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DIDACTIC AUXILIARY

STEAM EXPERIMENTS FOR PRESCHOOL

REALISED UNDER THE ERASMUS+ STRATEGIC PROJECT FOR EXCHANGE OF GOOD PRACTICES

"MODERN TEACHER"

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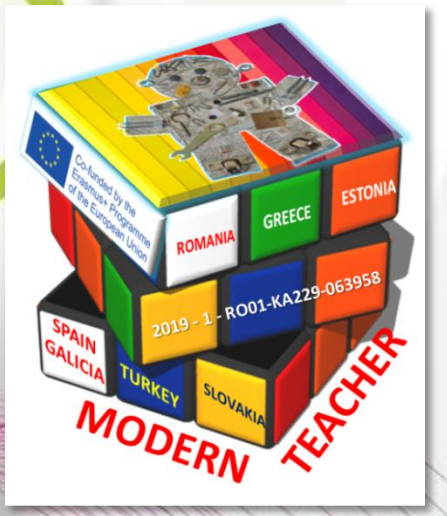

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The role of STEAM experiments in the development of the scientific knowledge and the critical thinking of preschoolers

Grădinița cu P.P. ”Dumbrava Minunată” Fieni, jud. Dâmbovița, România

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The experiment is the way to success.

Albert Einstein

As the motto we have chosen points out, the problem dates back to the time of Confucius. It's just that he's back strong now with the new vision of *learning by doing*, with the shift of emphasis from the content teaching to learning through personal experience and the individualization of learning.

It is essential to make sure that preschoolers benefit from useful experiences in kindergarten, which are essential to reach their full potential in adult life. A common question has always been to what extent the activities carried out build a solid basis for the further development of the child.

Experimental discovery is a complex *teaching-learning strategy*, being at the opposite pole from the verbalization and mechanical memorization of scientific concepts. Scientific and experimental investigation is based on direct and concrete experience, on questioning and research.

The *experimental learning* is not aiming to transmit information in their final form of assimilation, but to train the child in the learning process, to show him how to learn. It aims to support the child for further learning, to gradually turn him into a creative thinker. In this context, learning through experiments can stimulate the preschooler to research, explore and do personal work independently or in a team, through experimental-applied activities, through scientific and technical investigation, the results of which even represents obtaining new ideas or solutions, innovations and inventions that propels creation, novelty. The method of experimental *discovery* ensures the strong development of intellectual abilities, especially of imagination, critical thinking, scientific knowledge and creative thinking, emphasizing the active-participatory, formative-applicative and creative character of learning.

To begin with, the children training needs to be determined, with the aim of designing *effective learning* that provides autonomy. Preschoolers will be properly guided and supported as they experience. The focus will be on transforming the child into the person in charge of their own learning process, who will acquire more important and lasting skills and habits.

The children may have different learning styles and prefer to be active in different ways. They may like to be active, kinesthetic and enthusiastic about new experiences, gather information and reflect on it, be analytical, or be very pragmatic, trying things without long discussions. They may prefer to receive the information in different ways. *Fleming* noted that there are those who like to receive new ideas visually, by hearing, by reading, or by kinesthetic senses, such as touch or movement.

The way a child is taught must be compatible with the way he or she can learn.

The fact that preschoolers prefer certain ways of learning does not mean that these are the only approaches we should use. Sometimes it is necessary to offer them different experiences, so that they develop as individuals who are able to act in multiple contexts. The child, as an active factor in *scientific knowledge*, must have a *cooperative relationship* with his teacher. A warm and friendly teacher does not mean a teacher who will not be respected or will not maintain discipline but simply does it differently, reflecting the relationship that children are likely to have as managers or subordinates in adulthood.

A receptive teacher will establish a special relationship with the children, will feel their needs, hopes and unexpressed fears. He will respect the child's autonomy by dedicating time, understanding and support.

Experimental learning and *scientific investigation* are very much based on *cooperation* and *collaboration* and children need to develop the skills to interact with each other because this is the situation that most will encounter in adult life as an active member of society. Every child is unique, as is their ability to learn different things or their ability to develop skills and abilities. In a *child-centered approach* to a competency-based curriculum, we will assess our children when they consider themselves ready to succeed.

The role of the teacher must be that of learning facilitator, instructor, guide, guide who accompanies the child, mentor, advisor, consultant, transmitter of knowledge, the one who makes things possible, trainer, supervisor, coordinator, model and collaborator.

The teacher's activity in experiential learning is mainly that of organization and facilitation, not teaching, supporting children in formulating problems, managing time and resources.

Conducting experiments is becoming more and more important and the development of experimental spirit in children is already an essential task. Combining experience with action, experimental methods emphasize the applicative nature of teaching, favoring a closer link between

theory and practice. Experimenting means putting children in a position to conceive and practice a certain kind of operation themselves in order to observe, study, prove, verify, measure the results.

Experimental learning does not only involve the use of instruments or the operation of special equipment, but also involves active intervention by children to change the conditions of manifestation of objects and phenomena under study and to discover new data or proposed truths within the activity.

The first step in *successful experiential learning* is to capture children's attention and motivate them to make the learning be effective.

Types of experiments:

a) The scientific experiment assumes that:

- there is a problem to be researched;

- the hypotheses describe the expected solutions of the problem;

- these expected solutions are related to a mental model regarding the development of the phenomenon itself;

- based on the hypotheses, predictions are formed regarding concrete cases / contexts / in which the scientific experiment was performed / performed.

According to the literature, the scientific experiment essentially seeks to reject hypotheses (previously formulated by previous observations, computer simulations, previous modeling under certain objectively chosen experimental conditions. If none of the scientific experiments performed under these new experimental conditions, the hypothesis is rejected. , then the hypothesis is provisionally admitted.

b) Experimental observation is a method used for data collection.

Classification:

- experimental empirical observation;

- passive oriented experimental observation;

- experimentally oriented active observation with provocation of changes of the object of observation.

c) The didactic experiment

It follows the scheme of the scientific experimental approach, but it stops when the prediction is accepted as correct, because the hypothesis, the devices and the way of working lead directly to the expected correct conclusion, the purpose of the didactic experiment being the acquisition of new knowledge as accurate as possible. The didactic experiment, according to Cerghit, is classified according to the didactic objective pursued:

- research experiment through which students discover new knowledge;

- demonstration experiment by which some truths are verified;

- experiment designed to train practical skills specific to the laboratory.

Didactic experiment methodology

The didactic experiment involves 4 stages:

1) The preparation of the experiment by the teacher before the activity:

- setting operational objectives;
- documentation;
- experiment design;
- preparation of the necessary apparatus, tools, materials and utensils;
- performing the experiment to ensure success;
- elaboration of experimental activity sheets for each child or group;
- establishing the evaluation tests to verify whether the objectives of the experiment have been achieved.

2) The preparation of the experiment by the teacher with the children in the lesson:

- organizing children;
- presenting the objectives pursued and arguing the importance of the experiment for preschoolers to consciously participate in their own training;
- presentation of the devices, instruments, materials and utensils that will be used;
- presentation of the experimental activity sheets and the way to complete them.

3) Performing the experiment:

- the presentation of a problem, a problem situation, a phenomenon or a process;
- formulating a causal question (Why did this phenomenon or process occur?);
- the observation and analysis of real or reproduced generic facts (the generic fact is a description, an example, a sketch, which represents one or more of the essential features of the notion of format or elements of the scope of the notion);
- the elaboration of the hypothesis / hypotheses;
- designing the stages of the experiment, the way of working and specifying the didactic and technical conditions;
- performing the experiment;
- data collection and notation of results;
- processing of experimental data;
- confirmation or refutation of the hypothesis;

4) Valorization of the experiment:

- presentation of results;

- discussing the results;
- validation of research results - is achieved by applying them in practice.

Conclusions

The scientific **STEAM experiments** are representing a lot of fun for children and can be used successfully at the preschool level, especially under the conditions of *integrated teaching*.

Confronting children with natural phenomena and playing with nature represents the constructive analysis of the problem. The integrative approach from a multi-perspective point of view corresponds to the premises of education and becomes a key teaching function.

Reflect on the level of preschoolers you have, on the age characteristics and on the performance that you think they could touch! Then decide which of the **STEAM experiments** are more likely to ensure the effectiveness of *learning through discovery*!

Bibliography

1. Cerghit, I. (2006). *Metode de învăţământ*. Iaşi: Editura Polirom.

2. Ciascai, L. (2006). *Model ciclic de predare învățare bazat pe investigație*. Cluj: Editura Presa Universitară Clujeană.

3. Crișan, L., Șindilă, D. (2008). *Stimularea creativității elevilor prin metode de cooperare*. Botoșani: Editura Axa.

4. Dulamă, M. E. (2008). *Metodologii didactice activizante, teorie și practică*. Cluj Napoca: Editura Clusium.

Useful STEAM experiments developed in ”Dumbrava Minunată„ kindergarten

Grădinița cu P.P. ”Dumbrava Minunată” Fieni, jud. Dâmbovița, România

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1. Is it floating or diving?

During this STEAM activity, the children put a series of things in a recipient filled with water one at a time, such as: a fresh egg, a paper clip, a pencil, a car, a ball, a coin, a lemon, paper boats, geometric forms.

They tried to guess for each object if it will float or sink.

In the second part of the activity they added salt to the water and repeat the experiment and noticed that some of added objects are supported by water this time.

They also received the explanation: everything around us is made up of molecules, particles so small that they can only be seen with a microscope. The denser the molecules in an object, that is, the closer they are to each other, the higher its density. If molecules in an object are rarer, that is, they are more easily connected to each other, then that will have a lower density.

And water, in turn, has a density. And when we put different objects in water, it is the ratio between the two densities that decides whether the object will float or sink. For example, if the water has a higher density between the two, it will support the object on the surface. On the contrary, if the object is the one that will have a higher density, then it will sink.

The water in which we add salt changes its density: it becomes denser with the help of salt, so it has more power to support things. However, this is not a guarantee that salt water will be able to support all objects. There will always be things that will sink, but there will also be lighter things, which this time, with the help of salt, can be supported on the surface.

In the end we asked the children if they know any type of ship that needs to have good control of both floating and diving.

The submarine! At first, the submarine was created as a warship, meant to move underwater, in order to attack other ships and thus gain an advantage in battle. Today, this type of ship is mainly used in research and exploration and is called submersible.

In order to be able to control the two processes, floating and diving, the submarine uses several compartments inside it, called ballasts. When the submarine wants to sink, the ballasts are filled with water, the ship becomes heavier and thus descends into the depths. When the submarine wants to rise to the surface, the water from the ballasts is taken out with the help of compressed air, which replaces it and makes the ship lighter so that it can float.

2. What happens when the ice is melting?

Using a big ice cube and some water, the children better understood what happens when ice melts and what effects it has on the environment.

When you imagine an ice cube floating on the surface of a glass full of water, you think that soon the water in the glass will flow with the melting of the ice cube. But does that happen?

The kids found out easily trying the ice cube melting STEAM experiment.

Materials required:

- A clear recipient;
- Warm water
- Iced water

They filled the recipient with warm water. Then, gently released the ice cube into the recipient, being careful not to splash the table with water or drain water on the edges of the glass.

After that they watched the water level in the recipient as the ice melts. What happens?

Even if the ice cubes are melting, the water in the glass does not spill. When water freezes and turns to ice, it expands and takes up more space than when it is in the liquid state - which is why some pipes and conduits crack in the winter when it is cold.

Ice water takes up less space than water itself. When the ice cube melts, the water level remains unchanged.

3. The story of the Rainbow. Magic colors.

The purpose of this activity is the learning of the primary colors (red, blue and yellow) and how the secondary colors (orange, green, violet) are formed.

We prepared 3 glasses of colored water: red, yellow, blue (we colored the water with watercolors).

Then we told the "rainbow story" to the children, a short original story, created by us, the teachers, about the 3 primary colors that are arguing to rule the world. Eventually they shake hands and the rainbow that brings a lot of wonderful colors to the world is born from the joining of their hands.

We went back to the glasses of colored water and asked the children to combine the colors two by two (in the story joining hands means this combination). They used a pipette and painting brushes to combine equal amounts of color. Thus we obtained the colors of the rainbow: red, orange, yellow, green, blue, purple. We excluded the indigo color so as not to complicate the story with more explanations.

4. The Four Seasons inside sensory bottles

With these simple sensory bottles we can made the concept of weather and season more tangible for the little one. We made it very quickly, from materials that are definitely easy to find. To make these sensory bottles we can use any kind of transparent bottle or jar, of any size and shape you want.

To recreate the four seasons inside the bottles, we used water, transparent liquid glue to ad density to the water (elements in the bottle floated more slowly) and all kinds of small items such as beads, glitter, cotton, toothpaste.

The transparent glue can be replaced with glycerin.

5. The Rainbow Walking Water STEAM EXPERIMENT

The purpose of the walking water experiment is to teach children how water can flow without the help of external forces.

We told the kids the fact that the water is an important part of our lives. We need water to survive, it helps regulate our body temperature and carries nutrients throughout our bodies, and provides nourishment and we will learn about some of the properties of water using this simple science experiment.

Needed materials

- Water
- Red, blue and yellow liquid food coloring or quality tempera, strong watercolors, gouache;
- 7 clear cups or glasses of equal height;
- 6 sheets of paper towels, folded in half twice, lengthwise

After explaining the kids what we are going to do, we asked them: ”So, can water really walk?We will find out!

Step 1: We placed the 7 cups in a straight line with a 2-inch gap in between each cup.

Step 2: We poured water into the 1st, 3rd, 5th and 7th cups until they’re about ¾ full. The 2nd, 4th and 6th cups should be empty.

Step 3: We added 3 drops of red food coloring to the 1st and 7th cups. Then add 3 drops of yellow food coloring to the 3rd cup and 3 drops of blue food coloring to the 5th cup. We mixed until the food coloring is completely dissolved.

Step 4: We placed 6 sheets of the folded paper towels in the glasses.

Step 5: After a while, we observed that the water crawls up the paper towel and it changes color. Additionally, after a few hours, the empty glass will be filled with water. So, you've officially made the water walk!

Step 6: After a few hours, we found out that red and yellow mix to create orange and blue and yellow mix to create green. We now have a walking rainbow!

How long does the walking water experiment take overall? The set-up is simple, but it will take a little under 3 hours for the results to show.

The Science Behind The Walking Water Experiment

Kids learn about the mixing of colors. But apart from that, the walking water experiment helps kids learn about capillary action too.

What is capillary action?

In this experiment, children noticed how the water moves up the paper towels along with the food dye molecules. It is due to capillary action. This is the same way that the roots of trees absorb water from the ground. The fibers that are found in plants are the same as those found in paper towels and are called cellulose. They absorb water and the water travels through the gaps in the paper towel and into the empty glass. The attractive forces between the water and fibers in the paper towel helps the water move upwards against gravity.

STEAM experiments realized in Galicia - Spain

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EXPERIMENT 1: CLIPS CAN FLOAT

The objective is very simple. Get the clip to float on the water. If we try it, we will see that it is difficult to place it. It would depend on the orientation in which we immerse it. A trick that makes it much easier to achieve this is to use a second clip as "support" for placement as shown in the image. If we do it this way, we will get the clip to float. It just takes a little bit of patience. Students can carry out a series of activities to investigate.

EXPERIMENT 2: CAPILLARY.

An easy example for children to understand how plants work, which suck water from the ground by capillarity. In this experiment, the water is colored so you can see its path, and the capillaries are the little holes inside the napkins.

EXPERIMENT 3: SOLAR ENERGY.

The Sun is a great source of energy that reaches the Earth in the form of light and heat. For this reason, for centuries men have tried to capture the power of the star to generate electricity. Now, it is normal to find solar panels that provide energy to houses, offices, even vehicles. In this case we turned the blades of a windmill.

EXPERIMENT 4: RAIN SIMULATOR WITH SHAVING CREAM

Put a flake of shaving cream on the surface of the water. Wait a few moments and add a few drops of food coloring on the foam. The foam cloud, pressed by the dye drops, will cause a rain effect that you can see inside the jar.

EXPERIMENT 5: DENSITY OF SOME LIQUIDS.

Density refers to the amount of stuff there is in a given space. Different things have different densities. For example, a cup of water has more stuff in it than a cup of oil. The water is denser. A marble and a ball of the exact same size are made of different amounts of stuff – they have different densities.

EXPERIMENT 6: BUOYANCY.

Children marvel at the buoyancy. They love to see how there are elements that sink and are surprised to find others that stand on top of the water. But have you ever been asked why this effect occurs?.We made a few experiments at school to find this out.

EXPERIMENT 7: HOME MADE PLASTICINE

1 cup Flour

1 cup Water

1/2 cup Salt

1/2 cup Cornstarch

2 tbsp Oil

Food coloring

Put all the ingredients into a bowl and mix well. Pour the mix into your saucepan on medium heat. Mix whilst cooking until the dough stop sticking to the edge of the saucepan. Divide it by the number of colors you choose to make. Add a little food coloring to each ball of dough and knead until all the color is uniform.

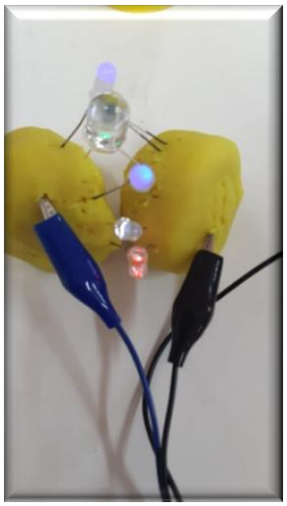
EXPERIMENT 8 : RAINBOW SCIENCE EXPERIMENT

1. Place M&M's in a circle around the outside of a plate, alternating colors.
2. Slowly fill the center of the plate with milk until the milk is barely touching all the M&Ms.
3. Wait and watch for a rainbow to appear in the center of the plate.

Older children might enjoy trying to make different shapes or patterns with the M&M's.

EXPERIMENT 9 : MAKING A SMALL CIRCUIT

Learning about electricity by building electrical circuits is the best way to show kids how electricity works. Students need to understand that electrons jump through the air to a positively charged atom and have to wait until there is bridge between the negative and positive areas to complete the cycle. This bridge is called a circuit. When students learn how to make a connection or bridge through an experiment or science project, they learn how electricity travels through a circuit so it can be used for everyday needs and activities.



EXPERIMENT 10: FOOD STARCH DETECTION

Place a small potassium iodide crystal on top of the piece of food. Add one drop of (sodium hypochlorite solution) and allow it to run over both crystal and food. If an intense blue-black color is seen, the food contains starch

EXPERIMENT 11: THE BUBBLE BOAT.

Materials: a plastic bottle with a stopper, baking soda, a paper napkin, a plastic straw, scissors, some play-dough, a glass of vinegar and a funnel.
With this experiment we work in the classroom on the concept of jet propulsion, which is a procedure by which an object is propelled forward as a reaction to the backward expulsion of a liquid or gas at high speed. In this experiment we use vinegar and bicarbonate, when these two substances come together they produce gas and foam and when the gas that has formed inside the bottle comes out through the straw, it propels it forward. Educational use: with experiments like these we bring children closer to science and create in them the curiosity to experiment and discover. Children learn to ask questions, hypothesize and develop logical thinking.

Experiments. Good practices from Slovakia

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1. Experiment with the sweets Skittles

When discovering colors, the children can track different shades of color through the experiment. We store skittles on the edge of the plate with water and the children observe how they dissolve, connecting colors and creating

2. Experiment with water and oil

We pour water into a large container, then the oil and the children can see how the water separates from the oil. When a dye is added to the container and effervescent tablets, the children observe as the oil rises upwards.

3. Experiment with milk and soap

We pour the milk into the container. Then we pour different colors into the milk. We apply liquid soap to the cotton bud stick. The children immerse the soap bar in a container with colors and can observe how the color separates from the milk. The children consolidate their knowledge of colors during the activity.

4. Experiment with shaving foam

We pour some water halfway through the container. We spray shaving foam on the water. Using a pipette, the children gradually drop colors and can watch them slowly move to the bottom. A rainbow is created. The children get acquainted with rainbow colors during the activity.

STEAM Experiments realized in Turkey

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1. MICROBE EXPERIMENT

It is done to show children the microbes that infect the hands in a representative way.

They may not be able to identify beings that they can't see with their eyes that they can't feel, that they can't hear. Therefore, germs are experimented so that they can have more permanent information about germs and the damage they cause.

2. DAY AND NIGHT EXPERIMENT

It is done to embody and explain how night and day are formed

3. RAIN EXPERIMENT

The purpose is to observe how the rain is in a dairy and have fun.


4. TASTE & DISCOVER EXPERIMENT

It is aimed to distinguish objects or things according to their taste with their eyes closed.


5. AIRLESS CANDLE EXPERIMENT

It is a nice experiment that explains the importance of air.



3. MAGNET EXPERIMENT



STEAM Experiments from Estonia

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Experiments are interesting for children and parents. In kindergarten we have tried different experiments on different seasons.

In summer we did a lot of experiments using colors.

1. Experiment with skittles

Shows that warm water melts colors better than cold water. For experiment you need candies, warm water and a plate. You have to arrange the Skittles in a single row colored pattern around the edge of each plate and then pour warm water in the middle of the plate.

You have to arrange the Skittles in a single row colored pattern around the edge of each plate and then pour warm water in the middle of the plate.

The Sugar rainbow experiment shows children how you can change water density with sugar. You need a few cups, food color, water, a lot of sugar. Children mixed different amounts of sugar to each cup and then we poured the mixtures on top of each other.

2. Mixing oil and water for sensory bottles

Children tried to mix oil and water and learned that the oil doesn't mix with water. We added colors so the difference would be seen better.

3. Running water experiments

Can show how water is able to move against the force of gravity with the help of paper towels. For the experiment we used paper towels, cups, food colors and water. Children could monitor how water walks around and the colors mix inside of paper towels. Later children used the same water and tried to change the color of flowers.

We also tried a similar experiment without paper towels and children saw that gravity pulls water always towards ground.

4. 3D structure building experiment to learn about shapes and engineering

5. Windmill experiment to detect wind in our kindergarten



6. The Snow Volcano experiment

During winter we made a snow volcano using vinegar, baking soda and a bottle. We also made ice necklace using ice cubes, yarn, water and salt to show the children how salt melts the ice.

Conclusions

Grădinița cu P.P. ”Dumbrava Minunată” Fieni, jud. Dâmbovița, România
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Following the frequent use of **STEAM experiments**, all the children had positive results, a lot of progress was made regarding the attention and motivation that are appearing at very high levels and also scientific knowledge, creativity and critical thinking developed in a considerable percentage.

The teacher's creativity must make its presence felt in each link of the educational act, because part of the child's creativity lies in the creativity of his teacher who sees the need to modernize and improve the instructional-educational activities.

Collaboration, mutual support and the stimulation of natural curiosity present in the conduct of scientific experiments are vital in an educational system that emphasizes team spirit, developed critical thinking, rich scientific knowledge, imagination, creativity and innovation. It is also imperative that the selected and used methods, strategies, techniques and educational materials are in line with the requirements of contemporary society, ensuring a modern, attractive and stimulating teaching-learning-assessment process.

The benefits were also visible in the case of children with special educational needs. In some respects they have benefited more than their healthy peers: a special child will understand certain concepts and phenomena much more easily when he / she visualizes or experiences tings than when he looks at simple pictures and receives verbal explanations. That's why the **STEAM experiments** helped them a lot to understand how things really work .

In order to capitalize on the results obtained from our activities, we put together our work regarding **STEAM experiments** developed by every partner kindergarten during the implementation period of the **Erasmus+ ”Modern Teacher” 2019-1-RO01-KA229-063958** strategic project dedicated to the exchange of good practices, with the purpose to disseminate the project results and make our knowledge useful to other teachers and preschoolers as well.