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NGSS

National Report (Focus Group & Desk Based Research)

TURKEY

(Uskudar MEM & BAHCESEHIR)

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1. Introduction

1.1. Context of the National Report

This document serves as a national report based upon the research of two partners from Turkey. The current report consists of the common desk-based research report for Turkey

and the focus groups analysis of both TR partners produced within the framework of the Intellectual Output 1 (IO1). In addition to this, this report will present the state of STEM-STEAM and Social Emotional Learning Education for pre-primary and primary school education in Turkey. The national report will define the place of STEM, STEAM and SEL in pre-primary and primary curriculum. The report also reflects any national policies, projects and research on these topics. The report outlines the gender-inclusive teaching methods, novel approaches that will focus on SEL and STEAM. The report will present a summary of focus groups results conducted with teachers, parents, STEAM and Art professionals to define the awareness, knowledge, practices, ideas of these target groups etc. about STEM and STEAM, SEL .

The report is divided into four main sections: first, in the Methodology section, the method used to conduct both Focus Group and interviews will be presented; second, the profile of the participants are described, including information about their type of group, sex, profession, and years of experience; third, the most findings from those sessions are reported in detail; fourth, and finally, an overview of comments and recommendations made by the participants are shown. At the end of the report the key points of the focus group meeting and interviews are summarized as the conclusion.

1.2. Objectives of the study:

O1. Identifying teachers, education stakeholders, parents and STEAM professional opinions related to STEAM implementation (good practices, difficulties, strengths, effects) in their region and the value of STEM+Arts education in increasing the motivation and participation of young girls in science education and careers.

O2. Identifying parent`s perceptions of gender differences in their children's play and/or school activities and

O.3. Identifying teachers training needs;

O4. Identifying criteria for good practices from the teacher`s perspectives.

O5. Offer a background in the development of the NGSS teaching resources for Pre-primary and primary school teachers .

2. Methodology

2.1.Methodes

The research methodology is based on the field research conducted through focus group interviews and document analysis (desk research).The focus group interviews were

conducted by two partners Uskudar MEM and Bahcesehir School. The main purpose of conducting these activities is to get feedback to develop and improve the recruitment of target groups and primary research and collect some useful insights about STEAM education in Turkey and project consortium.

To collect the data online focus group interviews and one-to-one interviews with the participants. Before planning the event, the profile of the participants was defined and the invitations were sent to participants to join the focus group activity. Based on their availability, two slots were set for in March , April 2021 with teachers , STEAM & Art professionals and parents. An official call was sent via the Uskudar MEM channels and it was addressed to professional teachers , professionals from the STEAM sectors, artists, and parents. All interviews were carried out online, using platform Zoom due to the quarantine imposed by Governments to prevent the spread of COVID-19. Each focus group interview lasted at least two hours. All participants signed a consent form which was approved by Uskudar MEM.

Structure of the Meeting:

A structured focus group discussion was conducted because the meeting questions had been prepared in advance. The questions were sent to the participants and the participants were given two minutes to think about these questions. Before the interviews all participants were informed about the purpose, duration and content of the project ahead of the focus group event. In the beginning of the meeting, all participants briefly introduced themselves. During the focus group discussions, two note-takers were appointed and permission was obtained from all participants for an audio recording of the session.

Name and the short profile of the Facilitators:

The first session was realized with the art professionals and the facilitator of the art professionals are Yücel Tüzün and Neslihan Sezgin. Yücel Tüzün and Neslihan Sezgin are the interviewing teachers of the art and design practitioners. Neslihan Sezgin has been an educator for 17 years and she is a STEAM enthusiast. Yucel Tuzun has been working with various age groups as a teacher of English for 18 years and has been involved in lots of educational projects directed by the Turkish MoNE and the Governorship of Istanbul.

The session with the STEAM professionals was conducted by Dr. Zuhal Yılmaz Dogan. She is the teacher trainer, academics and the researcher. The sessions with the teachers were conducted with Banu Yurtseven , Ulaş Yirmibeş and Dr. Zuhal Yılmaz Dogan.
Banu Yurtseven is an English teacher and has been working on these projects for nearly 12 years. Besides, she has experience as a teacher trainer of MoNE (For Harezmi – STEM project). Ulaş Güven Yirmibeş is a science teacher and working at Üsküdar Milli Eğitim Vakfı ortaokulu as Science teacher. He is also a chess trainer.

Mehmet Serhan Kal is the STEM and Projects coordinator at the general directorate of Bahçeşehir. In his previous assignments, he coordinated STEM, Robotic coding and Particle physics clubs and also led many projects. He was the consultant and manager of the first Turkish research station in the Arctic.

Cüneyt Dostoğlu has been working as the Head of the STEM Department at the General Directorate of Bahçeşehir College. He conducts online and face-to-face STEM professional development training, seminars and workshops in cooperation with Bahçeşehir University.

Benay Tümkaya has a master's degree at the Department of Educational Technologies and she has been working as the Head of the STEM Department at the General Directorate of Bahçeşehir College. Within the scope of my task that I have been continuing since 2018, Mathematics Olympiads, Science Olympiad organizations, STEM Teacher Trainings planning and organization in cooperation with the National Education Directorates, online and face-to-face STEM professional development trainings, seminars and workshops with nearly 1000 teachers in cooperation with Bahçeşehir University.

2.2. Study population and samples:

In total, 45 participants were involved in the Focus Group and interviews, including primary school teachers, parents, STEM professionals, and art and design practitioners, and all their responses were taken into account.

A) **Study population:**

The focus group interviews were carried out by Uskudar MEM and Bahcesehir with the teachers, parents, STEAM professionals and artists.

i) Teachers: Public school teachers working at primary and pre-school level in Üsküdar District, Istanbul (rural environments, disadvantaged environments etc.) ad science, maths, visual arts, Graphic Designer from Bahçesehir Schools.

ii) Parents from a variety of backgrounds

iii) STEM professionals (academics, teacher trainers and researchers, Academics, Education Manager, Physicist, CEO)

iv) Artists (freelancer painter, architect, dance professional, drama & philosophy teacher, Visual Arts ,Graphic Designer)

All of the above were invited via an open call which was distributed by Uskudar MEM officially.

Samples:

Overall, 26 participants from Uskudar MEM and 20 from Bahcesehir took part in the focus groups interviews.

Table 1. USKUDAR MEM and BAHCESEHIR focus group participants

Target Groups	**USKUDAR**		**BAHCESEHIR**		
	Gender	**Number**	**Gender**	**Number**	**TOTAL**
Teachers (T)[1]	Female	7	Female	8	15
	Male	2	Male	2	4
Parents(P)[2]	Female	6	Female	5	11
	Male	1	Male	1	2
STEAM Female Professional (F.P.)[3]	Female	6	Female	2	8
	Male				
Artists (A)[4]	Female	3	Female	1	4
	Male	1	Male	1	2
		26 participants		**20 participants**	**45 participants**

Samples

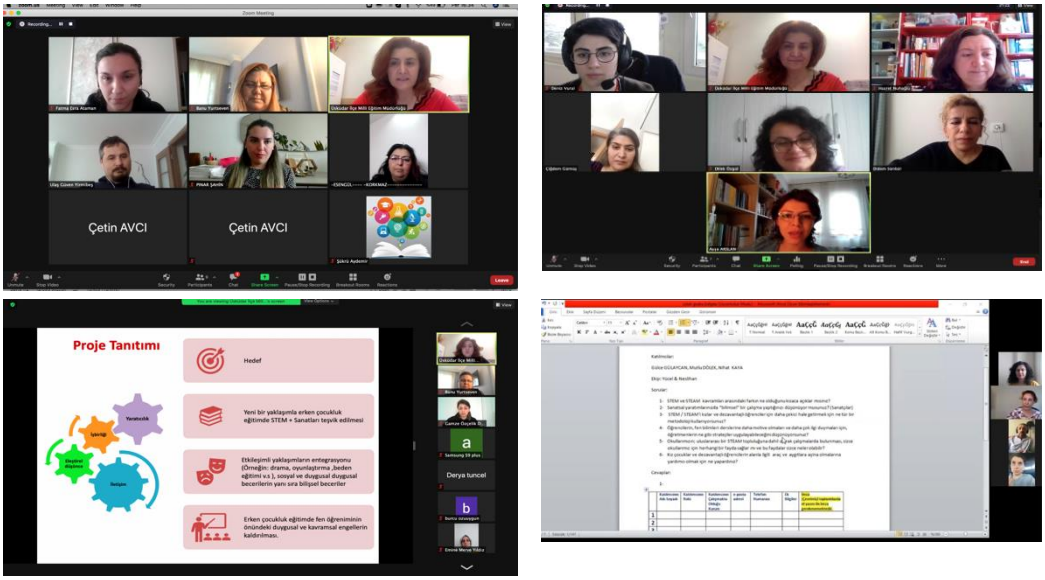
a) Teacher sample: 19 teachers (five from the Primary and 15 from the Preschool sector, from urban, wealthy, and disadvantaged areas), with an average teaching experience of six years. 10 from primary as *Science*, *Math*, *Visual Arts*, *Graphic Designer*

b) Parents sample: 13 parents from a variety of backgrounds (2 Males and 11 Females) (Occupations: Housewife, teacher, bank clerk, engineer, Architect, Finance Manager, Education Managers,)

[1] *T.# stands for teachers in the focus group,*
[2] *P.# stands for parents in the focus group,*
[3] *FP. # stands for female professional in the focus group,*
[4] *A.# stands for artist,*

c) STEAM professionals sample: 8 professionals (Occupations: Academics in education faculty, Researcher in Polar Research department, teacher trainer, the doctor of physics, Scientix ambassador and teacher trainer for gifted schools, ICT coordinator)

d) Artists sample (2 Males and 4 Females) (Occupations: Freelance painter Architect Dance performer, drama leader, Academics, Education Manager, Physicist, CEO.



3. Results

3.1. Focus group interviews results

3.1.1. The synthesis of the participants answers:

The focus group results of Uskudar MEM and Bahcesehir were summarized together. If any specific differences, these differences were emphasised.

- **What kind of experience the teachers and STEAM professionals had with STEAM approach; what do they know about STEM / STEAM**

Most of the teachers were aware of STEM and STEAM . Two pre-primary school teachers expressed that they have never implemented and taken seminars about STEM/ STEAM education. One teacher took many trainings and did implementations as the Scientix teacher. She also tested her lesson plans. Two teachers from disadvantaged school took part many trainings and seminars of HAREZMI Program[5]. One of the pre- school teachers believes that STEAM and STEM education isn't suitable for pre-school and early school education. Three teachers implied STEAM education as hands-on activities with the

[5] Harezmi Program is the national project focused on interdisciplinary teaching and STEM education.

integration of art. They also believe that it promotes multilevel development, collaboration and interdisciplinary teaching. One of the teachers also emphasizes the motivation in education and inclusion of the girls.

All female STEAM professionals are aware of the STEAM approach and all of them have already tested and trained the teachers on STEAM education. They link with self awareness, mindfulness, balance, creativity , enthusiasm and dealing with the problems. The responses of the artists are a bit different. Except for one artist , the rest of them have superficial ideas about STEAM and except the drama leader, they have never experienced it before.

- **If the STEAM professionals are aware of the possibility of teaching / approaching science and/or art in an integrated way (trans- and interdisciplinary) (see the answers to questions C1 and C2)**

  All female STEAM professionals are aware of integration of Art and interdisciplinary links. They believe that the integration of art makes difference and art is defined as flexibility, creation and making the learning long lasting. They proposed triggering the curiosity, using group work activities, digital tools and resources, engagement and motivation, using problem solving, critical thinking and decision-making process and experiential learning as the learning strategies.

- **What difficulties they faced/they could face in implementing this approach (difficulties related with their infrastructure/logistics, related with the framework provided by their national curriculum, with the lesson plans design etc.)**

  The difficulties the teachers faced in implementing STEAM are reported as in the following ;

  - lack of educational resources, space for the implementation and trainings for teachers time management
  - lack of STEAM integration in curriculum and it doesn't allow to design the STEAM lessons requires extra time and effort to design and test the STEAM lessons.
  - workload for teachers, mostly for the disadvantaged schools.

  The teachers have many responsibilities, and the main goal is to engage the students to schools to decrease the early school leaving. One of the pre-school teachers was so optimistic for the creation of the educational materials, taking the advantage of distance education even though she has never tested STEAM in her class.

- **How did they overcome these difficulties; which were their strengths; what/who helped them; did they have any support from the policy makers/stakeholders etc.**

  Most of the teachers focused on the financial support to afford the materials and run the projects with the students. One of the teachers expressed that he bore the financial burdens himself with the contribution of the students. Two teachers working in disadvantaged schools declared that they got support from family unions and school administration. Apart from this, they mentioned the support of the universities for teacher training, workshops with the students and designing and running the projects. One of the teachers expressed that she got support from her colleagues to design her lessons. Other solutions are organizing social responsibility projects, giving the students responsibility to conduct their projects and create the opportunities for collaboration among students.

- **Their own perceptions on their readiness for the implementation of STEAM approach, their training needs (especially regarding the use of methods and tools necessary for teaching STEAM).**

  All Turkish teachers declared that they feel ready to implement the STEAM approach. Some of them suggested solutions that could support them further on this matter. Except for two preschool teachers, the rest of the teachers feel themselves capable of designing their lessons and testing with their students if they get support from the academicians/ experts while designing the lesson plans, from the school administration to arrange the educational materials as long as their professional development is reinforced. They also believe that using technological tools would make this process easier. Defining the needs and learning styles of the students, linking the lessons with the real life problems and teaching STEAM in early school education are additional ideas.

- **What are the expectations related to the implementation of STEAM in their teaching; what they consider to be the characteristics / attributes of a "good practice" in STEAM education .**

  The teachers believe that STEAM education supports the self-efficacy, self learning, seşf identity and belonging, digital and productive skills of the students and transferring the knowledge and linking with the real life problems. Apart from this, it will be very helpful for the sense of belonging while running the projects with their teammates, studying independently.

- **What are the expected effects of STEAM teaching on children? (e.g. they will be more motivated; facilitating the understanding of science; increasing the interest in science for both boys and girls etc.)**

  Most of the teachers believe that STEAM promotes active learning by doing and experiencing. It makes learning more exciting, attractive and meaningful for the students through dealing with real life problems. It strengthens interdisciplinary learning rather than exam-oriented learning. It also supports ICT skills, sense of belonging and studying independently.

- **How did the STEAM professional manage to make STEM/STEAM more attractive to girls and disadvantaged students, and to get them become familiar with tools and other devices**

  The female STEAM professionals believe that peer coaching , projects with team work, involving drama as the overarching activities, running projects for disabled people, supporting solidarity projects, giving mechanical tasks to girls at an early age since their thin muscles are developing before the boys, getting family supports for the choice of the career, playing the instruments, visiting museums, telling stories about the scientific facts, experiencing scientific facts through workshops are some strategies to make them familiar with the STEAM and to make STEAM more attractive.

  The artists propose boat trips, using mobile applications and social media, teaching philosophy, running projects, teaching them how to make choreography, using titles such as ambassador, guide or leader to motivate them.

- **Did they take the pupils` social and emotional learning process into account, while teaching STEAM or science lessons?**

  All teachers declared that they take SEL into account when teaching STEAM. They think group work activities, games and using digital tools are very useful to engage the pupils into learning such as using break out rooms in zoom and using Web 2.0 tools and gamifications. They also believe that charging all students while running projects works very well in mixed ability classrooms. One of the teachers also declared that it is not possible to take into account their needs and social emotional learning process in a large number of classrooms. They also mentioned some strategies while delivering STEAM lessons. Adopting a flexible approach, introducing STEAM activities and letting the students create their ideas, promoting STEAM professionals as role models, using animism like fairy tales, stories to teach science and drama activities.

- **What is their perception on the value of STEM+Arts education in increasing the motivation and participation of young girls in STEM fields of study and careers.**

  All the teachers showed their willingness to act purposefully to support girls and disadvantaged groups. However, one teacher claimed that there is no need for special gender measures in teaching STEAM. The teachers working at disadvantaged schools emphasized the early marriages and absenteeism of the girls because of their parents. Therefore they stated that the parents should be educated and trained first from the early school education of their children. Without their support, it is very difficult to keep the girls in the schools. They also propose some strategies and solutions for the motivation and participation of girls and disadvantaged students. These strategies are supporting collaboration among students, using appropriate role models, inclusion of genders and corresponding the needs and interests of the girls.

- **If parents have biased perceptions of gender differences in the use of toys, programs and activities specific to their children's age.**

  Except one, all parents think that girls are different from boys but when it comes to how different they are, results are inclusive. It is worth noticing, however, that one of the parents thinks that their girl is slower in science. They believe that boys are good at maths, playing computer games and balls, girls are more enthusiastic in learning, learning by doing. Five out of six parents find that boys react differently to cartoons or play other toys than girls. Although results are inconclusive, due to the size of the sample, they still show that boys are being considered as computer gamers, more active (prefer balls, Legos and cartoon characters), whilst girls are assigned to “calm” playing, such as mind and board games.

  - **What are the parents' perceptions on the value of Science and Art; If and how did they help children understand it too.**

  Most of the parents perceived science and art as two different subjects and skills and most of the parents declared that they talk about the value of science and art when necessary to guide them according to their interests and abilities. Two parents let their children to design their prototypes by using recycling materials, two of them choose the activities, games and TV programs to support their Science and art. One parent stated that she chooses games and materials to support her child's social and emotional development.

3.1.2 *The conclusions of the Focus Groups Interviews* (from all of the 3 groups)

Regarding the feedback from the focus groups, the teachers look enthusiastic to implement the STEAM approach, they are open for new learning experiences, and they feel ready to deliver STEAM lessons. They declared that they require more training, workshops, academic support from the academics and experts, and financial support for the educational resources.

The female STEAM professionals are quite experienced in STEAM education, and they propose many innovative educational strategies to break the prejudices for science education and inclusion of girls and disadvantaged students.

The parents declare that the choice of the toys for girls are different from toys but both of them should have the opportunity to learn science and art effectively. They believe in the added value of art in their learning process, and they support their children to take courses to learn musical instruments. They try to create opportunities to understand the value of science and art but they have a superficial idea about the integration of art and science.

3.2.Desk research results

a) **The framework provided by the national curriculum for science education**:

In Turkey, the Ministry of National Education brings various changes and innovations to the science curriculum covering the years 2005, 2013 and 2018. The aims and objectives of scientific education have been determined by the national program in order to raise individuals who can “produce information, use it functionally in life, solve problems, think critically, be entrepreneurial, determined, have communication skills, empathize, and contribute to society and culture” (MoNE, 2018:4).

In recent years, primary and secondary school science courses include a learning process emphasizing that scientific knowledge is transformed into a product through engineering applications and thus future generations can contribute to the country's economy. Curriculums are designed for this purpose and students are encouraged to turn scientific knowledge into production with science festivals held at the end of the year.

Based on the basic principle of providing scientific literacy to the young generation (MoNE, 2013; MoNE, 2018), the national education program listed the objects and expected learning outcomes as follows (MNE, 2018:9):

1. Providing basic information about astronomy, biology, physics, chemistry, earth and environmental sciences and science and engineering applications,

2. In the process of discovering nature and understanding the relationship between human and environment, adopting scientific process skills and scientific research approach and producing solutions to the problems encountered in these fields,
3. Realizing the mutual interaction between the individual, the environment and the society; developing awareness of sustainable development regarding society, economy and natural resources,
4. Taking responsibility for the problems of daily life and ensuring that science knowledge, scientific process skills and other life skills are used in solving these problems,
5. Developing career awareness and entrepreneurship skills related to science,
6. Helping to understand how scientific knowledge is created by scientists, the processes through which this knowledge is created and how it is used in new research,
7. Raising interest and curiosity about the events that occur in nature and its immediate surroundings, to develop an attitude,
8. Raising awareness of safe working by recognizing the importance of safety in scientific studies,
9. Developing reasoning ability, scientific thinking habits and decision-making skills by using socio-scientific issues,
10. Ensuring the adoption of universal moral values, national and cultural values and scientific ethical principles

In the National Preschool Education Program published in 2013, science activities that can be done in schools, science centers and open spaces are listed as follows (GDBE, 2013:48-49):

- Observing, discovering and inventing living and non-living things in their natural environment,
- Examining the seasons or weather conditions,
- Recognizing and using simple tools such as magnets, magnifying glasses and compass, examining natural and unnatural materials,
- Examining the food materials in the kitchen,
- Reviewing books and magazines, taking photos, reviewing photos, watching documentaries,

- Inviting resource persons in related fields of science as guests,

In addition, the Ministry of National Education has published a guidebook covering science and nature activities for students with special educational needs (NMB, 2014). In this material that will guide the teachers, science and nature activities are designed according to the types and degrees of children's disabilities. Children are motivated to observe nature with a sense of curiosity, do research, focus on a particular object, perceive themselves and their environment, relate facts and objects, develop problem-solving skills, clarify their thoughts and ask questions. (MNE, 2014:4).

The curriculum prepared for the 3rd and 4th grades of primary school is as follows (MNoE, 2018:12):

3RD CLASS					
No	**Unit Name**	**Subject Area Name**	**Number of Achievements**	**Time**	
				Lesson our	**Percent %**
1	Let's Get to Know Our Planet	Earth and Universe	5	9	8,3
2	Our Five Senses	Living and Life	3	6	5,6
3	Let's Know Forces	Physical Events	4	15	13,9
4	Let's Get to Know Matter	Matter and Its Nature	4	17	15,7
5	Lights and Sounds Around Us	Physical Events	8	21	19,4
6	Journey to the World of Living	Creatures and Life	8	18	16,7
7	Electric Vehicles	Physical Phenomena	4	22	20,4
Total			**36**	**108**	**100**

	4RD CLASS
	***According to the instructions in the Science, Engineering and Entrepreneurship Practices section, students are expected to make applications during the year.**

Science, Engineering & Entrepreneurship	No	Unit Name	Subject Area Name	No of Achievements	Time	
					Lesson hour	Percent %
	1	The Earth's Crust and the Movements of Our Earth	Earth and Universe	5	15	13,9
	2	Our Food	Living and Life	6	18	16,7
	3	Effects of Force	Physical Events	5	12	11,1
	4	Properties of Matter	Matter and Its Nature	10	21	19,4
	5	Lighting and Sound Technologies	Physical Events	12	21	19,4
	6	Human and Environment	Creatures and Life	2	6	5,6
	7	Simple Electric Circuits	Physical Phenomena	3	6	8,3
	Total			46	108	100
	Science, Engineering and Entrepreneurship Practices: End of Year Science Festival (Students are expected to present their product effectively during the year.)					

b) **The previous use (if any) of STEM or STEAM approach in national or regional pre-primary and primary education**:

Although Turkey does not have a direct STEM action plan, some strategic goals to strengthen the STEM education were defined in the 2015-2019 Strategic Plan. These goals are aligned with the outputs of Technology and Design courses. It can be said that more studies should be carried out on 7th and 8th grade Technology and Design courses that include STEM. It is important to discuss STEM education as a priority for the students in order to improve the results of exams such as TIMSS and PISA (yegitek.meb.gov.tr, 2016).

In 2018, the revised science curriculum in 5th, 6th, 7th and 8th grade is aimed at the plan "Science and entrepreneurship for engineering Applications" connected by defining a

problem or need from everyday life, designing a tool by taking into account the material, time and cost criteria (MEB, 2018, p.10). In order to implement these in schools, it is essential to get the support of experts working in the field of STEAM.To be able to adapt the STEM education into the curriculum Science and Mathematics in primary and secondary schools must be decreased in order to have enough time for STEM activities on the other hand national exams should be updated. Students' inquiry, researching, developing products and inventing skills must be assessed and evaluated. Science labs in school should be modernized according to STEM education and essential resources should be provided to them (yegitek.meb.gov.tr).

According to the primary and secondary school science and mathematics curricula revised in 2013, it is defined that the inclusion of STEM education into these curricula aim for students to be educated as scientifically literate individuals with knowledge, skills and positive attitudes towards science, technology, society and the environment (FTTÇ) (TTKB, 2013). This means that although science and mathematics curricula attribute importance to the interaction between science, technology and society, STEM integration and engineering skills are not given importance in these curricula (Kertil & Gurel, 2016). Actions and deficiencies regarding STEM education in the renewed science education program are included in Figure 1 (MEB, 2017).

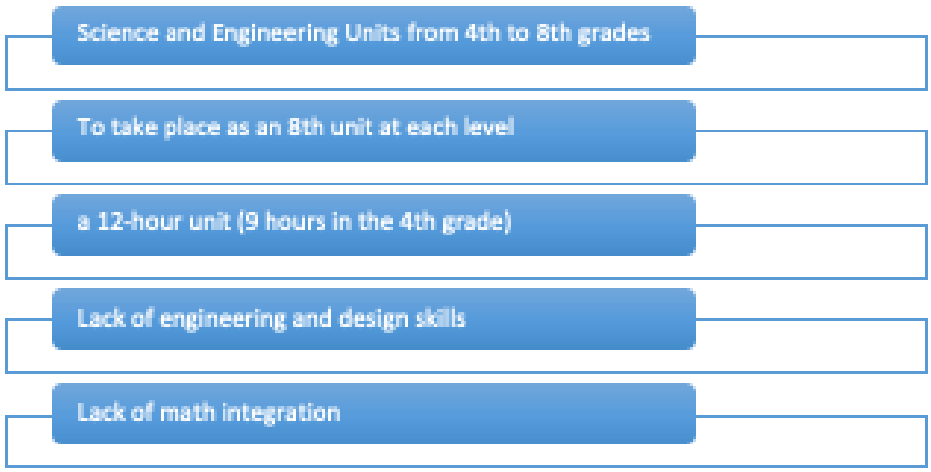


Figure 1. *Actions on STEM Education in New Science Education Program (Aydın University)*

As seen in Figure 1, when examining the updated science program in Turkey, it becomes apparent that the actions for STEM education take place from 4th to 8th grades under the name of science and engineering within the Next Generation Science Standards (NGSS). Although engineering design and science applications are planned from pre-school to

university within NGSS, in Turkey these actions are actually only implemented from 4th to 8th grade. In this program the engineering skills are highly emphasized but only emphasizing engineering skills does not mean the application of the STEM education approach in the science curriculum. As an approach, STEM education should be integrated into all science education curricula. Thus, students can acquire the skills of problem solving, design thinking, as well as the understanding of scientific and engineering methods (MEB, 2017).

When we look at the above definitions and the content of the MEB program within the scope of the STEM curricula, the skills that usually need to be developed in 2018 are related to life skills such as analytical thinking, decision making, creative thinking, entrepreneurship, communication, collaboration. In addition to this, and to the engineering and design skills (MEB, 2018). In addition to this, entrepreneurship and invention, the ability to gain self-esteem and to contribute to the economy of the country are factors that should be taken into account in STEM education.

c) Results/outcomes of previous projects on STEM education/ Arts education/ Social and Emotional Learning related to science education :

When we look closely at Turkey's modern and innovative education goals, it is clear that long-term and sustainable education policies are aimed at integrating STEM education into primary and secondary education programs. In order to achieve this, multifaceted action plans have been designed, such as providing STEM education for the needs of teachers and students, training STEM teachers, updating the curriculum to include STEM education and researching the course materials suitable for STEM education. With the transition to STEM education, it is expected that students will have a more qualified education and acquire skills suitable for 21h century skills such as problem solving, creativity, critical thinking, entrepreneurship and innovation. The STEM approach is desired to be adapted to the national education policies of countries for purposes such as sustainable economic development, raising individuals with the skills needed by the business world, and making each individual STEM literate.

After 2017, with the changes made in the Science Curriculum by MoNE, engineering and design chapters were added to the primary and secondary education curriculum, making the effect of the STEM program more evident (MoNE, Science Teaching Program, 2018). MoNE has published an online library that promotes STEM applications for preschool

and private institutions (Acquisition-Centered STEM Applications, 2019). STEM and Coding Education Standardization (SOSACT) project in order to determine the quality standards of STEM and Coding Education carried out in Turkey and to provide teachers with the STEM and Coding information needed, under the coordination of the Ministry of National Education- General Directorate of Innovation and Educational Technologies. The project still continues with the project partnerships of Gazi University, The European Schoolnet (EUN Partnership AISBL), the University of Poland (Spoleczna Akademia Nauk) and the University of Barcelona (Universitat de Barcelona).

The HAREZMİ project, which is an educational model that reinterprets the interdisciplinary approach by integrating computer science teaching with Social Science, was implemented by the Istanbul Directorate of National Education in pilot schools of different levels and types in the 2016-2017 academic year. Between 2019 and 2020, it was implemented in 439 schools in 39 regions of Istanbul with approximately 10,000 students and 1,863 practice teachers. In addition, 33 in-service trainings are organized for 810 teachers in 27 provinces (IPDNE, 2019).

Hacettepe University established the STEM & Maker Laboratory in 2009 in order to support STEM practices in Turkey, to increase the research, technological and scientific momentum of the country, and to contribute to the continuous development of the social and economic aspects.

BAUSTEM Center within Bahcesehir University organizes themes, content and applications for teachers who will implement the STEM program for primary schools. It also supports STEM practitioner teachers with face-to-face workshops and Webinar applications (BAUSTEM, 2021).

In addition to other initiatives, STEM education is organized in an integrated manner with social responsibility projects. One of them is the "Girls in STEM (GIS)" project for girls who will be women scientists in the future, led by Nobel Prize-winning scientist Aziz Sancar. In the project, girls discover both STEM education and their predisposition to scientific skills together with their peers living in other countries (GIS Project).

d) Identifying limitations on or opportunities for the engaging of girls and other economically or geographically disadvantaged groups in science learning in pre-primary and primary education

In the ‘’ The Turkish Republic Presidency of the Republic and the department of budget follow-up report’’ STEM subject should be considered on a preferential basis taking into consideration digital transition and the importance of Industry 4.0 revolution and the necessity of qualified education and also the impact of the Sustainable Development Aims (https://etkiniz.eu/wpcontent/uploads/2020/09/stem.pdf).

It is defined that applied concrete projects gave rise to the children’s schooling rate. So these carried out projects lead to get rid of regional and social gender apartheid based inequalities in the education system via the impact of the contracts signed by Turkey (ERG, 2019). The projects carried out with the cooperation of UNICEF and MEB like ‘’Glaonthus flowers’ ‘’Father please take me to school’’ ‘’ let’s girls go to school!’’ with the support of national foundations and entrepreneurs lead to progress the girls’ sensibility for the schooling with good results in the society (Taş and Bozkurt, 2020).

According to the data of TUIK/ the State Institute of Statistics ‘’the questionnaire related to the use of time’’ in 2014-2015 the difference between the rates of ‘’ labour at home’’ and ‘’care labour’’ is getting bigger years by years on behalf of the boys dramatically in the questionnaire applied for the girls and the boys aged 10-17 (Taş ve Bozkurt, 2020).

In the last years, it is seen that many projects have been carried out by NGOs in order to eliminate the STEM and social gender based inequalities. My Madam Curie (2013-2015), STEM For Disadvantaged Students Especially Girls Project (2014-2015), STING (2014-2017), Honey Bees Become Engineers (2015-2017), STEM: Engineers of the Future (2015-2017), Turkey's Engineer Girls Project since 2016, Aziz Sancar - Stem Camps Project for Girls (2016-2017), Science and Technology Seminar for Girls (2017), Girls in Science and Technology I and II (2017-2019), Girls Meet with Science since 2019, My STEAM Network since 2019, GirlCode since 2016 and STEM School Project for Girls since 2019 are some of the studies and projects carried out in recent years by Non-Governmental Organizations for the elimination of STEM and gender-based inequalities.

It is remarked in the report of ‘’ the Success Difference Gender-Based in Turkey’’ in which Batyra (2017) evaluated the 2015 PISA data; the female students stayed behind in the science and mathematics fields compared with the male students when the student, family and school features were kept stable in Turkey. This situation is convenient with

the biased choice of the female students. This work proves the gender gap in the student's success using the gender as a dummy variable in the regression.

In April 2014, Istanbul Aydin University launched a project called "STEM for Disadvantaged Students Especially Girls" to help socio-economically disadvantaged students and especially girls be more interested in STEM to improve the students' scientific process skills, creativity, problem solving and higher order thinking skills and to help students form positive attitudes towards STEM related occupations (Istanbul Aydın University, 2019).

4. Conclusions and recommendations

Turkey does not have a direct STEM action plan drafted by the Ministry of National Education, but some strategic goals were defined in the 2015-2019 Strategic Plan to strengthen STEM education. The lack of physical and technical infrastructure in the implementation process, the lack of knowledge of teachers to use these tools, as well as the problems in the implementation of the engineering component in schools were noted. However, in 2018, the plan "Science and entrepreneurship for engineering Applications" was introduced as a revision mechanism for the science curriculum in the 5th, the 6th, the 7th and the 8th grade and designed a tool by taking into account criteria of material use, time, and costs.

In order to be implemented in Turkish schools, it is essential to get the support of experts working in the field of STEAM and to adapt the curriculum of Science and Mathematics in primary and secondary schools.

On the other hand, national exams should be updated. Students' inquiry, researching, developing products and inventing skills must be assessed and evaluated. Science labs in school should be modernized according to STEM education and essential resources should be provided to them. Teachers should take orientations which are about classroom management, using online tools, evaluation and assessment.'

Regarding STEAM implementation in primary and pre-primary education the conclusion can be presented in the form of a SWOT analysis

Strengths	Weaknesses

• Teachers are positive towards STEAM implementations thanks to their previous experiences. • They feel ready to deliver STEAM approach if they get enough support from administration academics. • There is strong collaboration among universities and educational directorates. • There are many national and regional science, coding and STEAM projects that will support the NGSS project. • Uskudar MEM has a very strategic role to get support from municipalities to provide financial support to disadvantaged schools.	• Teachers require more academic support from the universities and experts. • They need funds to afford the educational resources to deliver STEAM lessons. • The pre-primary and primary science curriculum should be revised according to the STEAM approach. • The projects, science festivals and competitions should be planned more for primary levels. • The workload for teachers, mostly for the disadvantaged schools are too much to concentrate on different projects.
Opportunities	**Threats**
• The national and regional STEAM coordinators of Uskudar can contribute to the project for delivering the workshops and disseminating the project. • BAUSTEM is the strongest organization and current projects and teacher training programs will contribute to strengthen the content/ quality of the project outputs. • The existing national projects for the gender and disadvantaged students can be linked with the NGSS project. - The skill and design ateliers of the schools can be used for the workshops and students' events.	• Lack of educational materials, infrastructures decrease the impact of the project in disadvantaged schools and involvement of students. • Lack of a STEAM educational program makes the integration of the STEAM in the lessons difficult. • Since the format of the national exams don't match the STEAM principles, it should be revised.

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