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THE USE OF ANIMATION FILM IN FORMING REPRESENTATIONS ABOUT THE PLANET EARTH AND THE SOLAR SYSTEM

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Abstract

This research aims to analyse the process of grasping the Solar System by the students during their learning activities in which we used an animation film and other educational means (geographic globe, schematic drawings, 3D model, etc.), as well as the results obtained. In order to achieve this goal, we organized an action-research within Mathematics and Environmental Exploration subject, to the first-grade class, during the lesson "The Solar System". We sought to identify the criteria based on which the teacher chooses an animated film for a lesson, the ways to effectively use it in learning activities to facilitate the learning process. An experimental group and a control group took part within this action. We conducted three tests, an initial test, a post-watching test, and a test after the formative intervention from the experimental class. During the training experiment, we observed the students' behaviour and analysed the process of teaching, learning, assessment, and the students' results. The volume of students' knowledge about the Solar System increased when the most suitable animation film was used for the given topic and the students were involved in an active learning activity in which they discussed with the teacher the plot of the film, using also other visual materials. We have come to the conclusion that a learning activity making use of animated films and being mediated by the teacher has a greater efficiency in forming representations about the structure of the Solar System and its functioning than an individual viewing of an animated film about the Solar System. The results showed that the students had accurate representations about the Solar System, improved their thinking skills, in terms of scientific understanding, knowledge-implementation, and reasoning ability. The fact that the students watched the animated film about the Solar System and were involved in an active learning activity under their teacher's guidance can explain the positive results obtained by the students of the experimental group.

Keywords*: computer assisted learning, primary education, Natural Sciences, modelling, simulation*

INTRODUCTION

Students in the primary cycle are interested in knowing cosmic bodies and are keenly involved in their study. This topic is provided by the curriculum for the preparatory class and for the first-grade class within the *Mathematics and Environmental Exploration* subject (M.E.N., 2013b), introduced in the curriculum for primary education since the 2012-2013 school year (M.E.N., 2013a). Within this topic, several content elements provided in the curriculum are addressed: spatial orientation and space locations; positions of objects; bodies/3D; time: hour, day, month, year; duration; seasons: duration; intuitive elements regarding the Earth; the Universe; the Sun, source of heat and light (M.E.N., 2013b).

All these content elements have a high degree of complexity and require the students' involvement in learning activities in order to facilitate their understanding. Piaget (1952, qtd. by Mih, 2010, p. 56) argues that children construct and reconstruct their own understanding of reality through a continuous process of active reflection on the actions and events they come into contact with, but, in the case of studying the Solar System, this contact it is not directly achieved, but through representations, static and dynamic models. Piaget states that during this knowledge process the mental schemes, assimilation processes, accommodation and balance can be achieved (Piaget, 1952, qtd. by Mih, 2010, p. 56). Schemes are ways of organizing and primary processing of information, operating structures or groups of operations (Piaget, 1952, qtd. by Mih, 2010, pp. 56-57). Through the assimilation process, they use the available schemes to integrate new information into their own cognitive experience, by accommodating them, while adjusting their own mental schemes according to the characteristics of the objects or events they come into contact with (Piaget, 1952, qtd. by Mih, 2010, p. 59).

The purpose of this study is to analyse the process of knowledge of the Solar System realized by the students during several learning activities in which a series educational means are used (animated films, geographic globes, schematic drawings, 3D models, etc.) and the results they obtained. To achieve this goal, we conducted a research-action in which we tested the hypothesis: *An individual viewing of an animation film about the Solar System proves less efficiency in forming representations about the structure of the system (shape, size, composition) and its functioning (moving bodies in space) compared with a learning activity in which knowledge is mediated by the teacher*.

Therefore, we sought to answer several questions: What are the criteria based on which the teacher chooses an animated film to facilitate students' understanding of the Solar System? How can an animation film be used as effectively as possible during the learning activities organized by primary education? What are the ways by which the teacher can facilitate the process of understanding the structure of the Solar System and its functionality?

THEORETICAL FRAMEWORK

Cartoon films have a key role in the world of children by facilitating knowledge within social (Oruç & Teymuroglu, 2011) and natural sciences (Dulamă, 2001a, 2001b, 2006, 2008a, 2008b, 2008c, 2013; Dulamă & Gurscă, 2006; Dulamă & Ilovan, 2007; Ciascai, Dulamă & Marchiș, 2007; Dulamă, 2012). Animations provide dynamic information that is virtual or unavailable in real materials (Lowe, 2003). Within the digital textbooks in Romania, i.e. *Mathematics and Environmental Exploration* subject, some interactive learning activities are proposed to the students in order to facilitate their knowledge (Buzilă et al., 2017; Dulamă et al., 2017; Ilovan et al., 2018; Magdaș et al., 2017a), considering improving teachers' competences for didactic planning within this subject (Dulamă, Ilovan & Maroşi, 2015).

Teachers in Romania are interested in developing their digital skills (Dulamă, Ilovan & Magdaș, 2017; Ilovan et al., 2015; Magdaș et al., 2017b, 2018), in using digital products in *Mathematics and Environmental Exploration* (Magdaș, Vereș & Dulamă, 2019) and in other disciplines (Magdaș, Ilovan & Ursu, 2018; Osaci-Costache et al., 2015; Rus et al., 2019). They are also interested in using visual imagery in forming students' representations in the field of geography both at the university level (Ilovan, 2019a, 2019b) and at the pre-university one (Dulamă, Ilovan & Vanea, 2009).

The use of various types of films is appropriate to the learning style preferred by the digital natives of the Z generation (Dulamă et al., 2019). The use of animated films in university education is also facilitated by classroom smart boards (Magdaș, Zoltan & Dulamă, 2019; Zoltan, Magdaș & Dulamă, 2019). Some teachers are concerned about making films themselves with a smartphone in order to present examples of using teaching materials in the learning process (Dulamă et al., 2019).

In a qualitative study of three lessons conducted in the UK, different approaches of teachers were identified regarding how to initiate discussions with small groups of elementary school students about short animated films and how they follow the students' responses. The study highlights how teachers trigger children's ideas, how they select and develop them through discussions, how they evaluate them (Maine & Hofmann, 2016). Turan (2014) analyses the use of cartoon characters in mathematical education to primary school. Martynenko (2016) studies the immersion of the child in the animated film, how he digests the plot of the film, how he uses his higher mental functions to ensure understanding, and how the symbolic mediation capacity and arbitrary behaviour may develop. Lowe (2003) concludes that in order to build high quality mental models, students should extract relevant information from the animation and include it in their knowledge structures.

Eker & Karadeniz (2014) established that teaching with the help of cartoons positively influenced students' performance and knowledge retention. Other researchers also appreciated that the use of cartoons facilitated students' understanding of scientific concepts and significantly

boosted students' knowledge (Dalacosta et al., 2009). In other studies, related to science teaching in elementary education, the use of cartoons as an evaluation tool was approached (Dalacosta, Paparrigopoulou-Kamariotaki & Pavlatou, 2011).

METHODS

Participants. During this experimental research, 27 students of class I A from "Lucian Blaga" Highschool in Jibou town participated in. They were into 2 groups: an Experimental Group (abbreviated EG) and a Control Group (abbreviated CG). In order to have two equivalent groups, the sampling was performed on the basis of the pupils' average at the first control test. The research was designed and organized by the teacher for primary education, Sanda Vereș, researcher and author of this study.

Research stages. (1) In the first stage, we gave an initial test to identify their knowledge on this subject (Annex 1). (2) In the second stage, the students from both groups were involved in the learning activity no. 1, in which they watched the film *Paxi - The Solar System* (https://www.youtube.com/watch?v=XIBlVNtzymU). (3) In the third stage, we gave a second test to both groups (Annex 1). (4) In the fourth stage, the students from the experimental group were involved in the learning activity no. 2, in which they reviewed the film, discussed with their teacher and received additional information and explanations from the teacher. (5) In the fifth stage, we gave a final test (Annex 1) to the experimental group to determine the volume of students' knowledge about the introduced topic.

The evaluation tests consisted of three items that focused on knowledge about the position and role of the Sun within the Solar System, how to form the days and nights, knowing the names of the planets in the Solar System, ordered by distance from the Sun, characteristics of each planet of the Solar System. The tests included items similar to the three tests, but the difficulty level increased from the first test to the third test. The information evaluated in the three tests was correlated with the content of the animation film. The total number of possible correct answers was four at the first item, six answers at the second item, and eight answers at the third item. The maximum score that could be obtained in a test was 10 points (item 1 - 2 points; item 2 - 3 p; item 3 - 4 p; 1 extra point).

Procedure. For data collection, we used the three tests. We processed the test results statistically. Through the observation method, we collected data during watching the film and of the learning activity subsequently carried out. The students' responses to the tests and the oral text of the film were subjected to numerical analysis and thematic analysis. We analysed the animation film by visual methods.

The research material was represented by the animated film, the learning activity (the students' behaviour and the content used) and students' solving the two tests.

RESULTS

In Tables 1a and 1b, we present the results obtained by the students of EG and CG at tests. The tests were evaluated according to the scale in Annex 1. The average score obtained by the students of EG at Test 1 is 4.96, and the average score of the students in the CG is 4.61. There is a 0.35-point difference between the results obtained in the initial test by the EG and the CG, which is not significant to indicating that these groups are equivalent in level of knowledge. At Test 2, after watching the animation film, the results were recorded in Table 1 and were represented in Figure 1. The average scores obtained by the EG at Test 2 is 6.04, and the average scores obtained by the CG is 5.21. Table 2 shows a greater progress in the EG (1.08) than in the CG (0.60).

Test 3 was applied to the EG after the learning activity organized by the teacher. The results obtained at Test 3 are much better compared to Test 1. There is a significant increase in the average of the scores obtained by the EG in the three tests, from 4.96 in Test 1 to 8.15 in Test 3. Students in the EG achieved a greater progress of 2.11 after reviewing the animated film and learning activity based on the film. In Test 3, 4 of the 13 subjects, i.e. 31% of the subjects, obtained the maximum score of 10 points.

Table 1a. The results obtained by the EG students in tests

Experimental group (EG)															
Student no.	**Test 1**					**Test 2**					**Test 3**				
	I 1	**I 2**	**I3**	**Extra point**	**Score**	**I 1**	**I 2**	**I 3**	**Extra point**	**Score**	**I 1**	**I 2**	**I 3**	**Extra point**	**Score**
1	0.5	1	0	1	2.5	1.5	1	0	1	3.5	1.5	1	0.5	1	4
2	1	2.5	0	1	4.5	1.5	1	1.5	1	5	2	1	0	1	4
3	1	1.5	0	1	3.5	1.5	2.5	0	1	5	2	2.5	1.5	1	7
4	1	0.5	0	1	2.5	1	2	0	1	4	1.5	2.5	2.5	1	7.5
5	1	2	0	1	4	1.5	1.5	1	1	5	1	2	3.5	1	7.5
6	2	2	4	1	7	1.5	2	3	1	7.5	1.5	3	3.5	1	9
7	1.5	2	0.5	1	5	0.5	2	4	1	7.5	2	2.5	3	1	8.5
8	1	1.5	0.5	1	4	1	1.5	2	1	6.5	2	2.5	4	1	9.5
9	0.5	0.5	1.5	1	7.5	1.5	3	2.5	1	8	2	2.5	4	1	9.5
10	1.5	2	1	1	5.5	1.5	3	3	1	8.5	2	3	4	1	10
11	1.5	2.5	0	1	5	1	2.5	0	1	4.5	2	3	4	1	10
12	1.5	1.5	0.5	1	4.5	1	2	1	1	5	2	3	4	1	10
13	1.5	2.5	4	1	9	2	2.5	3	1	8.5	2	3	4	2	10
Mean					**4.96**					**6.04**					**8.15**

Table 1b. The results obtained by the CG students in tests

Control group (CG)										
Student no.	Test 1					Test 2				
	I1	I2	I3	Extra point	Score	I1	I2	I3	Extra point	Score
1	1.5	1.5	0	1	4	1	2	2.5	1	6.5
2	0.5	1.5	0	1	3	0.5	1.5	1	1	4
3	0.5	1.5	0	1	3	0.5	0.5	0	1	2
4	1	1	0	1	3	1	1.5	0	1	3.5
5	0	2	0.5	1	3.5	1	1.5	3	1	6.5
6	0.5	2	0	1	3.5	1	2.5	1	1	5.5
7	1.5	1.5	0.5	1	4.5	1	2.5	1	1	5.5
8	1.5	2	0	1	4.5	1	2	0	1	4
9	1	2.5	0	1	4.5	0.5	2	0	1	3.5
10	1.5	2.5	0	1	5	1	2	3	1	7
11	1.5	2.5	0.5	1	5.5	1	2.5	0.5	1	5
12	1.5	2	2	1	6.5	1.5	2	0.5	1	5
13	1.5	3	2.5	1	8	1	2.5	1.5	1	6
14	1.5	2	1.5	1	6	1.3	2.5	4	1	9
Mean					4.61					5.21

Table 2. The progress achieved by the EG and the CG

	Mean Test 1	Mean Test 2	Progress Test 2-Test 1	Mean Test 3	Progress Test 3- Test 2
EG	4.96	6.04	1.08	8.15	2.11
CG	4.61	5.21	0.60	-	-
Difference of means EG and CG	0.35	1.17	0.48	-	-

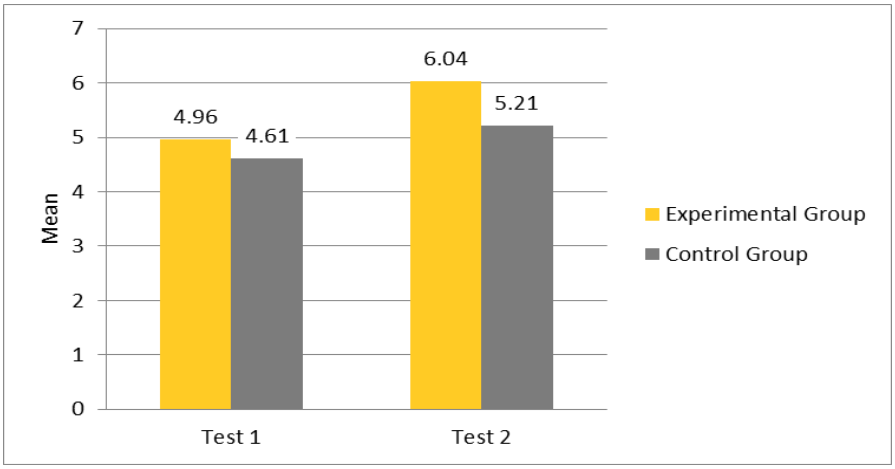

Fig. 1. The results obtained by the EG and the CG in Test 1 and Test 2

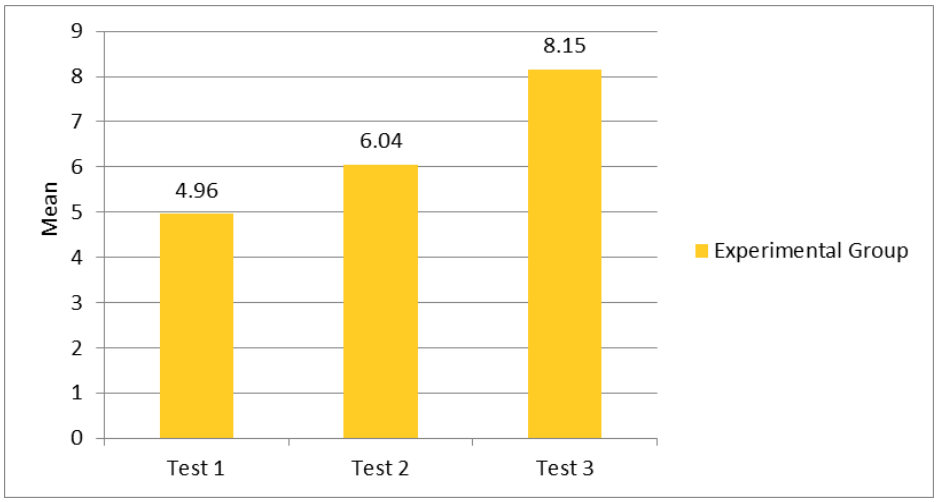

Fig. 2. The results of the students in the EG for the three tests

DISCUSSION

(1) The analysis of the context and the results of the initial test (Test 1). To ensure the most accurate assessment, the students were not prevented from evaluating their knowledge about the Solar System through testing. The students have previously undergone learning activities about the Solar System in a larger group within the thematic unit "How it is, was and will be on Earth" and during the preparatory class, in two lessons of the *Mathematics and Environmental Exploration* subject. During these activities, the students gained knowledge about cosmic bodies (Sun, Moon, stars, planets). The duration of the applied test was 18 minutes, the items were read by the teacher, and the students were asked to circle the correct answer for items 1 and 2 and to number the planets from the Sun using numbers, for item 3.

The results of the students in Test 1 indicate a low level of knowledge about the Solar System and confirmed that some students have a higher amount of knowledge than others. In the EG, six of the 13 students (46%) scored above 5. In the CG, only five of the 14 students (36%) got a score over 5. In the EG, in Test 1, only a student (the 13th student in Table 1a) obtained a score of 9 points out of 10. This is due to the curiosity expressed by this student regarding the Solar System. The student was highly interested in the topic of the Universe so the day after this activity she brought different encyclopaedias and a 3D representation of the Solar System to her colleagues.

(2a) The analysis of choosing the Solar System animation film. In order to choose the film for this experimental activity, we watched several animated films on YouTube: *Paxi - The Solar System* offered by the

European Space Agency ESA, *The Solar System* offered by The Children's World (2017) and *Everything about the Solar System* offered by CuriostyLand (2012). We chose to use the movie *Paxi - The Solar System* because we wanted to have a soundtrack, the explanations to be offered by an animated character, the viewing time not to exceed 5-6 minutes, the information to be adapted to the children's age and the animation to give students the movement of the planets, an aspect that could not be represented by the illustrative materials in 2D format.

(2b) The analysis of the animation film "The Solar System". The title of the movie *Paxi - The Solar System* is attributed because of the character Paxi. He is an alien, on the planet Ally-O, who came to Earth to bond with friends and take the children on a flight to explore the outer space. Because Paxi is a cartoon character, he can explore areas that would have been impossible to explore by documentary or artistic films. He is a character, children can identify, empathize, and interact with. Being drawn to the content of the cartoon, the students were thrilled and accepted more easily to learn new things by watching the cartoon than when the content is delivered by the teacher.

The movie duration of 5.18 minutes is optimal for the students of the first grade A because they cannot focus their attention more than 10-15 minutes. The film offers a lot of information (38) specific to astronomy related to time resources. About 7-8 new information are transmitted per minute. The total number of words in the oral text is 691. This film refers to four concepts (planet, star, comet, asteroid) and their properties, but also to 11 names of cosmic bodies (Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, Pluto, Sun, Moon). In Table 3, we presented the information that is offered in the film about each cosmic body.

Table 3. Information transmitted through the film's soundtrack

Cosmic body	Text information
Sun	- is a star - is hot - gives us light and heat
Mercury	- is a rocky planet - is very close to the Sun - is the smallest planet in the Solar System
Venus	- is very hot - has a very dense and toxic air for humans
Earth	- rotates around its axis - has a complete rotation in 24 hours, which is one day - half is lit – it's day - half is dark – it's night - revolves around the Sun for a year

	- orbits around the Sun as it rotates around its axis - is coated with liquid water, rivers, lakes, oceans - is the only liveable planet - is a rocky planet
The Moon	- is the natural satellite of the Earth - revolves around the Earth
Mars	- is covered with rusty dust which gives it a red-orange colour - is called the Red Planet - is a rocky planet
Jupiter	- is the largest planet in the Solar System - has coloured gas strips - its red spot is like a whirlwind of storm, which could comprise three planets of the Earth size - over sixty months (satellites) - is a gaseous planet
Saturn	- has rings made of billions of tiny pieces of ice, rock and dust - is a gaseous planet
Uranus	-is an ice planet -is stormy
Neptune	-is an ice planet -is stormy
Pluto	-is a dwarf planet - is on the edge of the Solar System
Asteroids	- are pieces of rock - they are millions - form the asteroid belt - orbit around the Sun
Comet	- is made of rock and ice

(2c) Analysis of the learning activity no. 1. In this activity, students from both groups watched the animated film on Solar System. Before the projection of the film, we transmitted to students the objectives of the activity. We invited them to watch the animated film carefully, followed by solving the given tasks. The purpose of the discussion was to acquire the knowledge transmitted through the animated film and aimed at fixing the concepts related to the Solar System, the way days and nights form, knowing the names of the planets in the Solar System, knowing the order of the planets from the Sun in the Solar System, and knowing the characteristics of each planet.

We watched the students' behaviour during the film screening. We noticed that not all students watched the entire animated film carefully, two of the CG students showed signs of fatigue, and one student in the EG showed other concerns, indicating that the film failed to capture the attention of all students. The most passionate students watched the animated film keenly.

(3) The analysis of the results in the Test 2. The results obtained after watching the animation film indicate a low progress of (1.08) in the EG and (0.60) in the CG, compared to those in Test 1. The students' progress was low because a lot of information transmitted to them failed to be retained. The gain of information was not very high because the students, although they watched many films on the Internet, need an adult, a teacher, to clarify the content of the watched movie.

(4) The analysis of the learning activity no. 2. The students in the EG reviewed the film, then discussed it with the teacher based on the content of the animated film.

"Where is Paxi walking?" (Paxi is walking through the Solar System.)

"Why is it called ... the Solar System?" (... because the Sun is in the centre of it.)

"What is the Sun?" (The Sun is a star.)

"What other cosmic bodies did Paxi observe in the Solar System?" (In the Solar System, he also observed planets, natural and artificial satellites, asteroids, meteors, and comets.)

"We live on planet Earth. Where does the light come from?" (The Sun illuminates the Earth.)

"What is happening on the side of the Earth illuminated by the Sun?" (... on this side, it is day.)

"But on the dark side?" (...it is night.)

In order to explain to the students, the rotational motion of the Earth around its axis, we first specified what the axis of the Earth represented, then we explained the days and nights cycle. We used the 3-D model (Figure 3) to make sure that the students understood the rotation motion of the Earth around its axis and formed correct representations.

"Look at the geographical globe (Figure 3)! It is crossed through the middle by a rod that represents the axis. Notice the picture (Figure 4)!" (https://www.twinkl.co.uk/resource/miscarea-pamantului-in-spatiu-prezentare-powerpoint-ro-us-t2-s-1026) (Slide 3)

"The axis is an inclined imaginary line that connects the two poles, passes through the centre of the Earth and around which the Earth rotates. What is the shape of the planet Earth?" (... it is spherical in shape, resembling a ball.)

"Notice how the Earth's globe rotates around its axis. This is how the Earth rotates around its axis. A complete rotation of the Earth around its axis takes 24 hours and determines the days and nights. Who accompanies the Earth all the time?" (The Moon.)

In order to retain the concepts transmitted by the animated film, we discussed them with the students.

The students and the teacher observed the schematic drawing comprising the planets of the Solar System (Figure 4).

"We look at the first four planets closer to the Sun. What does Paxi tell us about these planets?" (... they are small and rocky.)

"Which are these planets?" (... Mercury, Venus, Earth, and Mars.)

"What do we know about Mercury?" (... it is the closest to the Sun, the smallest planet, and rocky.)

"What did we find out about Venus?" (... it is a planet surrounded by a toxic air, it is hot, it is a rocky planet.)

"Which is the third planet from the Sun?" (... the Earth.)

"What did we find out about the Earth?" (... it is the only planet on which there is water in liquid form; it is the only planet in the Solar System that has life, living organisms; it is a rocky planet.)

"Seen from space, this planet appears as a blue globe, therefore the Earth is also called the Blue Planet."

"Which is the fourth planet?" (... Mars.)

"What interesting things did Paxi tell us about Mars?" (... it is a rocky planet covered with red dust, which is why it is also called the Red Planet.)

"What is following Mars?" (... the asteroid belt.)

"Follow the giant planets. Which are these?" (... Jupiter, Saturn, Uranus, Neptune.)

"What did we find out about Jupiter?" (... it is the largest planet in the solar system, it is a giant planet made of gas, it has a large red spot on its surface where the surface of the planet Earth could enter three times, it has its own satellite.)

"Which is the sixth planet?" (... Saturn.)

"What did we find out about Saturn?" (This planet has a spectacular ring; it's a gas giant.)

"Which is the seventh planet?" (... Uranus.)

"What do we know about Uranus?" (... it is an ice planet, cold, and stormy).

"What is the last planet in the Solar System?" (... Neptune.)

"What did you find out about Neptune?" (... it is an ice planet, cold, and stormy.)

"What is at the extremity, at the edge of the Solar System?" (... Pluto, comet).

"In recent years, astronomers no longer regard Pluto as a planet.

So, the Solar System has at its centre a star – the Sun –, eight planets, satellites, asteroids and comets."

By analysing this dialogue with the students, we notice that most of them have answered the questions. To answer the questions, the students used the test and the drawings from the materials displayed on the board (Figure 4). We note that the students have taken some characteristics of the planets (rocky planet; stormy planet) from the soundtrack of the film used to facilitate the formation of representations (cosmic body made of solid substances; gas dynamics). In order to understand the structure of the Solar System and the movement of the planets, we presented a 3-D model (Figure 5).

The students observed the model of the Solar System. They noticed the position of each planet towards the Sun. We explained the motion of the planets around the Sun.

"Which is in the centre of the Solar System?" (... the Sun.)

"How do you realize that it is the Sun?" (... it is the largest and has the colour orange.)

"Look! The planets revolve around the Sun." (A rotation motion of the planets around the Sun is simulated.)

"Which do you think planet Earth is?" (.... the third planet to the Sun.)

"How did you recognize planet Earth?" (... it is green and blue.)

"Which planet do you recognize the most?" (... Jupiter.)

"How do you realize that it is Jupiter?" (... is the largest of the planets.)

"Do you recognize another planet? Which?" (... Saturn.)

"How do you realize that it is Saturn?" (... it has a ring.)

"Let's list the planets from the Sun in their order!" (... Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune.)

To answer the questions, the students identified the planets in the model according to their position and colour. They indicated the planet they were talking about, which proves their level of concrete-operational development (Piaget, 1965).

In order to deepen their knowledge about planets, we presented some peculiarities about each planet (Figure 4) (https://www.twinkl.co.uk/resource/ro-t2-s-017-sistemul-solar-plane-informative). To fix their acquired knowledge, the students received tokens with the eight planets (Figure 6). They were given the task of colouring the planets using the given colours: brown for Mercury, yellow for Venus, blue and green for Earth, red for Mars, orange and yellow for Jupiter, orange for Saturn, light blue for Uranus and dark blue for Neptune. After colouring the planets, the students placed the chips by ordering the planets towards the Sun (Figure 7).

By matching each planet with a colour, the students managed to better recollect their names and some of their characteristics. As the names

of the planets in the Solar System can be difficult to memorize, we proposed to the students an easy-to-remember phrase. An easy way to memorize the planets in the correct order is the following mnemonic phrase „**M**ÂINE **V**OI **P**RIMI **M**ULTE **J**UCĂRII **S**AU **U**NA **N**EMAIPOMENITĂ" (translate as "Tomorrow I'll get many toys or an extraordinary one"), where M = Mercury, V = Venus, P = Earth, M = Mars, J = Jupiter, S = Saturn, N = Neptune (Figure 4) (https://www.twinkl.co.uk/resource/solar-system-planets-in-order-t2-s-928 https://www.twinkl.co.uk/resource/ro-t2-s-409-mnemonic-solar-system-planets-display-banner-detailed-images-romanian). This exercise was useful, six of the 13 students in the EG obtaining the maximum score on Item 3 of Test 3.

Fig. 3. Observation of the geographical globe and the rotation around its axis

Fig. 4. The illustrative materials displayed on the board

Fig. 5. Observation of the model of the Solar System

Fig. 6. Observing the planets before colouring

Fig. 7. Drawing and placing the planets from the Sun

Fig. 8. Representation of the Solar System made by an EG student

At the end of the activity, for knowledge assessment, we asked students to use the drawing technique to represent the Solar System without any visual support (Figure 8). The students demonstrated that they have the ability to make logical connections and correctly used the colours to render the characteristics of each planet. They correctly ordered the planets from the Sun. They represented the size and shape of each planet: the smaller inner planets, Jupiter the largest of the planets, and the outer planets larger than the inner planets. The students understood that the planet Earth is part of the Solar System and that there is life on this planet due to the existence of liquid water, which is why they coloured the Earth using blue and green.

(5) Analysis of the results in test 3. The results obtained by the EG students in Test 3 are much better compared to those of Tests 1 and 2, therefore the research hypothesis is confirmed. 11 students (84.61%) scored above 7 points, and seven students (53.84%) scored more than 9 points (Table 3).

Table 3. Scores obtained by EG students in Test 3

Score	4	7	7.5	8.5	9	9.5	10
No. of students	2	1	2	1	1	2	4

CONCLUSIONS

At the end of the research-action, we reached some conclusions. In the documentation phase, we found that, for Science learning during primary education and for the approached subject, there are only few suitable animated films with Romanian subtitles. Therefore, the Romanian teachers find this extremely difficult since there is no animation films database intended for Science learning, compared to the USA, for example (http://www.brainpop.com). Consequently, we recommend the setup of several animated films in Romanian language for learning Sciences, not only for the primary education, but also for the other education cycles.

We also found that by using the animated film, the students' understanding of the Solar System was facilitated. However, a large amount of information offered by an animated film while presented in a short period of time, cannot be learned following a viewing and can have a negative effect on their understanding and learning. Even if the animated film is a digital tool suitable for students, the teacher's intervention was needed to facilitate the process of understanding the structure of the Solar System and its functionality, fixing and evaluating this knowledge. Children need the teacher's mediation in understanding the contents presented in the animated film, in order to ensure the learning efficiency. The correct understanding of the contents represented by the animated film and the in-depth learning

depend on the teacher's expertise, having the main role in directing the process of understanding, learning, fixing and updating knowledge.

To create a learning-friendly context, to increase the accessibility and to facilitate the content understanding, to ensure the transition from the concrete to the abstract, the film viewing was followed by a second learning activity where other didactic materials were used (the animation film, 2D and 3D representation of the Solar System) that is addressed to several analysers (auditory, visual, tactile, kinaesthetic). This played an important role in capturing and maintaining attention throughout the activity.

At the end of the study we found that the amount of students' knowledge about the Solar System increased when the most suitable animation film was used for the given topic and the students were involved in an active learning activity by discussing the content of the film with their teacher, using other visual materials. The students who obtained very good results in the initial test remained constant, keeping their interest in learning, satisfying their needs for knowledge and processing the content, those with good or less good results in the initial test remained constant or progressed.

We consider that a learning activity in which animated films are used and in which the knowledge is mediated by the teacher has higher efficiency in forming representations about the structure of the Solar System and its functioning than an individual viewing of an animated film.

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Annex 1. Evaluation Tests

Grade: 1

Subject: The Solar System

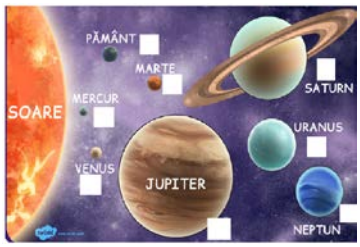
Objectives:

- to define the position and role of the Sun in the Solar System;
- to explain how days and nights are formed;
- to list the planets in the Solar System starting from the Sun;
- to identify a characteristic for each planet;
- to label the planets in pictures;
- to name the planet they live on;
- to name the Earth's natural satellite;

Name and surname .....

Date .....

Test 1	Test 2	Test 3
- to name the planet they live on - to name the Earth's natural satellite - to identify a characteristic for each planet	- to identify a characteristic for each planet - to define the position of the Sun within the Solar System	- to identify a characteristic for each planet - to define the position and role of the Sun in the Solar System
1. Choose the correct answer:	**1. Choose the correct answer:**	**1. Choose the correct answer:**
a) The planet we live on is called: 1) The Red Planet 2) The dwarf planet 3) The Earth	a) At the centre of our Solar System, there is: 1) The Earth 2) The Sun 3) The Moon	a) The Sun is: 1) a star 2) a planet 3) a satellite
b) The natural satellite of the Earth is: 1) Europe 2) The Moon 3) The Sun	b) The third planet from the Sun is: 1) Mars 2) The Earth 3) Venus	b) The planet on which there is life: 1) Mercury 2) Earth 3) Venus
c) The planet that has rings around is: 1) Saturn 2) Earth 3) Uranus	c) The rocky planets are: 1) Venus, Jupiter, Saturn 2) Mercury, Venus, Earth 3) Jupiter, Saturn, Neptune	c) The Red Planet is: 1) The Earth 2) Mars 3) Jupiter
d) The planet on which living organisms exist is called: 1) Mars 2) The Earth 3) Mercury	d) Giant ice planets are: 1) Uranus, Neptune 2) Jupiter, Saturn 3) Jupiter, Mercury	d) The furthest planet from the Sun is: 1) Jupiter 2) Uranus 3) Neptune

- to define the position and role of the Sun within the Solar System - to explain how days and nights are formed - to identify a characteristic for each planet **2. True or false!** Write **A** for true statements and **F** for false ones. a. The Sun is a star. b. On the side of the Earth illuminated by the Sun, it is night. c. The planet Earth receives light and heat from the Sun. d. The planets in our Solar System revolve around the Sun. e. The Earth rotates around its axis in 24 hours. f. The planet closest to the Sun is Venus.	- to define the position and role of the Sun within the Solar System - to explain how days and nights are formed - to identify a characteristic for each planet **2. True or false!** Write **A** for true statements and **F** for false ones. a. The complete rotation of the Earth around its axis takes 12 hours. b. Days and nights are formed as a result of the rotation of the Earth around its axis. c. Venus is very hot. d. Uranus and Neptune are hot and stormy. e. The Sun is a planet. f. On the side of the Earth not illuminated by the Sun, it is night.	- to define the position and role of the Sun in the Solar System - to explain how days and nights are formed - to identify a characteristic for each planet **2. True or false!** Write **A** for true statements and **F** for false ones. a. The complete rotation of the Earth around its axis takes 24 hours. b. Days and nights are formed as a result of the rotation of the Earth around its axis. c. Saturn has got rings. d. Uranus and Neptune are rocky. e. The Sun is a star. f. Jupiter is the largest planet in the Solar System.
- to list the eight planets in the Solar System starting from the Sun. **3. Number the planets in the Solar System, in order, starting from the Sun:**  https://www.twinkl.co.uk/resource/ro-t-t-11045-the-planet-names-wordson-planets-romanian	- to list the eight planets in the Solar System starting from the Sun. **3. Number the planets in the Solar System, in order, starting from the Sun:**  https://www.twinkl.co.uk/resource/ro-t2-s-407-planets-size-comparisonposter-detailed-images-romanian	- to list the eight planets in the Solar System starting from the Sun. **3. Write the name of each planet:**  https://www.twinkl.co.uk/create/app%20:/Users/acer/Downloads/2020_2_15_47628 16_13_51_Sistemul%20Solar.pdf

Tests Scale

Test no.	Score				
	Item 1	**Item 2**	**Item 3**	**Extra point**	**Total**
1	2 p.	3 p.	4 p.	1 p.	10 p.
2	2 p.	3 p.	4 p.	1 p.	10 p.
3	2 p.	3 p.	4 p.	1 p.	10 p.