of learning STEM
in secondary schools

ERASMUS+ KA220
Cooperation partnerships in school education

Overview on existing practices in teaching STEM through innovative pedagogical approaches for TÜRKİYE

ALİ ERDEM

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Institution, Place, Country

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TASK:

Dear partners in LearnSTEM,

Please, fill in text for your country in the chapters below.
Have in mind the you have to cite if you take ideas or sentences from other people or institutions.
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Please, finish this task until the next transnational partner meeting of LearnSTEM in Paderborn, Germany in August/September 2023.

Kind regards,
Marc

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2 Presentation of examples for existing practices in teaching STEM in Name of the partner country .....

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1 The importance of STEM in Educational contexts

Please, write here about half a side about the importance of STEM in education with regard to your partner country.

To keep up with and sustain digital transformation, Turkey needs a sufficient number of qualified workers. The business world needs a workforce with STEM skills—skills related to science, technology, engineering and mathematics—in order to stay in the race in the global economy, which is led by technology, innovation and digitalisation. An international, generally-accepted STEM education and work classification has not been done, yet there is consensus among experts that some fields require STEM knowledge.In today's world, where technological transformation plays a critical role, productive, entrepreneurial and discovery-based education is fundamental. STEM education not only improves education quality, but it also responds to the needs of the business world as it develops an interdisciplinary approach, teaches how to use theoretical information in practice, encourages critical thinking and instils problem solving skills.

People have started to feel the need to develop themselves with new knowledge in order to adapt to the conditions of the era. One way to achieve this is by informal and formal education that children experience during the first years of life with conscious education models. The task of educators is to fulfill their responsibility in transforming the individual into a creative, critical, productive and dynamic society member in order to prepare the individual for the future world. 21st Century skills enable people to focus on success in education and business. Thinking skills include collaboration, high level of communication, problem solving, information literacy, use of technology, openness to innovation, lifelong learning, decision making, productivity and leadership. STEM, which is one of the interdisciplinary approaches targeting 21st century skills, should be used in formal and informal education experiences from early childhood. With an appropriate learning environment, children will achieve more productive learning from an early age thanks to the STEM areas in which they gain a different life skill in each experience. In practice, the interdisciplinary attitude and the integration of the learned skills will take place. Within the framework of STEM trainings, subjects such as plants, rocks or stones, animals, force and magnets, different substances and their properties, states of matter, seasonal changes, electricity, sound, light, earth and space, living things and living areas can be taken as the lesson subject in primary education. In the program, implementation of many different activities, especially scientific activities are considered.

According to the Constitution of the Republic of Turkey, every citizen has the right to education which is free of charge for the compulsory primary education.Since 2012, twelve years of education is compulsary for boys and girls, which can be divided into 4+4+4 years of schooling.The Ministry of National Education (MEB) runs educational administration of the country and is responsible for drawing up curricula, coordinating the work of official, private and voluntary organizations, designing and building schools, developing educational materials and so on.The central government is responsible for all educational expenses of the public.The academic calendar generally begins in mid-September and extends through to mid-June, with some variations between urban and rural areas. The school day usually have a morning and an afternoon session, but in overcrowded schools there is a split session.Schools are in session for five days a week (Monday to Friday) in a total of 35-40 hours. The Turkish National Educational System is composed of two main sections: Formal Education and Non-formal Education.

Formal Education : Formal education is the regular education of individuals in a certain age group and given in schools. This includes Pre-Primary education, Primary education, Secondary education and Higher education institutions.

Pre-Primary education: Pre-Primary education is an optional education for children between 3-5 years of age who are under the age of compulsory primary education. The purpose of this education is to ensure physical, mental and sensory development of children and the acquisition of good habits, to prepare children for primary education, to create a common atmosphere of growth for those living in inconvenient circumstances and to ensure that Turkish is spoken correct and well. Pre-school education is given in kindergartens, daycare homes, nursery classes in primary schools, and in private nurseries, all under the supervision of the Ministry. They are usually concentrated in larger towns and cities.

Primary Education: Primary education is compulsory for all boys and girls at the age of 7 and is given free of charge in public schools. These schools provide eight (4+4) years of education. The purpose of the primary education is to ensure that every child acquires the basic knowledge, skills, behaviors, and habits to become a good citizen, is raised in line with the national moral concepts and is prepared for life and for the next education level parallel to his/her interests and skills.

Secondary Education: Secondary education is compulsory for four years and covers general, vocational and technical high schools (Lycees, Lise in Turkish) that provide four years of education (used to be 3 years until 2005).

- General high schools prepare students for higher learning institutions. Some of the secondary schools and the private secondary schools have foreign language preparatory classes. This kind of private lycees have double language education (such as Italian Highschool, German Highschool, Austrian Highschool, French Highschool, and so on).

- Vocational and technical high schools provide specialized instruction with the aim of training qualified personnel.

- Technical lycees include special formations such as electricity, electronics, chemistry, machinery, motors, building, etc.

- Vocational lycees can be Industrial Vocational Lycees; Girls' Vocational Lycees (home economics etc.), Public Health Vocational Lycees, Commercial Vocational Lycees, Agricultural Vocational Lycees, Meteorology Vocational Lycees, Animal Husbandry Vocational Lycees, Land Registration and Cadastre Vocational Lycees, etc.

The purpose of secondary education is to give students a minimum common culture, to identify individual and social problems, to search for solutions, to raise awareness in order to contribute to the socio-economic and cultural development of the country and to prepare the students for higher education, for profession, for life and for business in line with their interests and skills.In addition to normal high schools, there are also evening high schools usually operating in the same school building. These are designed to allow those who take up employment after primary (or middle school) to continue their formal education.

STEM Applications in Turkish Science High Schools

The idea of establishing Science High Schools in Turkey was discussed in a multilateral project at the beginning of 1963. The Ministry of National Education (MoNE), Ford Foundation, Middle East Technical University (METU), Ankara University, and International Development Agency (AID) participated in this project to establish these schools. In Ankara, Science High School project was a US funded and technically supported project, carried out jointly by the Florida State University, METU, and Ankara University.

Science High Schools' organizational goals were:

(1) to improve students' ability and increase their intelligence in science

(2) to increase the number of qualified personnel in higher education and industry,

and (3) to develop more laboratories by increasing students' scientific knowledge in order to be the center of research and development.

To train teachers in Turkey, a modern building was constructed at METU campus and the education at Ankara Science High School started in 1964. After the success of the Ankara Science High School, the MoNE started the Science High School Projects in Istanbul and Izmir.Today, there are 238 Science High Schools serving as public schools and the same amount of schools serving as private schools.

2 Presentation of examples for existing practices in teaching STEM in Türkiye

Please, give in 3 to 5 sentences an overview bout the existing 4 best practices, which you like to present below in detail.

2.1 Presentation of best practice 1:

Please, provide here a detailed overview on the first best-practice for your country. Start with a brief overview.Insert also 1 picture. This should be 2 pages

Project Title: Improving STEM Education Across European Schools

https://improving-stem-education.eu/

https://www.facebook.com/ImproveSTEM/

Project Start Date: 25.10.2020

Project Total Duration: 24 Months

Project End Date: 24.10.2022

Partner Organisations:

Applicant Organisation: Academy for International Science and Research UK

1. 21.YY Egitimciler Dernegi Turkey

2. VITALE TECNOLOGIE COMUNICAZIONE - VITECO SRL Italy

3. INSTITUTE OF ENTREPRENEURSHIP DEVELOPMENT Greece

4. Scoala Gimnaziala Gheorghe Magheru Caracal Romania

5. UC LIMBURG Belgium

Aims: GENERAL OBJECTIVE of the STEM project is to develop a methodology for teachers/educators and to develop and implement innovative pedagogies and methods for teaching and assessing STEM in the classroom, making it more attractive in the eyes of young people and students.

Specific Objectives

SO1: Boost a Europe-wide collaboration among STEM teachers as well as education researchers, policymakers and other STEM education professionals, exchanging inquiry-based and other innovative, effective and engaging approaches to science and maths education.

SO2: Transfer of innovative STEM teaching methods to a large number of teachers, an e-Learning Area that will be developed in order to help individuals exploring and sharing innovative tools and techniques to make STEM subjects attractive in the eyes of the students.

SO3: Explore the use of ICT in STEM education, to enhance its introduction in traditional teaching methods and create technology-rich learning environments for students.

SO4: Helping students to develop important transversal skills such as creative thinking, problem solving, etc., that can be utilised by young people in the labour market.

Target Groups: Whereas STUDENTS are targets of all education efforts, TEACHERS are the central agents of the educational ecosystem and their roles has changed from that of primary source of information to someone who creates structure and provide advice for students, monitors their progress, assesses their accomplishments and works as a coach. SCHOOL ADMINISTRATIONS are also within the target group because of their critical role as leaders and decision makers.

Results:

IO1: State of Art / Report on STEM Education & 6 Types of Training Materials

IO2: e-Learning Area/e-Courses (8 Different Topics)

IO3: Mentoring Scheme

"Improving STEM Education Across European Schools" (Erasmus+ KA201)

https://improving-stem-education.eu/teaching-materials/

The overall goal of the project was developing a methodology for teachers to deliver innovative teaching styles to make the STEM evaluation more efficient and its implementation more attractive for students. Over the course of the project we obtained the following results: 10 STEM pedagogical scenarios of which two were created by the teachers in our school. These were also translated in Romanian and listed on the project website (https://improving-stemeducation.eu/teaching-materials/).

I have personally contributed to the one about the active engagement in respecting the habitat. 25 online courses, grouped on nine STEM themes, of which five were created by our school's coordinator. Again, all courses were translated and can be found on the project's webpage (https://e-learning.improving-stem-education.eu/) 30 students' mentoring sessions, of which six were hosted by Romanian mentors who answered our call. The sessions were recorded and can be found here https://improving-stemeducation.eu/mentoring-scheme/ Three learning and teaching training mobilities which ten of our school's teachers benefited of. These took place in Greece (Nov 2021), Belgium (Apr 2022) and Ireland (Jun 2022) and had the following main themes: Class Management, Students Motivation, Robotics and Programming, 3D printing and Laser cutting.

I was one of the teachers who took part in the workshop in Belgium The project proved to be complex and challenging, even more given the fact that we were the only institution dealing with younger students. Over the project our school partnered with a university, a Science House Centre, a centre for teachers' professional development, an IT company, and an NGO dedicated to improving teaching.

2.2 Presentation of best practice 2: Name of the best practice

Erasmus + STEM

INTEGRATED APPROACH TO STEM TEACHER TRAINING

Please, provide here a detailed overview on the second best-practice for your country. Start with a brief overview.

Insert also 1 picture. This should be 2 pages

https://stem-project.org/about

Co-funded by the Erasmus+ Programme of the European Union

Duration of the project: January 2019 - September 2022

Erasmus + STEM

INTEGRATED APPROACH TO STEM TEACHER TRAINING

This project has been funded with support from the european commission. This website reflects the views only of the author, and the commission cannot be held responsible for any use which may be made of the information contained therein.

The wider project objective is to enhance the quality of STEM Teacher training at partner universities in line with Bologna provisions and needs of knowledge economy.

Specific project objectives:

- To develop STEM Teacher Training Master programs based on an integrated approach;
- To set up STEM regional resource centres providing consulting and engagement services;
- To train STEM ambassadors;

- To train teachers in new skills.

The project is aimed at tackling the partner countries needs in qualified STEM teachers by enhancing quality of STEM education: A unique Master program will be developed in the Teacher training on the basis of integrated approach in consultation with the EU partners. First, the teachers engaged in the new program delivery, then a wider circle of teachers from consortium members and regional universities and schools will be trained in the-state-of-the-art T&A methods.

The achievement of outputs is reached through the implementation of 6 work packages:

1. PREPARATION "Best policies and practices"

2. DEVELOPMENT "STEM Master's program development"

3. DEVELOPMENT "Training framework"

4. QUALITY PLAN "Quality assurance of project implementation"

5. DISSEMINATION & EXPLOITATION "Project visibility and sustainability"

6. MANAGEMENT "Efficient project management and coordination"

During the preparation phase the main project policies and plans will be devised and analysis of key employers' needs conducted. During the development phase main outputs are to be produced. Training of teachers will be done through the cascade model: first, the train the trainer program will be introduced for a small number of qualified teachers; then the trained trainers will transfer the skills to a wider circle of STEM stakeholders. All project outputs will be internally and externally evaluated. The project consortium consists of 10 universities from 4 EU countries and 6 universities from Russia and Kazakhstan. The associated partners will be actively involved in training and disseminating activities.

Duration of the project: January 2019 - September 2022

Erasmus + STEM

INTEGRATED APPROACH TO STEM TEACHER TRAINING

This project has been funded with support from the european commission. This website reflects the views only of the author, and the commission cannot be held responsible for any use which may be made of the information contained therein.

2.3 Presentation of best practice 3:
The project "Minds ON, Hands ON, STEM Goes ON"

https://www.facebook.com/groups/473363756379571/

https://erasmus-stem.weebly.com/

Description of The Project

• Minds on Hands on STEM Goes on project mainly focused on how science and math education can meet young people's needs and how it can be meaningful and joyful for students. • In the light of the problem, the main aim of the project was to make science and math education more relevant and meaningful for our students in the ways of respect, beliefs and cultural diversity.

• The Project focused on developed key competencies include 'traditional' skills such as communication in one's mother tongue, foreign languages, digital skills, literacy, and basic skills in maths and science, as well as horizontal skills such as learning to learn, social and civic responsibility, initiative and entrepreneurship, cultural awareness, and creativity.

Besides the aims implied above, our project contributed students' and teachers' competences below;

• improving attitudes toward STEM fields and careers

• engaging and supporting girls in STEM fields

• making students excited and enthusiastic about the natural world, learning about ecology and protecting environment

• Improving teacher competences and increasing their awareness on children needs and overcome difficulties in learning science

• broaden the understanding of practises, policies and systems in school education

• increasing opportunities for professional career development

• greater understanding of interconnections between formal and non-formal education

• having a positive impact on our wider school communities

During the Project, we have investigated how students, parents and teachers are engaged and affected by science in everyday life.

We have exchanged our experience and good practices, while organised STEM activities in a formal and informal environment such as camping in nature, visiting

museums and aquariums, preparing slowmation (slow animation) about science subjects, organising science fair s and robot festival . A Woman scientist in EU, digital book was created . Led jewellery workshop was implemented .

Teacher Training Course 24-26 October 2017 Antalya/Turkey

• At the beginning of the Project, Teacher Training Course was organised in order to improve teacher competencies and increasing their awareness of children needs and overcome difficulties in learning science.

• The course content encompassed “Integrated STEM Education”, "Nature of Science", "Informal STEM Education", "Learning science in out of school context" , "Slowmation/animation" preparation.

The 24 hours course was held with the participation of the lecturers, two scholars and the contact person of Turkey (PhD student on STEM education). At the end of the teacher training course, twelve teachers and administers were certificated. Certificated teachers informed their colleagues at their schools about STEM education.

Please, provide here a detailed overview on the third best-practice for your country. Start with a brief overview.

Insert also 1 picture. This should be 2 pages

STEM ACTIVITY BOOK
https://drive.google.com/file/d/1F5bJFb4r5PoPffgL-FiH4PBusGNUs5OW/view?usp=sharing

PROJECT DAIRY
https://drive.google.com/file/d/1K5wevn0nkEkaX2grUGBD3Qvsh3NO-0t3/view?usp=sharing

DESEMINATION DOCUMENTS
https://drive.google.com/open?id=1ZO1wGDRB4HKmVyaOPhulFPbmV6cK6du7

STEM Lesson plans
https://drive.google.com/open?id=1zKm3us1oyZhQaSI8uM_DmTkqA--jkv8q

ROBOTIC plans
https://drive.google.com/open?id=1XnGX4CZluVw2xGKPWQ8NAvu9IUtJUrMC

Learning/Teaching/Training Activities - photos during our mobilities

https://drive.google.com/open?id=1D7qrHfYSa2W8HdSymOhU6zE6fxGxF1pr

FACEBOOK PAGE OF PROJECT
https://www.facebook.com/groups/473363756379571/

If a scientist writes a fairy tale – MOVIES
https://drive.google.com/open?id=1OGsA40GhFomwfh8JiA9QtPqrpviitOQR

Women scientist in Europe
https://drive.google.com/open?id=1rkeSl6YSVdUJ1QmXUUvQx67DZFVQUGnf

Led- jewelry pictures
https://drive.google.com/open?id=1Fgn6-_ZjE1uzZ14WUtZfZrilywxRu9oo

Slowmation - slow animation
https://drive.google.com/open?id=1Lkp-oEXhEACTVQPyWDazvYBqq4vSdpqo

Science fair - pictures
https://drive.google.com/open?id=1TjJz1OkoJVodXaUE8Np_htrdn6_KQHLU

LED fashion show
https://drive.google.com/open?id=1lpCWp5dlH0AxEno0rsbrGIpfpKamwlrH

STEM CARER awarness day
https://drive.google.com/open?id=1IYr8TcCfPSBFykTMg-FPjHIUPoOMPnhW

Brochure - leaflet
https://drive.google.com/open?id=1-d0dsQYNCokjw-2MtngMzPDS5JQFQTxg

My country, my region, my school
https://drive.google.com/open?id=1DXce2EvACCOH0U96TgHWbnjQ9WMMcYCI

SCHOOL stem corners
https://drive.google.com/open?id=1PgHd2J6uAbjM5JupS7VLEj_COapomKvD

2.4 Presentation of best practice 4:

https://www.tubitak.gov.tr/en/funds/science-society/national-support-programmes

Supports by TUBITAK.(The Scientific and Technological Research Council Of Turkey). for STEM Education

The projects supported under TUBITAK Science and Society program was for to use STEM approach in the projects.In this project, the main goal is to trigger the participants' curiosity, for research and learning by making them to realize simple scientific facts, not by transferring the knowledge.

TUBITAK 4003 Program of Science and Technology Centers

This program was designed to bring people from different ages and different backgrounds together around science by providing information resources and to trigger their interest in experimental and applied sciences

The purpose of the program is also to increase participants' interest in and attention to science. These centers are expected to increase creativity. Along with their contribution to the science, these centers also have exhibited the history and culture of the regions in which they are located. They present a combination of art and science because the submission of scientific knowledge requires creativity and an artistic perspective. Science centers can help participants to broaden their horizon by using scientific approaches for explanation of daily events. Everyone can demonstrate creative thinking because creative thinking is a skill that can be improved. In particular, visitors can decide on their own whether to contribute to young or adults. Science centers are the center of attraction not only because of their content but also because of the structure within a diversity of green space. Large entrance and waiting room with high ceilings offer a comfortable environment for guests. The entrance with interactive outdoor science center exhibits invites them to the mysterious world of science. TUBITAK aims to develop scientific thinking, to spread the scientific knowledge, to create a culture among the society, to promote

asking questions, to raise pioneering individuals, to provide a new vision for society, and to take the leap in science that Turkey has needed by generalizing science centers in Turkey.

TUBITAK 4004 Nature Education and Science High Schools Program

4004 - Education in Nature and Science Camps/Schools Support Programme has been launched in 2007. The program supports training programs, which facilitate the understanding of the target audience on scientific concepts, fields, processes through observation and scientific applications in natural sciences. The activities containing one or more of the following are supported by the program: experimental observations, workshops, field visits, utilization of games or arts for training, drama, measurement and evaluation, focus groups, sports, interactive training. Universities, schools, and public bodies may apply with their training projects for preschool children, primary and secondary school students, graduate and post-graduate students, teachers, governmental personnel.

The aim of this program is to transfer the knowledge to the society in a comprehensive manner while using visualization tools and interactive applications. The main goal in this program is to trigger the participants' curiosity and ambition for the research, query, and learning by making them to realize simple scientific facts.

The aim of this program is:

• To popularize the science and scientists,

• To emphasize the entertaining part of science,

• To overcome prejudices, negative concerns about science and scientists in society and student concerns,

• To build bridges between the school and research organizations

• To develop scientific process skills,

• To provide an understanding of the nature of science,

• To understand the interaction among science technology, society, and individuals,

TUBITAK 4005 Science and Society Innovative Activities and Practices Program

4005 - Innovative Educational Applications Support Programme was launched in 2013 and designed for graduate students, academicians in universities, permanent teachers working actively in an institution, and employees of science centers run by public and municipal affiliates. Innovative Educational Applications Support Programme covers interactive activities that provide the students with the necessary knowledge and skills through innovative approaches to arouse interest and curiosity in their branches, develop positive attitudes, increase their motivation and enable them to learn. Since 2018, the project coordinator should have a Ph.D. degree.

This program was related to the topics about teachers' training. The program aims to arouse teachers' interest, to teach the content knowledge and improve skills to increase their motivation, to develop positive attitudes, to gain innovative approaches

through interactive methods and techniques in science related subjects, and to raise the awareness of teachers in innovative approaches outside the traditional teaching methods,Some examples to achieve the objectives under this program are presented in the following paragraphs. Quantum Physics and Optics Laboratory offer exciting opportunities for computerized monitoring of research and applied physics. Students in applied research frequently learn theoretically and experimentally with new devices in optical, electromagnetic, acoustic, nanotechnology, photonics and systems. In optical projects, imaging systems, vision sensors, color, human perception, image processing, holography, laser interferometry and other applications are located. Students in Modern Physics Laboratory were engaged in research on metamaterials, holographic data storage, atoms, quantum, nuclear, solid state, and elementary particle physics. The main target of the laboratory followed by professionals in the field of contemporary research topics is to attract the attention of students in cooperation with schools. Optics and some projects are carried out in the Modern Physics Laboratory:

TUBITAK 4006 Science Fair Support Program

In accordance with the protocol signed between the MoNE and TUBITAK, the program was established to develop the scientific culture of our country (The Scientific and Technological Research Council Of Turkey, 2015). Within the framework of the school curriculum, students have been studying courses and making research on the issues that they have identified by their own interests, so that they can share the results of their research. Therefore, the program needs to include following items to create an environment where the learning is fun for all:

• Encourage the adoption of science and scientific work by the new generations,

• To link the science to everyday life,

• To develop research techniques and scientific reporting as well as to distribute the scientific presentations in order to improve young people’s skills,

• To provide an opportunity for every child in different science projects and cognitive developmental level,

• To create new environments and opportunities for students to do research projects and sharing,

• To introduce entertaining and interesting part of the science to students to eliminate the pressure of competition on students,

• To ensure equal access for scientific projects to school districts in different socioeconomic levels,

• To teach how to adapt the science and solutions to real-life problems.

4007 – Science Festivals Support Programme has been launched in 2015. This program aims to create awareness on basic scientific concepts and to promote the curiosity, research, questioning, and learning behavior in public, by science communication, exploitation of scientific knowledge to a large community, understanding of the interaction between science and technology via exhibitions, shows, performances, laboratory applications, science games, contests, and interviews. Universities, science centers of public or local administrations, municipalities, and other public bodies may apply for getting support in the organization of science festivals in their premises, region, or city.

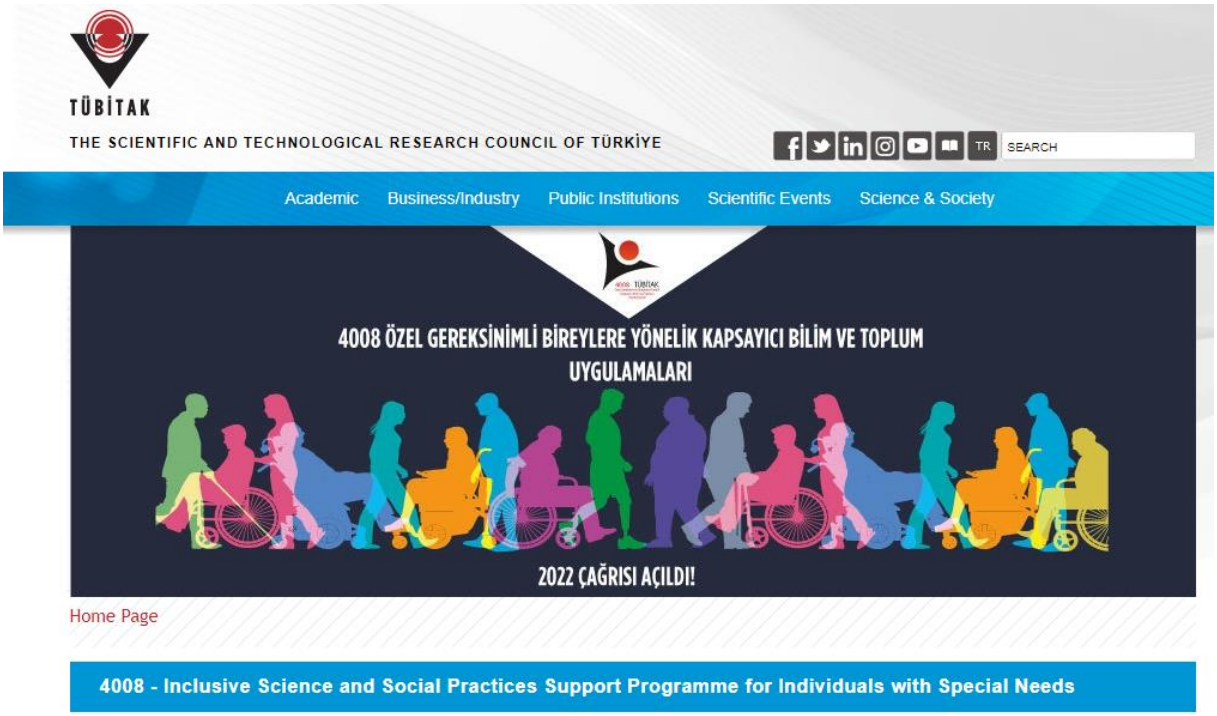
The aim of this program was to provide science communication, to spread scientific knowledge to a broader community, to raise the interaction of science and technology for public, and to comprehend exhibitions, stage shows, performances, workshops/laboratory work, thematic science games, contests, interviews and so on (The Scientific and Technological Research Council Of Turkey, 2015).

TUBITAK 5000 Open Source Digital Content Support Program

The overall objective of the program is to accelerate the creation of high quality e-books and e-courses for K-12, so that equal opportunities for all students can be provided (The Scientific and Technological Research Council Of Turkey, 2015).

4008 - Inclusive Science and Social Practices Support Programme for Individuals with Special Needs

The programme was first launched and the call was published on April 23, 2022. The programme aims to raise awareness among individuals with special needs and those who provide services to them through the projects that are supported by the programme. It aims to facilitate their integration with society by providing support in education and independent living and to ensure the spread of scientific practices for these individuals.



3 Scientific Meetings Grant Programmes

SUMMER SCHOOL AND RELATED ACTIVITIES SUPPORT PROGRAMME FOR MSc AND PhD STUDENTS

Purpose:
Within the context of the program, summer schools are supported in accordance that they aim to transfer the current improvements in the Science and Technology and to teach the currently used techniques in the fields of Natural Sciences, Medical Sciences, Engineering and Technological Sciences and Social Sciences and Humanities.

NATIONAL SCIENTIFIC MEETINGS GRANT PROGRAMME

Purpose:
to support the scientists pursuing post graduate education/research and post-doctoral research programs in the fields of Natural Sciences, Medical Sciences, Engineering and Technological Sciences and Social Sciences and Humanities due to their participation in national, international or with international participation scientific events.

“TRAINING THE TRAINERS” PROGRAMME

Purpose:
to support the primary-secondary school and undergraduate students who show excellent achievement and encourage them in their academic and scientific performance by supporting science camps, theoretical or applied summer or winter courses. Additionally, the programme includes seminars for high school teachers and academicians.

4 Final comment

Write here 3 to 5 summarizing sentences

Teacher training about STEM education in Turkey

Innovation is very important for countries. It is an interactive and multidisciplinary process and tightly connected to life. In our time, there is a clear consensus among stakeholders on the importance of STEM education to the innovation.

Well, what is STEM education? STEM is an abbreviation of the “Science, Technology, Engineering and Mathematics” words. It is a curriculum based on in an interdisciplinary and applied approach. STEM integrates these four disciplines into a cohesive learning paradigm based on real-world applications.

The objectives stated by Turkey’s Vision 2023 and the Ministry of National Education (MoNE) strategic documents require defining STEM education on a national scale In June 2017, regulations in national education policies announced that STEM education would be applied for the first time in secondary school level in Turkey. This education would be gradually expanded to all grade levels starting from the 5th grade and be covered in the last unit in all grade levels. With the curriculum revised at the beginning of the 2018-2019 academic year, schools started offer STEM education under the name “Science, Engineering and Entrepreneurship Practices” starting from 4th grade.

This revised curriculum states that science, engineering and entrepreneurship practices will be embedded in all units within an academic term and students are expected to realize the design and production process of products in connection with the related units in the school environment (MoNE, 2018). The age of innovation, which we are already in, guides a generation to lead the country in the future. Called as “Generation Z” or “digital natives/digital settlers”, these children interact and socialize with mobile communication tools. Unlike the generations preceding them, these digital natives are exposed to information and communication technologies since the moment they are born. Providing this generation, which constitutes 17% of Turkey’s overall population, with a well-planned STEM education will make it possible to create a sustainable economy and having a greater say in global competition. While a new generation is expected to lead the changing world, it is unthinkable that education is not affected by this change. In this respect, STEM education to be delivered through distance education could allow teaching to emerge from the boundaries of traditional schools, to ensure equal opportunities in education and to provide students with the skills of the modern age. However, while research on distance education has been increasing recently, studies on distance STEM education have been limited. In addition, how to ensure the sustainability and feasibility of STEM education is a problem to be discussed.

Therefore, distance STEM education can be considered as an alternative education approach that can provide solutions to these problems. As a matter of fact, it should be taken into consideration that this education is an inevitable need for career development of students, teachers and administrators and for the future of countries. Within Turkey context in particular, the status of current STEM education practices and the feasibility of STEM education could be considered as issues that should be investigated in detail. In order to apply STEM education in Turkey, the existing curriculum, infrastructure and teachers' competence for this education should be identified and supported within the framework of an innovative educational policy.

Conclusion In Turkey, public and private science high schools contribute to the actualization of 2023 targets by submitting qualified students to universities.

For a better quality, the following suggestions should be considered.

1.Curriculum needs to be changed to accelerate the transition from industrial society to the information society, so individuals should be trained for future technologies and professions. Laboratories in STEM High Schools should be updated.

2. Physical conditions of high schools should be improved to the best level. Cooperation between alumni, students, parents, and schools should be strengthened.

3.There should be cooperation between universities and schools for K-12 such as METU and Ankara Science High School. Freedom in decision-making and implementation should be provided to the science high schools.

4.Science high school teacher selection should be rearranged according to much more objective principles (McKinsey & McKinsey, 2007).

5. Master of philosophy and doctorate in teacher appointments and knowledge of foreign languages should be set as prerequisites.

6. In-service training for teachers should be permanent, teachers' knowledge and experience should be enhanced, and teachers should go to abroad, so that they can be up to date about new developments in the world.

7.More resources and new programs must be devoted to public and private science high schools.

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