Experiments
Учебен експеримент в природните науки

TECHNIQUES OF THE SCHOOL EXPERIMENT IN SCIENCES, FOR BULGARIAN STUDENTS WITH SPECIAL NEEDS

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Abstract. This study discusses the influence of teaching experiment in the mainstream schools and special schools in Bulgaria. The study presents teaching experiment related to the school subject Man &Nature. This school subject is part of the curriculum both at special and at mainstream schools. There are detailed explanations and descriptions as well as concrete methodological directions for each experiment. Some photographs are included in the text. In order to achieve better visualization of the experiments described. The developed experiments in Natural Sciences, for student with special needs, are just a small step in the understanding of the idea that all learners, regardless of their impairments, can participate in the learning process. This is in accord with the initiative of most nations to place more emphasis on the education of people with special needs, supporting their explorative aspirations and desideration to know the surrounding world.
*Keywords***:** teaching experiment, Man & Nature, special needs

Introduction

Recently, the number of people in the world with visual, auditory, and other types of impairments, who work in Science, has increased enormously. Their presence is seen not only in paleontology and biology, where the subject of study can be touched, but also in fields such as astronomy and microbiology. The factors making it possible are the improved equal opportunity laws, allowing access to higher education; the availability of technology for easier communications; and the ever changing society.

It is proven that teaching, regardless of the type of school, yields better results when it is based on experiments. These are an indelible part of the learning process and serve as a foundation for establishing fundamental definitions in each school subject.

The major subjects, in which experiments are recommended, according to different school programs, are Natural Sciences and Environment. In Bulgaria (in Elementary and Middle school), these are Homeland (First grade); The World Around (Second grade); Man and Nature (Third – Sixth grade); Physics and Astronomy (Seventh grade); Biology and Health Education (Seventh grade); Chemistry and Environment (Seventh grade).

Children aged between six and thirteen years demonstrate a very strong interest in nature and the environment. They want to learn how the world works. Because of that, the teachers exercise effort in helping with their quest for knowledge and exploration of the world.

However, for special needs students, things look differently.

The importance of the experiment in the lessons designed for them is a perfect challenge, but the majority of students with impairments do not exhibit a lot of interest in the Natural sciences (Zamfirov et al., 2010). It is possible that they experience difficulty in explaining everyday events, applying recently learned scientific laws. A great part of the learners interprets the world as too complicated to be understood and the natural phenomena, laws, and events are a distant matter (Zamfirov, 2012)

The World Around (second grade) and Man and Nature (third - sixth grades) classes in Bulgaria and the students with special needs

Major activities of the students are observation, studying, experimentation, as methods for developing and advancing students' cognitive, civic, and personal characteristics (Замфиров, 2012).

The goal of the World Around education in second grade is to satisfy children's needs to navigate through their natural and social environments. This training has two goals. The first one is to acquire the knowledge of definitions and terminology in the classes in question, as well as to master the methods of investigation and study of the natural world (Цанова & Томова, 2005). The second one is to instill interest and positive attitude in the students toward Nature and the sciences which study it. The Man and Nature class is essential, since its curriculum grants knowledge of the foundations and methods of exploration of multiple natural sciences.

The experiment, as an element of the syllabus, is an integral part of the educational process. Therefore, it can be concluded that students with special needs, regardless of their impediments, should be capable (to the extent of their abilities) of: (i) describing the natural phenomena, utilizing appropriate terminology; (ii) analyzing processes; (iii) interpreting or developing studied or described models; (iv) formulating simple and straightforward hypotheses; (v) performing experiments to test said hypotheses; (vi) realizing that the interdisciplinary aspects of the studied material in the Human and Nature class are practically everywhere.

One way for achieving these goals is by easy to complete and comprehend experiments, in the classes The World Around (second grade) and Man and Nature (third-sixth grade).

Methodological approach

Natural Sciences are based on experiments. Conducting them when working with special needs students, one requires exceptional professional qualifications (Tafrova-Grigorova et al., 2011).

Science explains how Nature works. Through accumulating experiments from their own physical and social environment, children form their own ideas and concepts about physical, chemical, and biological phenomena, even before attending school. They are "forced" to do so, because of the necessity to foresee developments or explain the events happening around, or with, them, regardless of how far from the scientific model their notions are.[1)]

When teaching subjects as The World Around and Man and Nature, instructors must stimulate the interest of special needs student, as well as change their preconceived erroneous concepts and models. It is a well-known fact that students learn best when they come to a conclusion, or to an explanation of a phenomenon, on their own. They gradually combine the newly acquired information with the previously accumulated one. Welz (2006) proposes five stages of adding new knowledge to the already stored one: *Engage (I)*, *Explore (II)*, *Explain (III)*, *Elaborate (IV)*, and *Evaluate V)*.

I. Firstly, the students must be engaged with a specific question cogitatively. This starting-off point captures their interest and ensures sharing of knowledge on the topic. The learners can impart their own notions, ideas, and concepts on the subject matter.

II. The students perform activities which allow them to examine and test their ideas and comprehension of the explored issue. They explain the problem or the phenomenon in their own words. If the learners have erroneous notions, this second step's purpose is to prove that their ideas and understanding on the subject cannot logically explain the particular phenomenon.

III. Logically, a rationalization follows every investigation. The teachers do not have to explain at this phase, because the students arrive to conclusions, based on the experiments and their personal journey to the correct results.

IV. This stage allows the students to apply the learned material to different situations and to deepen their knowledge. It is important at this time that they compare ideas among each other.

V. The last stage has two goals: to allow for further understanding of the matter in question and to assess the students' knowledge on the subject.

The following experiments have been described utilizing Welz's five-stage model.

Examples of specific experiments

The following instances provide an expanded view of the learning process, emphasizing the importance of the experiment. The examples are components of, and not entire, lessons, developed and applied by the author in a school setting, with the participation of adolescents with Dawn syndrome. Some of the experimentations are very well known, while others have been created in an informal setting. In the examples, we have tried to provide explanation for each testing, which cannot always be executed in a brief manner,

but we have attempted to do just that. The experiments are linked to particular classes, grades, and lesson subjects, to assist the teachers who work in a specific area of study, as well as to facilitate the creation of individual programs.

"Sun and Earth"

Grade four; Subject: Man and Nature; Topic 3: Planet Earth

*Appropriate for students with***:** mild mental retardation; moderate mental retardation; hearing impairment.

Description of the experiment:

Begin a dialogue (Engage), by asking the following questions: what would you suppose to see on a journey to the Sun? How do you imagine the Sun?

It is useful to start this activity with a free-style discussion, which will allow a demonstration of the children's erroneous perceptions.

Upon finishing the conversation, ask the students to create play-doh models of the Sun and Earth (Explore) (Fig. 1).[2)]

Fig. 1. A moment in the process of depicting the "Sun and Earth" with play-doh in the experiment with an identical title

The goal of the above modeling exercise is for the learners to realize that the Sun does not have eyes and a mouth; the two cosmic bodies have spherical shape, and to acquire some manual dexterity, while utilizing the pliable medium.

Methodological directions:

Ask the students to model with play-doh the Sun, the Earth, the Moon, and the stars (Explore). Upon concluding the task, sow the children a documentary about the Sun and Earth (Explain). Once the film ends, ask the students to model the Sun and Earth (Elaborate), incorporating the new information and using the same modeling material as before (Evaluate).

"Sun"

Grade 5; Subject: Man and Nature; Topic 1. Movement of space bodies in the Solar system

*Suitable for students with***:** mild mental retardation; hearing impairment.

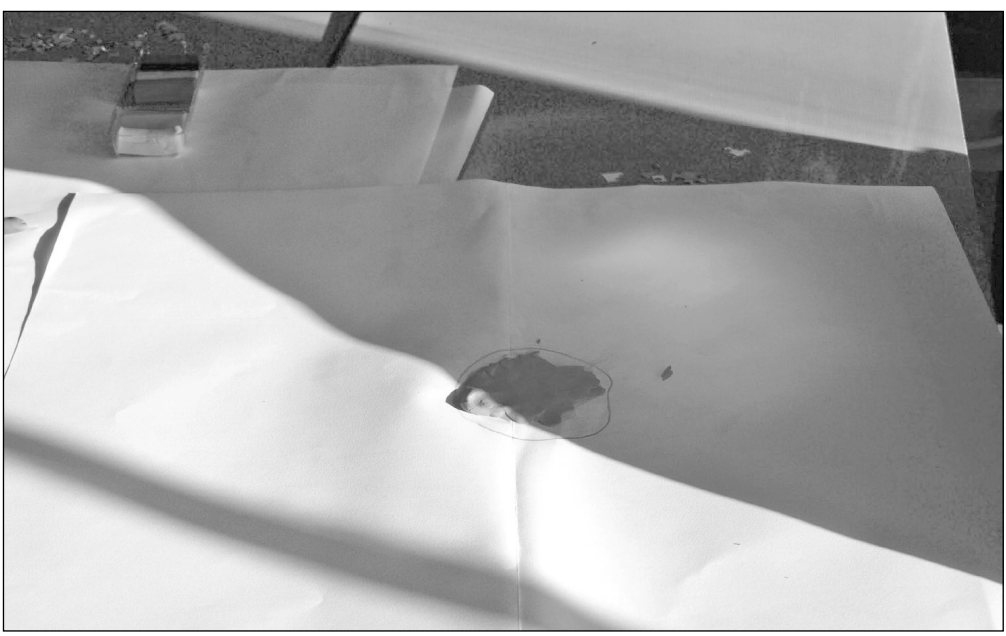

Fig. 2. A moment in performing an activity
(projecting the Sun onto a play-doh shape) from the "Sun" experiment

Description of the experiment:

The former inquiry (Sun and Earth) could have had a different scenario. The goal and instructions are identical, as well as the procedural directions. The difference is only in Phase Examination. Instead of watching a documentary, binoculars are utilized.

Methodological instructions:

It is necessary to place the binoculars (or a mirror, through which to reflect the Sun, in the absence of the required tool) on a stand, so it is steady and not moving. Cover one of the two eye-lenses, in order to allow the sunlight to enter through the other one. Aim the spot of light from the Sun to a blank sheet of paper (Fig. 2).

At this time, the students can begin their observations (Explore). It is of greater benefit to the learners to complete the first part in groups (Fig. 3).

Fig. 3. A moment in performing an activity (projecting the Sun onto a play-doh shape) from the "Sun" experiment

After all steps are completed, the children must be asked to depict the Sun in the manner in which it was observed through the binoculars (Stage Evaluation). It is possible for the learners to claim not being able to see anything and that I why the discussion is very important at the Engage phase.

”How can you create a model of the Universe?”

Grade five; Subject: Man and Nature; Topic: Movement of cosmic bodies through the Solar system.

*Suitable for students with***:** mild mental retardation; moderate mental retardation; hearing impairment.

Description of the trial:

A good technique for presenting the idea of expanding the Universe (Engage) is to ask learners to complete the following: (1) take a balloon; (2) draw six dots on it, equidistant from each other. Assign letters to each one (Explore); (3) use a string, or a thread, and a ruler, to measure the distance (in millimeters) from point A to the rest of the points (Explore). Enter the measurements in a table; (4) inflate the balloon to a medium size and record the distances between all points (Stage Explanation) (Fig. 4); (5) fill the balloon with air to a greater size and, again, note the space between each point (Explain).

Fig. 4. A moment of performing an activity (measuring the distance between the points drawn on a balloon filled with air) from the experiment “How to create a model of the Universe?”

Methodological directions:

Ask the following questions (Stages Building-Upon/Further Development: (1) What happens to the space between the points, when the balloon inflates? (2) Which distances change the most? (3) Which ones change the least?

"Bubbles"

Grade: five; Subject: Man and Nature; Topic: Transition between physical states of matter and bodies.

Suitable for students with: mild mental retardation; moderate mental retardation; hearing impairment.

Description of the experiment:

The children can learn more about surface tension and its changes simply by making soap lather (Engage) (Fig. 5). Upon creating the foam, ask the students to touch the bubbles with a wet finger and observe the result (Explore).Then, let them touch the bubbles with a dry finger (Explore). What is happening (Explain)?

Fig. 5. A moment of performing an activity (blowing bubbles) from the experiment "Bubbles."

Methodological instructions:

Direct the students to observe from a close distance the lather. Ask the learners how many colors are discernible and if they change (Explain). A bubble consists of air or

gas, confined in a ball of liquid. Its membrane is very thin. When a dry object touches it, this casing becomes very fragile (Explain). This is because the soap film adheres to the body that touches it (Elaborate and Evaluate).

"Stethoscope"

Grade: 5; Subject: Man and Nature; Topic: Vital processes in the human body.

Suitable for students with: mild mental retardation; moderate mental retardation; hearing impairment.

Experiment description:

Begin the test with the following text: *The Pediatrician can hear your heart rhythm with a stethoscope. This is the listening device hanging on the doctor's chest.* (Engage).

Fig. 6. A moment from performing an activity (listening to a heartbeat) from the experiment "Stethoscope."

Tell the students the following (Ландвеер, 2007): *Would you like to listen to your classmate's heart?* (Engage). *Take a funnel and insert its narrow end into a hose. Secure the point of entry with duct tape. Here is your handmade stethoscope* (Explore). *You can now touch the chest of your assistant with the funnel.* (Fig. 6) *Thump, thump, thump, thump. Thump. Do you hear the beat?* (Explore).*It is possible to do so, because*

the heart creates sound waves when it works. They enter the funnel and then reach our ears through the hose. This is how you can hear the heart.

Methodological directions:

Explain to the child that the heart supplies the human body with oxygen. In the lungs, the blood is enriched with this gas and the heart pumps it out to all organs. Once this process is completed, the blood lacking oxygen is returned from the organs back to the heart, where the cycle repeats and it is enriched once again. This is how in the student's body constant circulation is achieved. In a state of rest, the heart pumps out, in approximately one minute, all the blood in a body to the respective organs and receive it back. While in a state of motion, this amount is greatly increased. During its heavy labour, the heart makes noises. For example, its valves open and close, while pumping. With the handmade stethoscope, the student can hear just that (Elaborate and Evaluate).

"Who is this?"

Grade: Sixth; Subject: Man and Nature; Topic: Vital processes in the human body.

*Suitable for students with***:** mild mental retardation; hearing impairment.

Fig. 7. A moment from an activity (creating a dark graphite blot) in the "Who is this" experiment

Experiment description:

Begin the exercise by stating the following: "One of the ways to establish someone's identity is by examining his/her fingerprints. Every person has a unique set. Regardless of their differences, fingermarks can be grouped in three large groups. In this activity, you will observe and catalogue your own, after which you will use the classification of prints to solve a mystery (Engage). After this, ask the students to: (1) make a dark graphite spot on a sheet of paper, using a pencil (Fig. 7), then, instruct them to rub their thumbs in the stain, in a way that the skin of the finger becomes dark (Explore); (2) place their thumbs on the adhesive side of a scotch tape and then remove it, direct them to adhere the tape to a blank sheet of white paper, to write their names on the back of the paper and to submit it to the teacher (Explore); (3) make, everyone in the class, two fingerprints each, on two separate sheets of paper and to indicate their names on each piece of paper (the first one is for the teacher and the second one for the student) (Explore); (4) observe carefully the marks of the participants in every student's group, what indicators can be used to classify the distinctive traits (Explain); (5) suppose which features of the fingermarks would be encountered most often in each student's group (Explain).

Methodological instructions:

You can begin a conversation, by asking the following question: what kind is your fingertip (Elaborate). Discuss in the group through what method the specific traits of the fingermarks can be classified; which type of print is the most common in your group; in your class? To what degree do the conjectures you made in the beginning reflect the true results (Elaborate). Lastly, discuss (Elaborate and Evaluate): (1) how can you use fingerprints to identify someone; (2) after the teacher hands you the papers with the marks on them, make an effort to guess what the print is holding. Then, turn the sheet over and see if the written name coincides with your presupposition.

Conclusions

The developed experiments in Natural sciences, for student with special needs, are just a small step in the understanding of the idea that all learners, regardless of their impairments, can participate in the learning process. This is in accord with the initiative of most nations to place more emphasis on the education of people with special needs, supporting their explorative aspirations and desideration to know the surrounding world.

Today, the educators in the nations with advanced education utilize diverse technologies, for the integration of all students in the educational programs. For instance, the blind people visiting the Planetarium in Boston, seat together with the seeing for the séance on the winter sky. They receive a special booklet with images of comets, planets, and

constellations, in relief, along with descriptions in Braille. In the dark hall, they read the raised dots with their fingers, while the rest of the visitors observe the bright dots on the dome. The unseeing examine with their hands models of the Hubble telescope, satellites, the projector of the planetarium. There are devices helping the hearing impaired enjoy the show as well. Simultaneously with the projection and speech for the other visitors, the text for the deaf could be seen on a few monitors.

The activities presented in this article are purposed to show students with special needs that science plays an enormous role in everyday life and it is used in many different aspects and areas. They also demonstrate that studying Natural sciences do not require expensive equipment and complicated experiments.[3)]

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NOTES

1. http://www.ed.gov/parents/academic/help/science/science.pdf
2. All the pictures are from the author's archive.
3. Друга версия на тази статия вече е публикувана (Zamfirov & Saeva, 2012).

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