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## USING THE VENN DIAGRAM IN PRIMARY EDUCATION

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### ABSTRACT

*During the primary education, students do many exercises in which they analyse and compare elements of the environment and sets of elements. An effective technique that can be used for this purpose is to draw the Venn diagram. The aim of the research is to find the answer to some questions regarding the use of this diagram in primary education: What subjects and topics can be used? What support materials can be used? What are the advantages and disadvantages of using it? What other similar graphic or cognitive organisers can be used? These questions were answered in structured interviews by nine primary school teachers and a university professor with expertise in teaching geography. We came to some conclusions: the teachers suggested the students to complete most of the Venn diagrams during the Romanian language and literature, Geography, and Science classes; the activities took place not only during the different stages of the lesson, but also at home; not only support texts and various visual materials, but also the pupils' and students' previous knowledge were used; the compared topics were very different, with varying degrees of complexity; the key benefits of the students were the development of the competence to compare on the basis of criteria of some objects intended for knowledge and the representation of the compared results (specific and common aspects) concisely; the greatest disadvantage was identifying and charting the criteria on which the comparison was made.*

**Keywords:** *analysis, comparison, comparison criteria, similarities, differences, graphic organiser, cognitive organiser*

### INTRODUCTION

It is crucial that students are offered contexts in which to practise their mental operations and to develop their cognitive processes during the

primary education. To achieve this goal, teachers should use various methods and provide them with information processing tools.

The Venn diagram is a graphical or cognitive organiser consisting of two circles or ovals that partially overlap. This diagram shows the similarities and differences resulting from the comparison of two aspects, ideas, concepts (Steele, Meredith & Temple, 1998a, 1998b) and phenomena (Flora, 2003). The Venn diagram highlights the common and different features of objects, events, etc. (Bernat, 2003). The specific differences or aspects are mentioned in the free, outer areas of the circles, and the common aspects or similarities are mentioned in the area of overlapping circles (Dulamă, 2002, p. 166) or in the intersection area (Bernat, 2003).

The Venn diagram was created by the English logician John Venn to visually represent complex logical sentences and algebraic statements (Edwards, 2004). There are few studies in the educational sciences on the use of this diagram in the educational process. Lynam et al. (2007) used the Venn diagram in the study of Natural Sciences. Gottfried (2015) referred to the use of graphic organisers of various types, including the Venn diagram in Geography. Wijesinghe et al. (2017) used the Venn and Euler diagram to increase the efficiency of assessing student's knowledge and abilities. They created an automated assessment system by comparing the student's answer with a model answer, followed by grading assignment.

The Venn diagram was used in Romanian didactic works to compare: concepts or notions (Breben et al., 2002), animals (Breben et al., 2002), plants, countries (Costa & Antonie, 2006), peoples (Dulamă & Ilovan, 2004), waters or hydrographic units (rivers, seas, and lakes) (Costa & Antonie, 2006), relief units (Dulamă, 2008, p. 346; Pădurariu & Măţă, 2017). Venn diagrams were included in the lesson plans for the study of the European continent where continents, countries (Dulamă, 2010b, 2010c; Ţolaş, 2010), cities, civilisations, relief units (Ilovan & Mihalca, 2010), rivers (Ilovan, Dulamă & Mihalca, 2010), and lakes were compared while the comparison of some forests was suggested (Dulamă & Mihalca, 2010). Dulamă & Ilovan (2004) asked students to compare peoples aiming at evaluation. The Venn diagram has been proposed for use in geographic learning activities (Dulamă, 2002, 2008, 2009) and in research activities (Costa & Antonie, 2006).

The significance of the mental process in analysing some objects or sets of objects was emphasised in the didactic works. Through this essential mental operation, a whole is decomposed into the elements that compose it and the properties of the parts and the whole are identified, as well as the connection between them (Dulamă, 2010a, p. 163). In Venn's analysis, another operation performed is the comparison. In order to be able to compare two topics (objects to be known, categories of objects or living organisms, etc.), they are mentally or physically joined together and the similarities and differences between them are established, depending on certain criteria (Dulamă, 2010a, p. 163).

In Romania, teachers and professors in pre-university education have provided many examples of diagrams and highlighted the benefits of using

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this cognitive organiser in the educational process, but there are no studies that can deeply analyse the process of and the effects on students' cognitive development.

### **METHODOLOGY**

*Objective.* The main objective of this research was to investigate how the Venn diagram is or can be used by teachers, together with students, in the study of Natural Sciences and Geography.

*Participants.* Nine teachers for primary education who in parallel with the students' activities attended the study programme on "Pedagogy of Primary and Preschool Education" at Babeş-Bolyai University in Cluj-Napoca were involved in the research. The university professor was also involved in the research, giving lectures and seminars on "Sciences and Didactics of Sciences" and "Geography and Didactics of Geography". The participants agreed to answer the questions of an interview, while respecting confidentiality.

*Materials and methods.* Information on how to use the Venn diagram in the teaching activity was collected by the interview method. The interview guide included the following questions: What subject did you use the Venn diagram in? Why did you choose to have students complete the Venn diagram in your activities? What lesson stage did you use the Venn diagram in? What topics did you ask the students to compare? What materials did you provide to students to complete the Venn diagram? What are the advantages or benefits of completing the Venn diagram for primary school students? What difficulties did the students or you have in completing the Venn diagram? What other graphic or cognitive organisers did you use to make comparisons by students?

*Procedures.* Having their consent to participate in an interview, each teacher answered the questions in the interview guide. For a deep understanding of how they used the Venn diagram in the study of Natural Sciences and Geography, teachers were asked additional questions for details and examples. The data collected by the researcher were written or represented by the interviewed teachers.

*Data analysis.* The answers to the questions given by the teachers during the interview and the diagrams provided as examples were subjected to content analysis.

### **RESULTS AND DISCUSSIONS**

*School subjects in which the Venn diagram was used.* Teachers were asked to specify which subjects they used the Venn diagram in and what topics they suggested to students to compare. Table 1 shows that all the interviewed teachers suggested the students that they should complete the

Venn diagrams in *Romanian Language and Literature, Biology and Geography*, which indicates that the topics studied during these subjects favour the use of this comparison tool. Although in the literature it is mentioned that the Venn diagram was used in logic and in comparing the sets, it was little used by teachers in Mathematics, probably due to the way it is used in activities with the students in the primary education.

**Table 1.** School subjects and homework used in the Venn diagram by teachers

School subjects	No. of answers	Compared topics
Romanian Language and Literature	10	- characters from stories (Santa's daughter and grandmother's daughter; fox and bear); - literary works (story and fairy tale; story and poetry).
Biology	10	- categories or classes of animals (mammals and reptiles; reptiles and birds; insects and spiders; wild and domestic animals, etc.); - species of domestic animals (cat and dog; goat and sheep; duck and goose, etc.); - wild species (lion and kangaroo; bear and fox; blackbird and stork, etc.); - species of domestic and wild animals (dog and wolf); - plant associations (deciduous forest and coniferous forest); - plant species (snowdrop and tulip; spruce and fir).
Geography	10	- human settlements (village and city; Cluj-Napoca and Bucharest); - waters (running water and lakes); - relief units (the Apuseni Mountains and the Western Plain); - the planet Earth and the Sun; - communication routes (railway and highway; road and highway).
History	4	- voivodes (Stephen the Great and Michael the Brave); - fortresses (Suceava and Neamț Fortresses); - castles (Peleş and Huniazilor Castle).
Mathematics	3	- geometric figures.

*The motivation to use the Venn diagram in teaching activities.* In Table 2 we summarised the teachers' answers. All the teachers focused on the final layout of the diagram on which the similarities or common aspects and the specific differences or aspects are represented. Only three teachers showed interest in using criteria based on which students could compare topics. Most of the interviewed teachers were concerned with learning techniques for comparing topics and were aware of the role of the Venn diagram in performing mental operations (analysis and comparison).

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**Table 2.** Objectives to be achieved by using the Venn diagram in teaching activities

Objectives	No. of answers
- identifying the similarities and differences between the compared topics	10
- visual representation of information	10
- grouping information into categories (similarities or commonalities; differences or specifics)	10
- variety of teaching methods and techniques	9
- exercising mental operations – analysis and comparison	8
- learning techniques for comparing topics	7
- focusing on students' interest	5
- solution-focus thinking (perseverance)	4
- development of information processing skills	4
- evaluation of students' knowledge	4
- use of criteria based on which the comparison is made	3

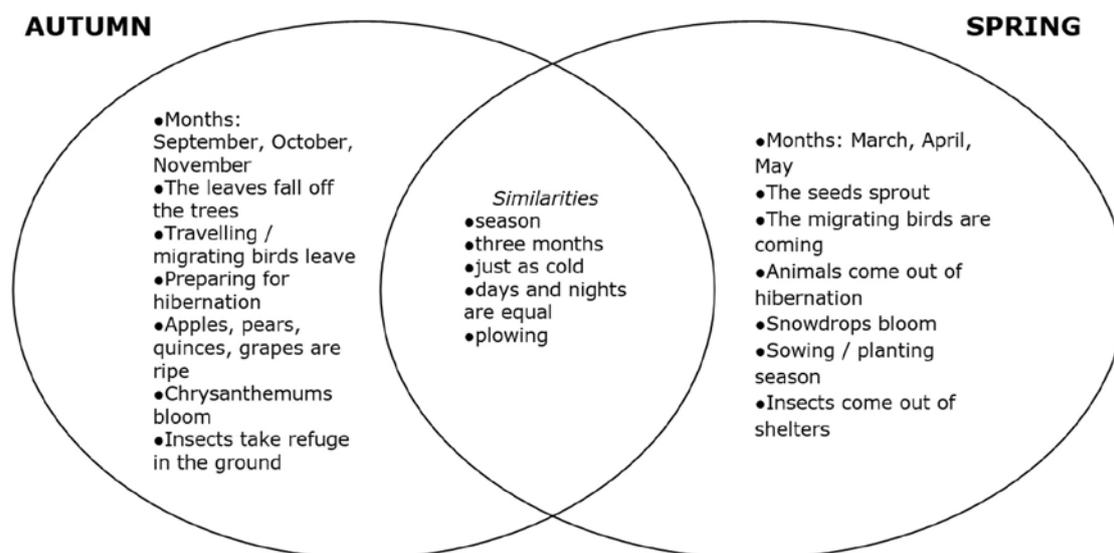
*Stages of using the Venn diagram in the lesson.* All the teachers suggested their students to complete Venn diagrams in the reflection stage in case they structured lessons according to the principles of constructivism and applied the model Evocation-Realisation of meaning-Reflection. Also, all the teachers claim that they proposed students to complete such diagrams either as homework or as components of some portfolios. Fewer teachers (4) stated that they used the Venn diagram in written tests during the previous knowledge checking stage. The Venn diagram was used less during the practice or feedback stages.

*Topics for students to compare.* Table 3 lists the topics proposed to students by teachers in order to compare them. Some of them have a high degree of complexity (categories of animals, plants, landforms, etc.) and are difficult to be compared by primary school students because they can't grasp their attributes (for example, what the essentials characteristics of the mountains are). Some topics were proposed to students for comparison, although they had a high degree of internal complexity. Nevertheless, they can identify certain visible aspects based on which they establish that the compared topics are similar or different (for example, the similarities and differences between a house and a block of flats).

The following figures show several diagrams provided by teachers as examples of topics of high complexity that have been proposed to students for comparison: two seasons – autumn and spring (Fig. 1); deciduous forest and coniferous forest (Fig. 2); domestic animals and wild animals (Fig. 3); the planet Earth and the Sun (Fig. 4); two cities – Cluj-Napoca and Bucharest (Fig. 5). We notice that sets of elements (Fig. 1; Fig. 2; Fig. 3; Fig. 5) are compared in the first four diagrams and two objects or bodies (Fig. 4) are compared in a diagram.

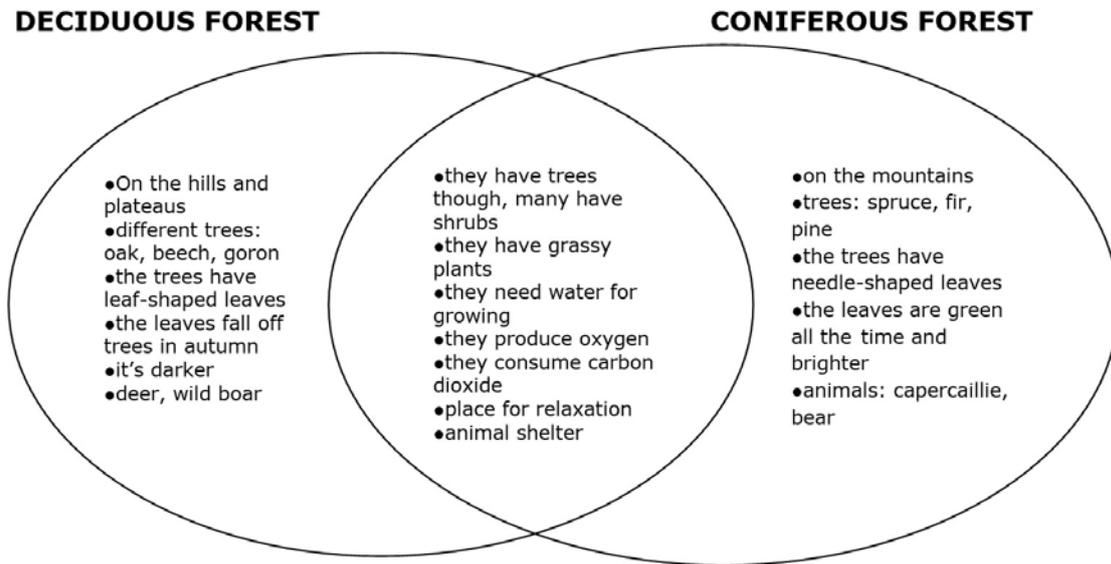
**Table 3.** The topics proposed to students for comparison grouped by category according to the degree of complexity

<b>Categories</b>	Natural	Animals	Mammals and reptiles; reptiles and birds; insects and spiders; wild animals and domestic animals, etc.
		Plants	Vegetables and cereals
		Landforms	Mountains, hills, plateaus, plains
		Waters	Lakes, rivers, seas
	Manmade (anthropogenic)	Human settlements	Rural settlements (villages) and urban settlements (cities)
<b>Individual elements</b>	Living organisms	Animals	Cat and dog; goat and sheep; duck and goose etc.
		Plants	Snowdrop and tulip; spruce and fir.
		People	Maria and Ionel
	Lifeless bodies	Natural	Granite and limestone; the planet Earth and the Sun.
		Manmade	House and block of flats; car and train; railway and highway; road and highway; castle and fortress.

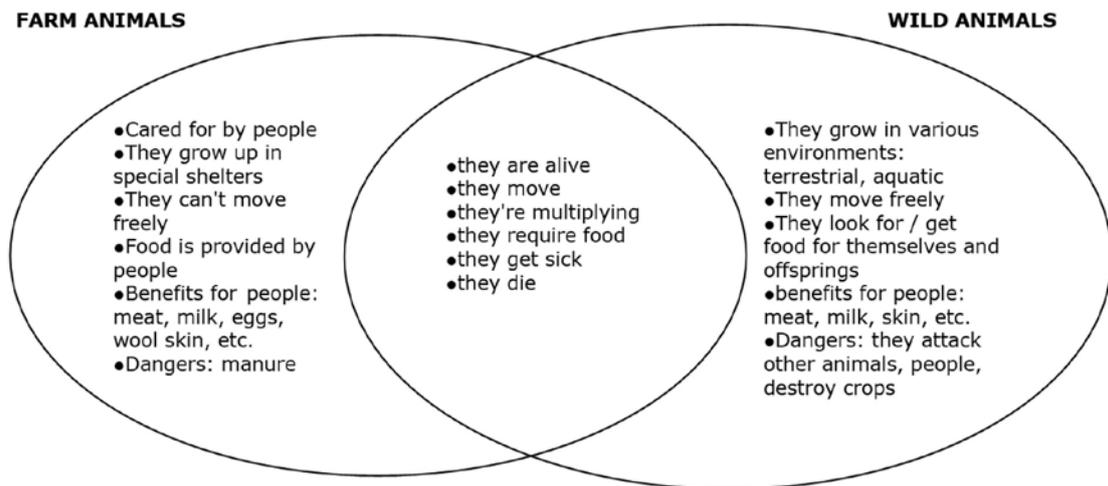


**Fig. 1.** Comparative representation of two seasons on the Venn diagram made by an interviewed teacher

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**Fig. 2.** Comparative representation of two forests on the Venn diagram made by an interviewed teacher



**Fig. 3.** Comparative representation of two categories of animals on the Venn diagram made by an interviewed teacher

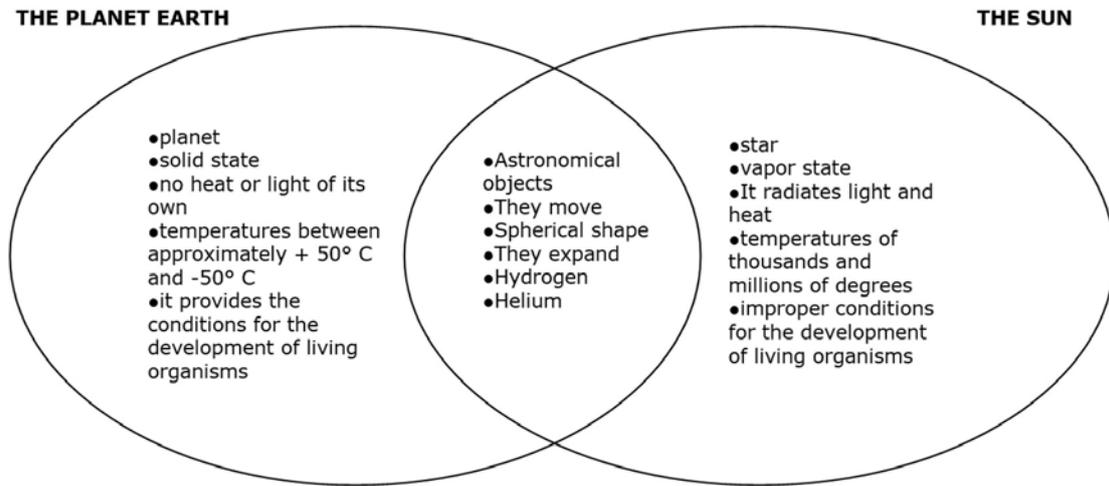


Fig. 4. Comparative representation of two cosmic bodies on the Venn diagram made by an interviewed teacher

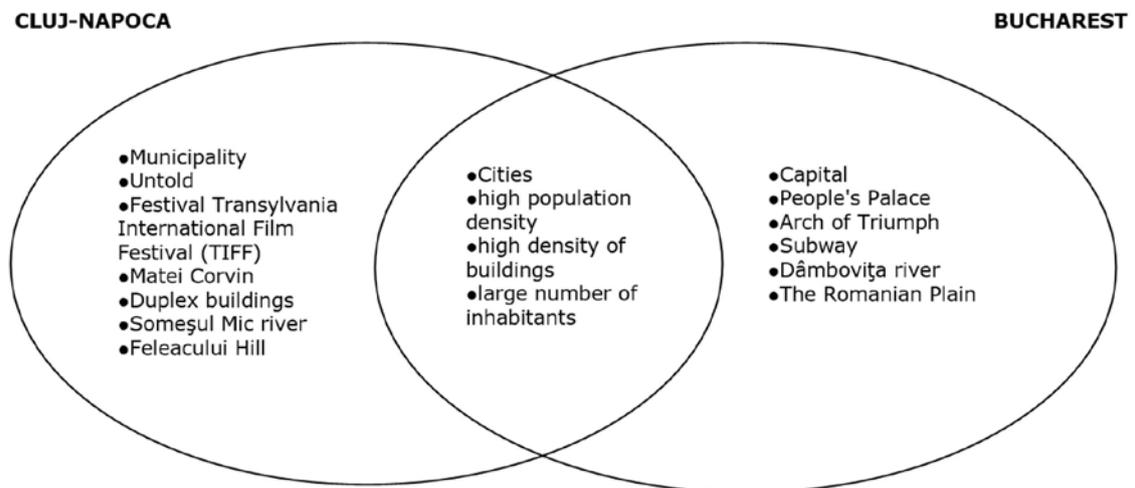


Fig. 5. Comparative representation of two cities on the Venn diagram made by an interviewed teacher

*Support materials for students to complete the Venn diagram. All the teachers provided the students with texts from which they could extract the necessary information – specific and common aspects – or they could deduce them. They also claimed that they were provided with visual*

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materials (photographs, drawings, maps, illustrations of stories) on the basis of which they were able to establish specific and common aspects. One teacher said that the students completed such diagrams based on direct observation of a lake and a river flowing into it.

*Advantages and benefits.* The interviewed teachers stated that the students liked to complete these diagrams, regardless of how the activity was organised (individually, in pairs or in groups), the place where they worked (at school, at home). The students also liked the fact that they could colour the diagrams or complete them with colourful colours, so their representation was more pleasing.

Regarding the cognitive processes, the greatest benefit of pupils and students is that they learn to identify the criteria on which they compare and based on these criteria, they determine whether the compared elements are similar or different, therefore they perform reasoning.

Another benefit is that they learn to restructure the information as concisely as possible, but in such a way that another person understands the meaning of the figured information. Some authors consider that Venn diagrams "have maximum efficiency in observation activities, in stories, didactic games, conversations" which are performed in order to structure some knowledge or restructure some ideas (Breben et al., 2002).

*Disadvantages.* The greatest disadvantage for pupils and students was to identify the criteria on the basis of which the comparison of the two objects was performed. They noticed certain aspects specific to each topic and some common aspects, but without having done the mental operation of comparison. For those who observe Venn diagrams already completed by others, it is difficult to notice that the identification of features or characteristics was done on the basis of criteria – where this was done – because those were not written on the diagrams.

Based on the information analysis introduced by the pupils and students on the Venn diagrams, the teachers noticed that the information was not grouped in pairs. For example, the common feature of the Sun and the Earth is that they are astronomical objects, but the Sun is a star and the Earth is a planet (Fig. 4). In the case of animals, people provide food for raising domestic animals, while the wild ones have to look for food for themselves and their offsprings (Fig. 3.).

*Graphic organisers used for comparisons.* The interviewed teachers claimed that they used the double bubble to highlight the specific aspects of some topics and their common aspects. Also, after identifying the similarities and differences of two compared topics, they summarised them in a table. Some teachers also used tree-like schemes to visually represent the similarities and differences.

## CONCLUSIONS

Regarding the use of Venn diagrams in primary education, we came to some conclusions at the end of this study. These diagrams are most frequently used in Geography, Science, Romanian language and literature, during the stage of reflection on the topic studied, but also in order to fix or evaluate the essential knowledge of students about a topic.

Venn diagrams were made in various learning contexts: at school, but also at home or in the field; based on information extracted from texts, visual materials (photographs, drawings, maps, etc.) or previous knowledge existing in one's own knowledge background. The topics proposed for comparison were different, with varying degrees of complexity.

Regarding the benefits, we came to the conclusion that they aim at both the development of cognitive processes and skills, and the quality of the products made of the completed diagrams respectively. By making Venn diagrams, pupils and students learn: to observe and analyse carefully the topics under comparison; identify the criteria on the basis of which they will compare the two topics and establish the similarities and differences by reasoning.

As a visual representation of the information, through the exercises of completing the diagrams and observing the rules given by the teachers, the pupils and students learn to introduce information on the Venn diagram concisely, in as few words as possible and to order them in three areas on logical criteria.

Finally, we emphasise that in order to complete Venn diagrams at a higher level of quality, teachers must have a large body of knowledge about the topic studied, knowledge of logic and psychology related to the analysis, comparison, abstraction of information and their conceptualisation and understanding from the perspective of the didactics of each subject, on which topics the use of the Venn diagram is recommended and how it should be completed respecting all the requirements mentioned in the literature. We emphasise that both teachers and students need to complete many Venn diagrams in order to reach a higher level of understanding of how information is represented in its areas.

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