STEAM TRAINING MODULE FOR EDUCATORS

In the preschool period, children begin to acquire science, mathematics, technology, engineering and scientific concepts. Some activities are needed while teaching these concepts to children. The approach that teaches by supporting these gains is the STEAM (science, technology, engineering, art, mathematics) approach. Children take the knowledge revealed by the basic sciences and make some innovations by mixing art, technology and engineering. Thus, children are given the opportunity to think critically, plan, test their practices, question and learn through play.

WHAT IS STEAM?
Science
Techonology
Engineering
Arts
Mathematics

Science
The aim of the STEAM approach is to raise people who are active, productive, able to think critically, move what they know in a common direction, support the economy of their country with what they produce, and be useful to their country and humanity.

Technology
Modern Education College students experience the applicability of the knowledge they have learned by having the opportunity to work under the supervision of professional instructors in our school's state-of-the-art workshops in order to realize their dreams in the fields of interest with the STEAM education model.

Engineering
Again, thanks to this model, students were asked to answer the question "What does this topic do for me in my daily life?" They answer the question on their own by applying their theoretical knowledge in workshops and making new discoveries through invention.

Art
They have the opportunity to take part in all the artistic activities they dream of.
Mathematics (Matematik)

With this system, students' knowledge is consolidated and becomes permanent. No more understanding, learning and forgetting.

STEAM activities include activities where more than one discipline is used together. It is a curriculum based on the idea of educating students in specific disciplines including science, technology, engineering, arts and mathematics. This education; It can be said that it is one of the most important educational approaches of today, as it provides science and technology production, design, providing students with an interdisciplinary perspective and enabling students to implement their projects concretely. Within the scope of STEAM activities, project development and application studies can be carried out in a wide variety of fields in order to reveal the interests and abilities of the students.

The fact that the areas where the project will be carried out are promising areas will enrich the imagination of the students and pave the way for the development of domestic and national patents and inventions that can make a significant contribution to the country's economy in the future. The following topics can be used as STEM project topics;

- Seeding
- Recycle
- Bird House Design
- Energy-saving
- Shelter for Stray Animals
- Aquarium Agriculture
- Renewable energy
- Designing a Musical Instrument
- Making a Sundial
- Happy Maps etc.

STEAM Education projects enable students to associate their knowledge and skills in the fields of STEAM (science, technology, engineering, art and mathematics) with an interdisciplinary understanding by having them work in groups, and then using these knowledge and skills to direct them to research, invention and production, and the ability to make projects. It aims to reveal, develop and support students' ability to develop projects related to STEAM fields, their interests and attitudes.

STEAM education is important in terms of enabling the transformation of theoretical knowledge in the fields of Science, Technology, Engineering, Art and Mathematics into practice, products and new inventions.

On the basis of education; students are directed to ask questions, do research, produce and make new discoveries rather than learning content and memorizing. In order to be able to apply the STEAM education approach in schools, it is necessary to create STEAM education projects and learning environments to reveal the interests and skills of students in asking questions, product development, invention and innovation.

STEAM is an approach that requires teachers from different branches to work in collaboration and teamwork, rather than an approach to be applied by a single teacher.

With the developing technology, changing needs and new requirements, the need for more qualified individuals, individuals who have the ability to work in teams and use technological tools has increased. STEAM provides opportunities for children to gain concrete experiences and make sense of the world around them by providing project-based, collaborative work and learning by doing.

Preschool children are ready and willing for STEM education as individuals who are constantly in the process of discovery, love to experiment and engage with various materials, solve problems, make comparisons, question facts and rules. In preschool environments where STEM activities are practiced, children construct scientific and mathematical relationships through the discoveries they make through materials. Thus, meaningful learning takes place, which forms the basis for future learning. Some researchers argue that STEM is a puzzle consisting of components that complement each other, and this puzzle is completed with the addition of art. Integrating art with STEM education not only enables preschoolers to be more successful in STEM disciplines, but also increases their motivation and participation in learning in these areas. In addition, the integration of visual arts with scientific disciplines supports the development of children's manual dexterity, fine motor skills and visual spatial skills required to be successful in scientific subjects.

Suggestive steps that can be followed while carrying out STEAM education projects with students are listed below:

1. Determination of the project team
2. Determination of the project subject
3. Associating the project topic with the achievements of science, technology, engineering and mathematics disciplines
4. Determination of project objectives
5. Making a plan to solve the problem
6. Implementation of the project plan
7. Evaluation of the project
8. Preparation of the project report

To realize the project;

Each product or invention has different methods and solution methods for its realization. It should be tried to use the most modern methods and technological tools for making the product or invention. In addition, support and help can be obtained from experts, scientists and engineers in the production of products or inventions with students. During the construction phase of the project, students should be assisted to use science, technology, engineering, mathematics, arts and social sciences knowledge and skills together as much as possible. Students can also involve their parents in STEM projects, and it will be very useful in terms of providing school-student-parent interaction.

STEAM IN THE WORLD AND IN TURKEY

Work intensity is increasing in every field and the use of technology is increasing in this intensity. In order to keep up with all these intensity and changes, individuals need to have faster and different skills than ever before. For this reason, many developed and developing countries are aiming to abandon their rote learning systems based only on knowledge teaching and to base their education systems on project and design-based interdisciplinary STEAM education aimed at researching, producing, questioning and inventing. For this reason, the interest in STEAM education in the world has increased considerably in recent years. Developed countries have started to teach content only and give up the rote-based education system and focus their education systems on learning by doing-living.

In our country, a proposal to use STEAM applications in education was presented in the STEAM Research Report published by the Ministry of National Education, General Directorate of Innovation and Educational Technologies (YEĞİTEK). It was mentioned that the activities should be increased by establishing STEAM centers and that teachers should improve themselves by taking these trainings.

TÜBİTAK conducts project studies and organizes competitions in order to reveal successful teachers and students in STEAM education. Science centers have started to be opened by TUBITAK in various provinces related to STEAM education. In these centers, STEAM activities are held with students during extracurricular times.

In addition, STEM Education Centers for STEM education, which university students and teachers can reach, have been opened by some universities and some institutions in our country.

BENEFITS OF THE STEAM APPROACH

• The content of the training program provides an invigorating learning environment.

• It enables students to discover new inventions and better understand the relationships between events.
• Develops self-confidence and self-efficacy.
• Critical thinking, problem solving, questioning, creative intelligence etc. It helps in the development of mental functions.
• Develops skills such as observing similarities and differences and classifying.
• Art promotes awareness raising, risk taking, responsibility and entrepreneurship.
• It helps to visualize one's ideas or dreams, to turn them into sound or text, and sometimes to create animated performances that combine them all.
• It allows to gain 21st century skills.
• It enables them to produce solutions to the problems they encounter in a shorter time.
• Since it will be more fun to present products at events, it increases their interest in events.
• Increases learning motivation.
• Supports design-oriented thinking and being innovative
• It provides the transfer of learned information to new and different problems.
• Arouses interest in science, mathematics, engineering, art and technology.
• Develops cooperation, teamwork and independent working skills.
• It enables them to use technology consciously.
• Develops students' creative and innovative perspectives.
• It aims to transform theoretical knowledge into practice and to introduce a new product.
• It contributes to the preparation of children for life by carrying out project work and learning to cooperate.

THE ROLE OF THE TEACHER IN THE STEAM APPROACH

• Bringing students to the level of high-level thinking, product development, invention and innovation by guiding students instead of providing theoretical knowledge.
• To create environments within the education system that will develop self-confidence so that students are not afraid of making mistakes.
• Participating in STEAM-related trainings and following innovations
• Organizing and developing STEAM events
• Being a support, guide and facilitator for students
• Working in coordination with the school administration
• To ensure that the students in the project team review and evaluate all phases of the project work at the end of the project implementation.

THINGS TO PAY ATTENTION

• The teacher should follow the activity well.
• Efficiency should be tested and deficiencies should be reviewed.
• The activity should keep students' interest alive, be fun and economical.
• It is important to be able to reveal new ideas and gain scientific working steps.
• Motivation is very important in this approach.

LEARNING CYCLE IN STEAM METHOD

1. Create question
2. Design a product/invention
3. Test the product
4. Draw conclusions
5. Evaluate
6. Share
7. Rethink

Module 1: STEAM Preliminary Survey

STEAM Education Approach - Preliminary Survey

1. What is your branch?

……

2. Gender

1 Woman
2 Men

3. What year are you in the profession?

1-5 years
6-10 years
11-20 years
20 years and above

4. Your Institution

kindergarten
Primary school
Middle school
High school
Science and Art Center
University
Other

5. Your graduation

Associate Degree
Licence
Degree
Doctorate

6. Have you participated in any activity related to STEM education before?

Yes
No

7. If you have attended, please indicate the person, institution, organization organizing the training, the place and date of the training.

8. I associate STEAM Education with real life problems.

Rarely
1
2

3
4
5
Always

9. My students develop their problem-solving skills by doing research, e.g. solve scientific, design, or inquiry-based problems.
Never
1
2
3
4
5
Always

10. My students work in groups of 3-4 people.
Rarely
1
2
3
4
5
Always

11. They observe and measure.
Never
one
2
3
4
5
Always

12. They use data collection tools, eg. calculators, computers, tablet and phone/apps, rulers etc.
Rarely
1
2
3
4
5
Often

13. They take notes of research observations and data and transfer them to graphics.
Never
1
2
3
4
5
Always

14. I allow my students to present their work orally and in writing.
Rarely
1
2
3
4
5
Always

15. I allow students to give feedback on each other's work.
Rarely
1
2
3
4
5
Always

16. I get support from experts on a subject other than my field of STEAM Education.
Rarely
1
2
3
4
5
Always

17. Explain in which area you need support in order to reach your goals in STEAM training.
Science Education
Technology Education
Engineering Education

Art Education
Mathematics Education
Associating these fields with each other
In Preparation of Lesson Plan
Relating to real life problems

Module 2: What is the STEAM Education Approach?

1. What is the STEAM Education Approach?

*Science= **Bilim**

*Technology=**Teknoloji**

*Engineering=**Mühendislik**

*Arts= **Sanat**

*Matematics=**Matematik, alanlarının bütünleşik şekilde ele alınmasıdır.**

- STEAM Education has been accepted as an interdisciplinary approach covering the Higher Education process from Pre-School Education.
- The aim of STEAM education is 21st century. It is aimed to raise an innovative, solution-oriented generation with advanced communication skills who can use technology effectively.
- Many countries around the world have started to integrate the STEAM education approach into their curricula.

- The essence of the STEAM education approach is to raise a generation with advanced problem understanding and solving skills and scientific process skills.

- In this context, countries that express the concept of STEAM literacy aim to ensure that students are not only interested in STEAM fields, but also equipped to solve real-world problems with the knowledge and skills of these fields.

- Because with STEAM Education, students acquire many knowledge and skills simultaneously, and many skills such as material science, problem solving, teamwork, communication, use of technology, scientific data collection and analysis are employed simultaneously.

- We cannot keep students' curiosity and interest alive by memorizing the topics in a textbook and asking them to solve a limited number of problems. Students must understand why they need to learn certain information and where they can use that information. Once students realize the meaning and purpose of learning, they can increase their ability to solve real-world problems through the process of designing solutions and discovering and testing them for themselves.

- Most real-world problems cannot be solved with a single domain knowledge. These are complex issues that can be solved by combining and using useful information gathered from various fields of study. To solve real-world problems, integration is inherently applied in the process of using knowledge on various topics. Therefore, knowledge in STEAM, S, T, E, A and M fields should be used in solving a problem. Integration of STEAM is a tool, not an end. It is a naturally occurring approach in the process of achieving a goal.

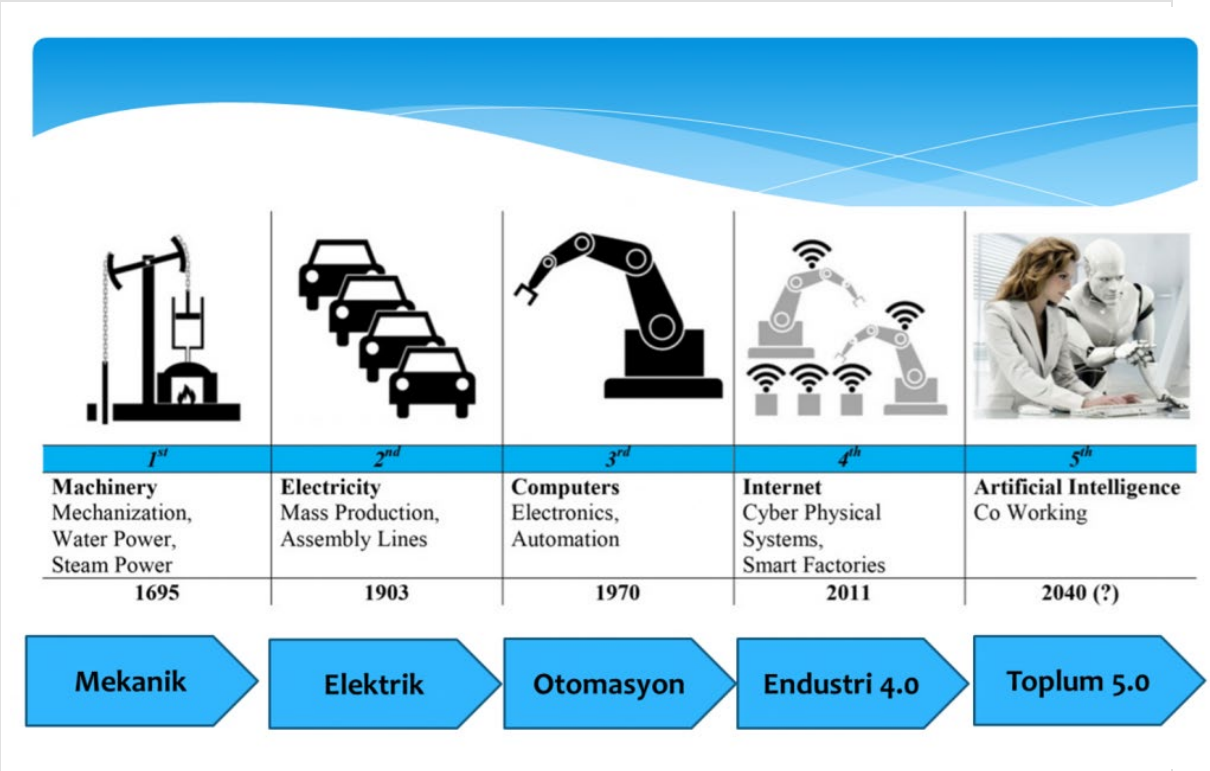
Module 3: Why Has the STEAM Education Approach Gained Importance?

When we look at the history of the STEAM Educational Approach, it can be said that space exploration emerged as a result of space exploration and scientific information warfare between the USA and the Soviet Union. Because while space exploration brings with it the developments in technology, trained manpower is needed in this field.

In the 21st century, technological developments and the race in this field have accelerated, the United States (USA) entered a competitive race with Japan in the 1980s; Afterwards, China emerged on the scene as a competitor both in the economic and technological fields and in the defense industry.

This situation has led developed countries to invest in science, engineering and innovation.

The new production approach, which aims to reduce costs and increase production with Unmanned-Light-Free-Touchless Production, is increasing the competition between countries.



Production and consumption patterns are changing all over the world. While this situation creates new professions, these new jobs require brand new skills. In the face of this rapid change and transformation, all countries had to reconsider their education systems.

Because the professions of the future require interdisciplinary knowledge and skills, education methods and techniques also need a new multi-disciplinary and interdisciplinary, process-oriented educational approach that can transform knowledge into skill.

Module 4: How to Plan a STEAM Training

STEAM aktiviteleri dünya çapında yaygınlaşırken farklı modeller olarak gelişmekte olsa da, STEAM eğitiminin odak noktasında öğrencilerin derslere etkin katılımını sağlayan zenginleştirilmiş etkinliklerle, proje ve problem temelli, sorgulamaya dayalı eğitim içerikleri yer alır.

Bu etkinliklerde öğrenciler bir grup içerisinde veya bireysel olarak çalışabilir.

Dersler okul içinde ve okul dışı ortamlarda (bilim merkezleri, müzeler veya doğada) gerçekleştirilir. Bu sayede öğrenciler farklı öğrenme süreçlerini deneyimler, hem bireysel, hem de grup içerisinde birbirinden esinlenme, özgüven geliştirme ve başkalarının fikrine saygı duyma gibi pek çok beceriyi birlikte edinme imkanı bulurlar.

Although STEAM activities become widespread around the world and develop as different models, the focus of STEAM education is enriched activities that enable students to participate effectively in classes, and project and problem-based, inquiry-based educational content.
In these activities, students can work in a group or individually.
Lessons take place in and out of school settings (science centres, museums or in nature). In this way, students experience different learning processes and have the opportunity to acquire many skills together, such as being inspired by each other, developing self-confidence and respecting the opinions of others, both individually and in groups.
STEAM training,
• It enables students to produce different and innovative solutions to real life problems with the theoretical knowledge they have acquired.
• It improves students' acquisition of scientific study methods and their ability to collect data, observe and analyze.
• Arouses interest in science, mathematics, engineering and technology.
• Increases learning curiosity.
• Collaboration improves teamwork skills.
• Develops students' creative and innovative perspectives.
• It enables them to use technology consciously.
We should consider these issues when planning STEAM Training:
1. How much do we give students a say?
2. In identifying the problem
3. Thinking over the problem, developing ideas
4. Explore
5. Comparison
6. Observing
7. Data collection analysis
8. Argument development
9. Prototype development

10. Making a presentation
11. Do not give constructive criticism
12. Use of Technology
13. To what extent do we allow them to experience the sense of achievement together?
14. Suitability of the activity to the student
15. How much time do we devote to extracurricular activities?

You can also add new ones to these questions.

Before a STEAM training, we need to test the activity we will do as a teacher, review the working and failing aspects, and plan the ways to obtain the written visuals and application materials that we will use in this activity. While doing this, it is equally important that the activity keeps the interest of the students alive, is fun and economical, can develop aesthetic perspectives, reveal new ideas, and gain scientific study steps.

While doing this, knowing the engineering design process will help us design the content of our course.

Engineering Design Cycle
The Engineering Design Cycle is the whole of the steps that the engineer follows to go to a manufactured product or process, starting from an idea or need. When the engineer is producing a product, for example, there may be a sunk output route to streamline this traffic, it follows the following cycle:

Design: Gathers information about a need or problem, brainstorms its solution, chooses a solution from the solutions found, and then draws how to make the product in real life.

Build: Uses tools and materials to build his product. It prototypes it, that is, it makes a sample of a product before finalizing it.

Test it: Uses your product to find out how well it works.

Improve: Makes changes to your product to fix parts that don't work well.

Module 5: Preparing a STEAM Education Lesson Plan

While preparing the Lesson Plan, it will make our job easier to go on a theme-based approach.
As it is known, the student must be active in STEAM Education.
In order to make the student active, we need to keep the students' curiosity about learning alive.
In case the students determine the problem by giving the subject, the student will be directly involved in the work and own the subject.
Now let's do this practically. Our topic: Water -Air-Leaf-Stone-Light-Energy, or it can be ecological problems.

1. Issue and problem identification
2. Associating the topic and issue with STEAM domains
3. Determining course outcomes
4. Determining the research data collection steps
5. Determining the materials and tools to be used at each stage
6. Determination of criteria, determination of limitations
7. Prototype drawing and making
8. Testing and reviewing
9. Asking the Expert
10. Present and get feedback
11. Reconstruction
12. Preparing cost and promotional brochures
13. Supporting work with digital tools at every stage, as far as possible.
14. Involving inquiry-based, project-based research projects that will develop engineering design process and scientific process skills
15. With Web 2.0 tools, tablet or phone applications, students should be provided with the opportunity to collect data, photograph, create graphics and tables on the computer, analyze the collected data and prepare posters for presentation.
16. Creating an assessment rubric considering the criteria and constraints.

Module 6: STEAM Training Examples

While applying the activity principles discussed in three different themes in this module, attention was paid to the activities whose body could be applied.

Theme: Weather

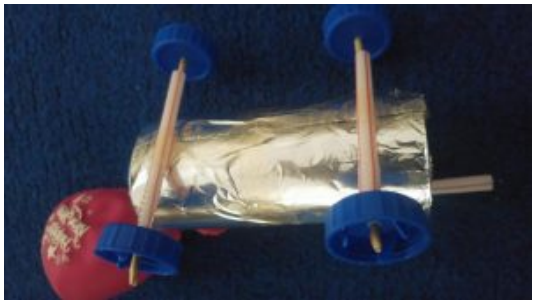
Blow It Go

In this activity, students have an idea about how they can improve their designs by observing, observing and measuring the movement of an object with the thrust of the air.

Materials:
1 toilet paper roll
1 A4 size Aluminum foil
4 pet bottle caps
2 straws
2 skewers
1 pack of tires
1 medium balloon
1 duct tape
1 puff cup
Scissors

Materials to be used by the groups:
10 marbles
Metre
Stopwatch
Precision Balance

Fabrication:
First, the toilet paper roll is wrapped with aluminum foil. A straw is cut in half and fixed with duct tape under the roll. Four pet bottle caps are pierced with a garbage skewer and passed through straws and wheels are attached. The tip of the other pipette is placed inside the balloon and its structures are made with rubber. The balloon is fixed on the top of the roll with tape in the middle so that it does not touch the ground.



Balloon cars are tested by students. They are asked to measure the maximum distance their car has traveled. They take notes of their measurements. A distance of two meters is then determined. They measure how many seconds their cars travel the two-meter road, and note their measurements on the table

Then the meat puff box is fixed on the balloon cars. They are asked to measure the weight of their car on precision scales and take notes. They are asked to measure the distance their vehicle travels by placing five balls in meat puff cups. They test how many grams of weight they can carry by increasing the number of balls. They measure how many marbles, how many meters they can carry, and note down their measurements. They transfer the data they have obtained to the excel table opened by the teacher, so that the data of the whole class is compared.

In the final stage, they are asked to compare the data by testing their vehicles on a slippery and rough surface.

GO BLOW			
	How many seconds did it go?	How far has it progressed?	Observation (How did your car move?)
1 attempt			
2 attempt			
3 attempt			

Conclusion:

……..

What would you do differently if you needed to rearrange?

……

How do you think it goes on rough ground?

……

Missile Construction

1.Origami Missile

A simple origami missile is folded up to spark students' imaginations prior to missile construction. Students are asked to speculate and picture what might happen inside and outside the missile. Then, they are asked to explain whether these missiles will be manned or unmanned, how many crew they will carry, how many days they will stay in space and for what purpose they are sent to space.




2.Pet Bottle with Missile

Materials:

1 thick straw

1 fine straw

Scissors

colored papers

Tape

Sponge

1 pet bottle

Fabrication:

A thin straw wrapped in a sponge is passed over the mouth of the pet bottle. If the pipette is bent, it is cut. The mouth of the bottle is taped with duct tape so that the long end of the straw is at the top of the bottle. (Another way of doing it is to pierce the lid, pass the thin straw and stick it with silicone, so that air leaks are completely prevented and this works better. Both ways can be included in the event to draw attention to the effect of air leaks on flight.)

Then, a stopper is made with a sponge on one end of the thick straw. Three wings of colored paper are taped to the bottom of the thick straw and passed over the thin straw on the bottle.

The weight of the missile head (the weight of the thick pipette) is measured on a precision scale and noted on the excel table on the computer.


By applying pressure to the bottle, the flight distance and time of the missile head are recorded.

It would not be right to have students compete during the activity, they are only asked to compare the data and draw attention to factors such as air leakage, pressure difference applied to the bottle, and the weight of the missile head, and they are asked to think about how the missile head can fly farther. Students develop their missiles by reviewing these issues.

This activity can be continued with water rockets or rockets flying with vinegar and carbonate in the school garden, and the subject of motion of an object as a result of the compression of liquids and gases can be included.