ROMANIAN REVIEW OF GEOGRAPHICAL EDUCATION,
Volume II, Number 1, February 2013

pp. 26-51
DOI: http://doi.org/10.23741/RRGE120132

USING DIDACTIC GAMES FOR THE FORMATION OF GEOGRAPHICAL REPRESENTATIONS AND OF VARIOUS ABILITIES IN PRE-SCHOOL CHILDREN

ANCA VIORICA HAIDU

Chieşd Kindergarten, Sălaj County, Romania,

e-mail: haiduanca@ymail.com

MARIA ELIZA DULAMĂ

Babeş-Bolyai University, Faculty of Psychology and Sciences of Education, Cluj-Napoca, Romania,

e-mail: dulama@upcmail.ro

GABRIELA OSACI-COSTACHE

University of Bucharest, Faculty of Geography, Romania,

e-mail: gabrielaosaci68@yahoo.com

(Received: January 2013; in revised form: February 2013)

ABSTRACT

The goal of this paper is to investigate the way in which it is possible to influence the formation of geographical representations and the development of skills through didactic games in the field of Geography. The work hypothesis for this research was the following: if didactic games were used during the environment discovery classes, the result would be the development of children's representations and cognitive abilities. An experimental activity was organized during the 2011-2012 school year at the Kindergarten in Chieşd. Research involved 23 children in the pre-school group. The accomplishment of the research goals covered a number of different stages. First, we selected the Geography topics to be covered, the objectives and the games. We conceived and applied an initial test; we involved the children in learning situations based on didactic games with various Geography contents, after which a final test was applied. At the end of the study, the tested hypothesis was confirmed.

Keywords: *behaviour, cognitive development, level of development, pre-school education, integrated curriculum*

ISSN 2285 – 939X
ISSN – L 2285 – 939X

INTRODUCTION

We conceived this research based on the observation that pre-school children displayed difficulty in representing the geographical covers and in understanding the relationship between the elements to be found on the Earth's surface (Dulamă, 2006). We were interested in finding the most appropriate games by means of which to accomplish the objectives regarding the discovery of the environment, as specified in the Curriculum for pre-school education (3-6/7 years) (2008) and by means of which to increase the level of children's understanding the geographical space and the quality of their mental representations of this space (Dulamă, 2006). This study focused on the representations of some components of the geographical cover by a group of pre-school children as well as on the abilities they developed through games with Geography content.

The main objective of our research was the study of results obtained by a group of pre-school children through getting involved in didactic games with Geography content. The secondary objectives of our research were the following: 1) identifying a number of didactic games by means of which pre-school children developed certain representations of the environment and particular abilities of logical thinking; 2) conceiving an evaluation instrument; 3) analysing Geography oriented abilities and the abilities of pre-school children developed through didactic games.

RESEARCH HYPOTHESIS

The work hypothesis for this research was the following: if didactic games were used during the environment discovery classes, the result would be children's development of representations and cognitive abilities The independent variable was represented by the didactic games with Geography content in which children took part. The dependent variable was defined by the abilities and the level of knowledge development attained by children during the research.

THEORETICAL BACKGROUND

In the Curriculum for Pre-school Education (3-6/7 years) (2008), the Field of Sciences includes the approach of Mathematics by means of practical experiences and the understanding of nature, based on the assumption that the pre-school student should be introduced to this field through guided games involving the subject. It is argued that, in this way, pre-school children will develop certain representations and will be involved in activities

that suppose discerning, classifying or making quantitative descriptions. By establishing contact with the field of environment discovery during certain activities (such as observing particular creatures/plants/animals/objects in the immediate environment), pre-school children may develop abilities and competences associated to the trials of scientific investigation (observation, selecting elements, generating hypotheses and alternatives, conceiving and carrying out experiments, organizing data resulting from observation) (p. 11). It has also become obvious that games are "the fundamental form of activity during early childhood and the form of learning with a decisive role in the development and education of the child", "the most natural form of learning" and "of expressing the mental content of every person" (p. 13).

What stands out as relevant for the current research is the emphasis this document places on the importance of the domain of cognitive development, which "includes the abilities of logical thinking and problem solving, basic mathematical knowledge of the child together with knowledge of the world and of the environment" (p. 15). Cognitive development is defined as the child's ability "to understand the relationships between objects, phenomena, events and persons, beyond their physical characteristics" (p. 15). The dimensions of this domain are: the development of logical thinking and problem solving; basic mathematical knowledge and abilities, knowledge and understanding of the world (basic mathematical representations: numbers, numeric representations, operations, concepts regarding space, geometrical shapes, understanding models, measurements, knowledge and understanding of the world: the living world, the Earth, outer space, and scientific methods) (p. 16).

The educational curriculum for pre-school education displays a systemic approach, which is also specific to studying the environment at a scientific level. This approach can be noticed in the fact that the annual study program is organized around six important topics: Who am I/who are we? When, how and why it is happening? How is/was/will be life on Earth? How do we plan an activity? How do we express what we feel? and What and how do I want to be? (p. 21). We note that in the field of Geography together with the analysis of geographical covers and their components, synthesis is equally important as it allows the theoretical reassembly of reality. According to the basic principle of Geography, that of integration (e.g. spatial, structural), during the process of *synthesis*, the geographer "is reconstructing the territorial unit in which the properties of individual components are manifested" (Dulamă, 2011, p. 6).

We are correlating this research with some of the frame objectives in the domain of Sciences: the development of pre-mathematical intellectual operations; the stimulation of curiosity regarding understanding and explaining the surrounding world; understanding and explaining the environment, alongside the stimulation of curiosity for investigation; development of the capacity to observe and establish causal, spatial, temporal relations; using the adequate language in describing naturally occurring phenomena and environmental phenomena; developing and practising abilities for the care and protection of the environment with the purpose of educating a positive outlook regarding the environment (p. 29).

The list of reference objectives has been reduced in the present paper to those depending on which we have selected the content and games of the current didactic experiment: to enrich their sensory experience as a basis for the mathematical knowledge regarding the recognition and naming of objects, their quantity, classification, constituting groups on the basis of common features (shape, size, colour), considered either separately or in simultaneity; to perform operations with groups of objects they constituted depending on various criteria either given or selected by themselves: triage, grouping/regrouping, comparing, classifying, ordering, appreciation of quantity by making correspondences; to understand and to name the relative spatial relations, to place objects in a given space or to place themselves correctly in relation to a given reference point; to be acquainted with the elements comprising the surrounding world (objects, air, water, soil, plants, animals, the human being as integrated part of the environment, natural phenomena) as well as the interdependence between them; to recognize and verbally and/or graphically describe particular changes and transformations in the environment; to be familiar with elements of the social and cultural environment and position the human element as an integrating part of the natural environment (p. 30).

METHOD

The basis of this research paper is manifested by the paradigm of constructivism (Piaget, 1969; Doolittle, Hicks, 2003; Joiţa, 2006). For understanding the projection and organization of the experiment, in this research we have used the terminology and methodology recommended by the Curriculum for pre-school education (3-6/7 years) (2008).

Venue and research period: as pre-school teacher rather than as a researcher, the first author of this paper organized the experimental activity for the 2011-2012 school year at the Kindergarten in Chieşd.

PARTICIPANTS

The research involved 23 children in the pre-school group. The group was homogeneous as age (5-6 years old) and heterogeneous as gender and level of geographical knowledge. We did not resort to sampling, but rather included the entire population available in the experimental activities.

Procedure: In order to attain the goals of our research, several stages were included. We selected the objectives, the Geography topics and games with geographical content.

In the attempt to identify the abilities and knowledge about environment displayed by children, we conceived and offered an initial test to this particular group (Table 1) in September 2011. By this test, we

sought: to identify the declarative knowledge children possessed (i.e. to determine the level and quality of information absorbed by children regarding plants, animals, seasons, jobs, means of transport, spatial positioning); to identify children's procedural knowledge (i.e. to identify the level of development in the ability to analyse, generalise, make associations, and to perform orientation in space).

In the following stage, we involved the children in learning situations based on didactic games (Table 2) with the following topics: "Autumn", "Winter", "Animals", "Spring", "Means of transport", "I'm choosing a job". Following these activities, we applied a final test (Table 1) in order to identify children's progress as compared to the initial test.

Table 1. Tests for initial and final evaluation

Initial evaluation	*Final evaluation*
A1) Evaluation objective: children will be able to perform space orientation by correctly indicating spatial position: left-right. Task: Colour the object on the left in red. Colour the object on the right in green. A1) Evaluation objective: children will be able to perform space orientation by correctly indicating spatial position: up-down. Task: Colour the planes oriented upwards in blue. Colour the planes oriented downwards in green.	A1) Evaluation objective: children will be able to perform space orientation by correctly indicating spatial position: left-right. Task: Circle the planes oriented towards the left with red. Circle the planes oriented towards the right in green. A1) Evaluation objective: children will be able to perform space orientation by correctly indicating spatial position: up-down. Task: Colour the pencils oriented upwards in red. Colour the pencils oriented downwards in green.
A2) Evaluation objective: children will be able to use temporal reference points that are common to the group. Task: Colour the image that displays the event that unfolds first.	A2) Evaluation objective: children will be able to use temporal reference points that are common to the group. Task: order the events by assigning them numbers.
A3) Evaluation objective: Children will be able to perform time orientation by correctly indicating the temporal reference points: morning-evening. Task: Circle the image in which it is morning. Colour the image in which it is evening.	A3) Evaluation objective: Children will be able to perform time orientation by correctly indicating the temporal reference points: morning-evening. Task: Colour the images of the activities you do in the morning. Circle the images of the activities you do in the evening.
A4) Evaluation objective: children will be able to perform classifications by selecting the animals belonging to the same category. Task: Colour the domestic animals in red. Colour large domestic animals in blue. Colour large wild animals in green. A4) Objective: children will be able to perform classifications by selecting the means of transport belonging to the	A4) Evaluation objective: children will be able to perform classifications by selecting the birds belonging to the same category. Task: Circle the wild birds. Colour the large wild birds in blue. Colour the large wild birds in green. A4) Objective: Children will be able to perform classifications by selecting the means of transport belonging to the same category.

same category. Task: Colour the means of transport that travel on water.	Task: Circle the means of transport that travel on land.
A5) Evaluation objective: children will be able to order the objects by length. Task: Write the appropriate numbers in boxes, arranging the pencils by length. A5) Evaluation objective: children will be able to order the objects by size. Task: Attach the circles in descending order from left to right.	A5) Evaluation objective: children will be able to order the objects by thickness. Task: write the appropriate numbers in the boxes, arranging the books by thickness. A5) Evaluation objective: children will be able to order the objects by size. Task: Attach the squares in descending order from left to right.
B1) Evaluation objective: children will be able to compare objects by length. Task: Circle the longest pencil with green and the shortest pencil with red. Circle the pencils that have the same length with purple.	B1) Evaluation objective: children will be able to compare objects by length. Task: Circle the longest car with green and the shortest car with red. Circle the cars that have the same length with purple.
B2) Evaluation objective: children will be able to compare objects by width. Task: Circle the widest table with green and the narrowest with red. Circle the ones that have the same width with purple.	B2) Evaluation objective: children will be able to compare objects by width. Task: Circle the widest car with green and the narrowest car with red. Circle the cars that have the same width with purple.
B3) Evaluation objective: children will be able to compare environment components by height. Task: Colour the star of the tallest fir tree in yellow. Colour the star of the shortest fir tree in red. Colour the stars of the fir trees having the same height in green.	B3) Evaluation objective: children will be able to compare two environment components by size. Task: Circle the small animals with yellow. Circle the large animals with red. Circle the animals having the same height with green.
C1) Evaluation objective: Children will be able to identify the houses among other buildings and their numbers. Task: Circle all the houses with blue. Write the number of houses you found in the corresponding box. C1) Objective: Children will be able to identify the railway among other transport ways. Task: Colour in brown the place where the train travels. C1) Objective: children will be able to identify environment components. Task: Circle in red the animals that do not live in the forest. C1) Evaluation objective: children will be able to associate a domestic animal with its living environment. Task: Unite the animals to the place	CO) Evaluation objective: children will be able to identify the forms of relief. Task: Colour the mountain in brown and the plain in green. C1) Objective: children will be able to associate the means of transport with the area in which they travel. Task: Draw a line to show where each means of transport travels. Colour the means of transport that travel through the air. C1) Objective: children will be able to identify the environment components. Task: Circle the wild bird with blue. C1) Objective: children will be able to associate the wild animal with its living environment. Task: Draw a line to unite the animals with the places in which they live.

where they live by drawing a line.	
C2) Evaluation objective: children will be able to enumerate the parts of the human body. Task: Fill in the blanks with what is missing. Enumerate the parts of the human body. C2) Evaluation objective: children will be able to enumerate the component parts of a plant. Task: Enumerate the component parts of the fir tree. C2) Evaluation objective: children will be able to enumerate the component parts of an animal. Task: Enumerate the component parts of a dog. Circle the animal's tail with blue.	C2) Evaluation objective: children will be able to enumerate the parts of the human body. Task: Fill in the blanks with what is missing. Enumerate the parts of the human body. C2) Evaluation objective: children will be able to enumerate the component parts of a plant. Task: Enumerate the component parts of the tulip. C2) Evaluation objective: children will be able to enumerate the component parts of an animal. Task: Enumerate the component parts of the cat.
C3) Evaluation objective: children will be able to identify natural phenomena. Task: Circle the image in which rain is represented. Colour the image in which lightning is represented.	C3) Evaluation objective: children will be able to identify natural phenomena. Task: Circle the image in which snow is represented. Colour the image in which hail is represented.
C4) Evaluation objective: children will be able to identify natural phenomena specific to the seasons of winter and summer. Task: Circle the phenomena specific to the season of winter with red. Circle the phenomena specific to the season of summer with green.	C4) Evaluation objective: children will be able to identify natural phenomena specific to the seasons of autumn and spring. Task: Circle the phenomena specific to the season of autumn with red. Circle the phenomena specific to the season of spring with green.
C5) Evaluation objective: children will be able to identify modifications occurring in the life of plants specific to the seasons of spring. Task: Circle the phenomena specific to the life of plants in the season of spring with red. Circle the aspects specific to the life of plants in the season of autumn with green.	C5) Evaluation objective: children will be able to identify modifications occurring in the life of animals specific to the seasons of spring. Task: Circle the phenomena specific to the life of animals in the season of spring with red. Circle the aspects specific to the life of animals in the season of autumn with green.
C6) Evaluation objective: children will be able to identify specific local elements. Task: Circle the kindergarten in which you are with red. Circle the church in your town with green.	C6) Evaluation objective: children will be able to identify specific local elements. Task: Circle the school in which you are with red. Circle the city hall in your town with green.
C7) Evaluation objective: Children will be able to identify celestial bodies. Task: Circle the Sun with red. Circle the Moon with green.	C7) Evaluation objective: Children will be able to identify celestial bodies and space vehicles. Task: Circle the Earth with red. Circle the space vehicle with green.
D1) Evaluation objective: Children will be able to describe the environment in their own kindergarten. Task: Describe the environment in your	D1) Evaluation objective: Children will be able to describe the environment in the park. Task: Describe the park.

own kindergarten.	
E1) Evaluation objective: Children will be able to express their own emotions regarding the environment in their kindergarten. Task: Express what you like about your kindergarten.	E1) Evaluation objective: Children will be able to express their own emotions regarding the environment in the park. Task: Express what you like about the park.

Table 2. Didactic games with Geography content

Objectives	*Games*
A1) Evaluation objective: children will be able to perform space orientation by correctly indicating spatial position: left-right. A1) Evaluation objective: children will be able to perform space orientation by correctly indicating spatial position: up-down.	"Where has the butterfly landed?" (Dima, Pâclea, Candrea, 1995). "The windmills" (Vodiţă, 2003) "Look around and find orientation" (Ana, Cioflică, 2000) "We play with toys" (Antonovici, Jalbă, Nicu, 2005)
A2) Objective: children will be able to use temporal reference points that are common to the group.	"What image comes next?" (Vodiţă, 2003) "From youth to old age" (Vodiţă, 2003)
A3) Objective: Children will be able to perform time orientation by correctly indicating the temporal reference points: morning-evening.	"The wheel of time" (Vodiţă, 2003) "When does it occur?" (Dima, Pâclea, Candrea, 1995)
A4) Objective: children will be able to perform classifications by selecting the animals belonging to the same category.	"Let's set them right!" (Vodiţă, 2003) "Where did the wheel make its stop?" (Dima, Pâclea, Candrea, 1995). "Set me in the right place!" (Dima, Pâclea, Candrea, 1995) "How do we travel?" (Dima, Pâclea, Candrea, 1995)
A5) Objective: children will be able to order the objects by size.	"Put the objects in order!" (Ana, Cioflică, 2000)
B1) Objective: children will be able to order the objects by length.	"Long and short sticks" (Antonovici, Nicu, 2003)
B2) Objective: children will be able to order the objects by width.	"Arrange the toys by width" (Antonovici, Jalbă, Nicu, 2005)
B3) Objective: Children will be able to compare components of the environment by height.	"Arrange the toys by height" (Antonovici, Jalbă, Nicu, 2005)
C1) Objective: Children will be able to identify the houses among other buildings and their numbers. C1) Objective: Children will be able to identify the railway among other transport ways. C1) Objective: children will be able	"Set it in the right place!" (Antonovici, Nicu, 2003) "Set me in the right place!" (Dima, Pâclea, Candrea, 1995) "Who has just arrived?" (Dima, Pâclea, Candrea,

to identify environmental components. C1) Objective: children will be able to associate a domestic animal with its life environment.	1995) "Guess who it is!" (Dima, Pâclea, Candrea, 1995) "Who can match them correctly?" (Taiban, Petre, Nistor, 1976)
C2) Objective: children will be able to enumerate the parts of the human body. C2) Objective: children will be able to enumerate the component parts of a plant. C2) Objective: children will be able to enumerate the component parts of an animal.	"What do I know about the human body?" (Mitu, Antonovici, 2005) "What has Irina forgotten to draw?" (Vodiţă, 2003) "What has the painter done wrong?" (Taiban, Petre, Nistor, 1976)
C3) Objective: children will be able to identify natural phenomena.	"When does it occur?" (Taiban, Petre, Nistor, 1976)
C4) Objective: children will be able to identify natural phenomena specific to winter and summer.	"Winter and summer" (Vodiţă, 2003)
C5) Objective: children will be able to identify modifications occurring in the life of plants specific to spring.	"When and why does it occur?" (Taiban, Petre, Nistor, 1976)
C6) Objective: children will be able to identify specific local elements.	"Let us build a new neighbourhood!" (Antonovici, Jalbă, Nicu, 2005)
C7) Evaluation objective: children will be able to identify celestial bodies.	"Who knows them all?" (Taiban, Petre, Nistor, 1976)
D1) Objective: Children will be able to describe the environment in their own kindergarten.	"The kindergarten furniture" (Dima, Pâclea, Candrea, 1995)
E1) Objective: Children will be able to express their own emotions regarding the environment in their kindergarten	"Let's play kindergarten!" (Mitu, Antonovici, 2005)

DATA COLLECTION

We gathered the data by the method of observation and we organised the data by means of the instrument in Table 3 and in Table 4.

Table 3. Children's scores at the initial and final evaluation test - Group 1

	Subject 1		*Subject 2*	
	Initial evaluation (I)	*Final evaluation (F)*	*Initial evaluation (I)*	*Final evaluation (F)*
A) Pre-mathematical intellectual operations				
A1)				

RESULTS AND DISCUSSIONS

1) Analysis of didactic games

The didactic games in this study are, by content, games that focus on knowledge of the environment, mathematical games, but all the contents were approached in an integrated manner. As pre-school children do not employ written language, all the games were carried out orally. Taking into consideration the level of development in children's thinking, in order to ensure correct formation of representations, we used support materials in all the games. Since the aim was to form intellectual abilities, we resorted to games for focusing attention and developing space orientation, games for mental analysis and synthesis, games for accomplishing mental comparisons, games for generalising and developing abstract thinking.

2) Analysis of instruments for the evaluation of behaviours

For the evaluation instruments used in this study (Table 1), we selected several behaviours (abilities) from the Evaluation form for pre-school children as proposed by MECTS. The selection was done in accordance with the desired objectives and with the contents chosen from the field of Geography and knowledge of the environment. From the previously mentioned behaviours, we selected a number of 17 at which children had demonstrated poor knowledge in the period preceding the research.

A first observation to be made is that the Curriculum for pre-school education makes no reference whatsoever to this evaluation form. We would also like to underline that in this particular chart, the behaviours are grouped on experiential domains. Within the framework of each experiential domain, the behaviours are grouped on categories (a, b, c, etc.). For the present study, we selected five distinct categories of behaviours: a) pre-mathematical intellectual operations; b) ability to use measuring units correctly and by using adequate vocabulary; c) ability to know and understand the environment, together with stimulating curiosity to investigate it; d) using appropriate language in describing natural and environmental phenomena; e) habits to care for and protect the environment.

We also point out that in official documents there is no specification of the term *behaviour category* as there is no other term used to name them. When analyzing the formulations and content, according to the following definitions, we consider them to be competences: a competence comprises a range of declarative knowledge, procedural knowledge and attitudes that are activated in planning and carrying out a task (Brien, 1997): "a competence is the ability to exploit the knowledge one possesses in order to carry out a task, while the observable behaviour is the external manifestation of the competence" (Dulamă, 2009, p. 246); "a competence represents the proven aptitude to select, combine and use knowledge, abilities and other assets appropriately consisting of values and attitudes

through successfully solving a certain category of situations involving work or learning as well as professional and personal development in conditions of efficiency and effectiveness" (Law of National Education, 2011, p. 62).

Within each category mentioned in the Evaluation form, behaviours are numbered with Arabic numbers and each has a corresponding box in which the teacher can write the score the child obtained at the Initial evaluation, at the Term evaluation (1st semester), and at the Final evaluation (2nd semester). It grades results as follows: I- Integrated behaviour; D- Developing behaviour; A- Absent behaviour.

When analysing formulations, we consider these formulations as being descriptors of competences, i.e. they indicate the level of competence that pre-school children should possess at a certain age. In the present paper, we shall use the term behaviour. We are correlating this term with the theory of objectives in which (target) behaviour that is observable and measurable and that was obtained by the student in a learning situation is expressed through an action verb, clearly specified so that anyone could represent the expected result approximately in the same form (Dulamă, 2011, p. 88). The verb in question expresses a single logical operation, a mental or physical activated ability, a visibly manifested attitude that results in a product that can be measured both in point of quantity as well as in quality (p. 88). We have correlated the behaviours (descriptors) in the Evaluation Form with the evaluation objectives and with the tasks submitted to children for fulfilment. We also point out that in the Evaluation form, some behaviours or descriptors actually refer to several behaviours. For example, "He/she knows the significance of usual spatial relations (up, down, to the right, to the left, on, under, above, below, near, far, inside, outside, here, there, etc.) and uses the appropriate language". We would prefer a more detailed form, which should include all the abilities, behaviours or skills that the child is developing. In order to tackle this issue, we formulated several evaluation objectives for each behaviour.

With the help of the instrument we created, we observed and evaluated 17 behaviours for each child, in their initial and final stage. The results (behaviours) of each child in the initial and final test were included in Table 3.

3) Analysis of the data collection instruments

The instrument we used in recording the children's results in the initial and final test of this experiment (Table 3) allowed us to analyse the level of development of each child's competences and the status in the formation of a certain competence at the level of the entire group. The instrument in Table 4 allowed the centralization of the results. We emphasized the results of a summative evaluation for each child at the initial test and at the final test.

Each instrument emphasizes the progress or regress of each child regarding various behaviours and at certain competence levels.

4) Analysis of children's results at initial and final tests

In the following section, we shall analyse the results obtained by children at each test item. All the tasks submitted to children (Tables 1 and 2) display Geography content related to the Domain of Sciences in the Curriculum for pre-school education.

A) Pre-mathematical intellectual operations

A1) *Know the significance of usual spatial relations (up, down, to the right, to the left, on, under, above, below, near, far, inside, outside, here, there, etc.) and use the appropriate language.* When analysing the results (Fig. 1) we noticed the children's development in the sense that in the final test, out of the total 23, 7 children (30%) displayed integrated behaviour and 16 children (70%) displayed developing behaviour. We also noticed that by means of location games, which were actually exercises for the children to develop particular operations, children understood accurate perception and space orientation.

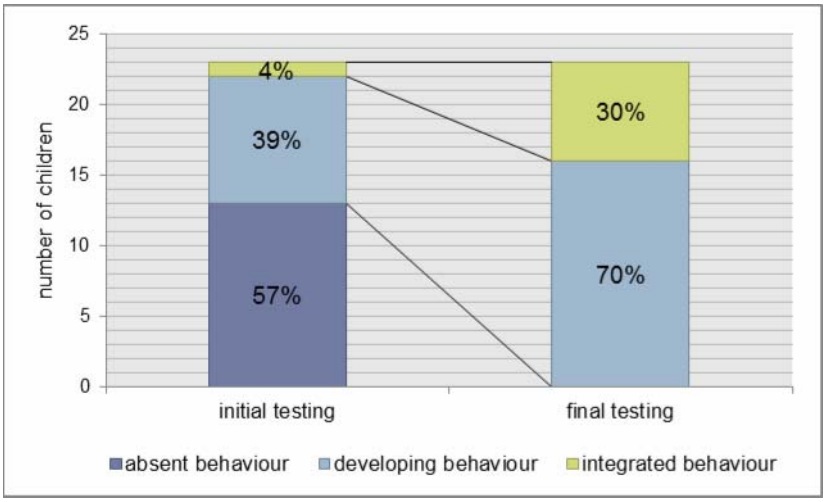

Fig. 1. Results in item A1 (pre-mathematical intellectual operations) in initial testing and in final testing

A2) Use temporal reference points that are common to the group (depending on the reference point in their timetable) or depending on natural pace patterns. When analysing the results (Fig. 2), we noticed children's development in the sense that in the final test, out of the total 23, 6 children (26%) displayed integrated behaviour, 15 children (65%) displayed developing behaviour and 2 children (9%) displayed absent behaviour, therefore most pre-school children displayed the ability to use temporal reference points common to their group either in integrated or in a developing form. Through these games, children acquired time perception and temporal orientation.

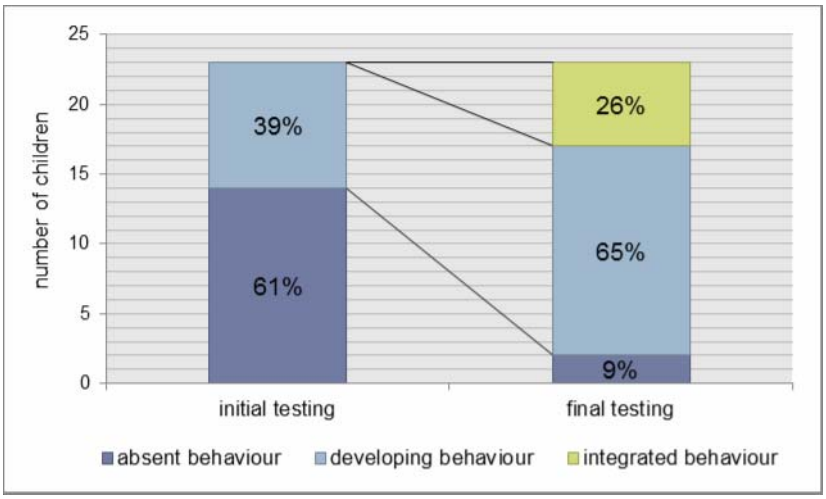

Fig. 2. Results in item A2 (pre-mathematical intellectual operations) in initial testing and in final testing

A3) *Understand the significance of usual temporal reference points: now, then, later, firstly, today, tomorrow, in the morning, in the evening, at noon etc., and use them correctly*. We noticed that the scores of the children in the final test were superior to those in the initial test (Fig. 3): 8 children (35%) displayed developing behaviour, 15 children (65%) displayed integrated behaviour, and therefore the children understood and used the evaluated reference points correctly (morning, evening). Some difficulty was experienced in using the temporal reference points tomorrow and yesterday, but those were not being tested at that point.

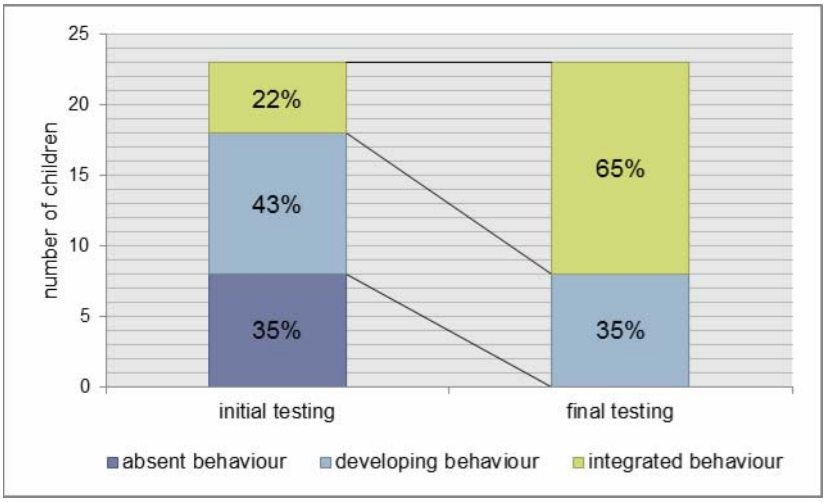

Fig. 3. Results in item A3 (pre-mathematical intellectual operations) in initial testing and in final testing

A4) *Classify a range of objects/beings by naming a common property (e.g. large/small, tall/short, beings/objects, animals/birds etc.).* When analysing the results (Fig. 4), we notices children's progress. Thus, 13

children (56%) displayed integrated behaviour, 8 children (35%) displayed developing behaviour, 2 children (9%) displayed absent behaviour. We noticed that most children are able to classify components of the environment (objects/beings) according to various size criteria.

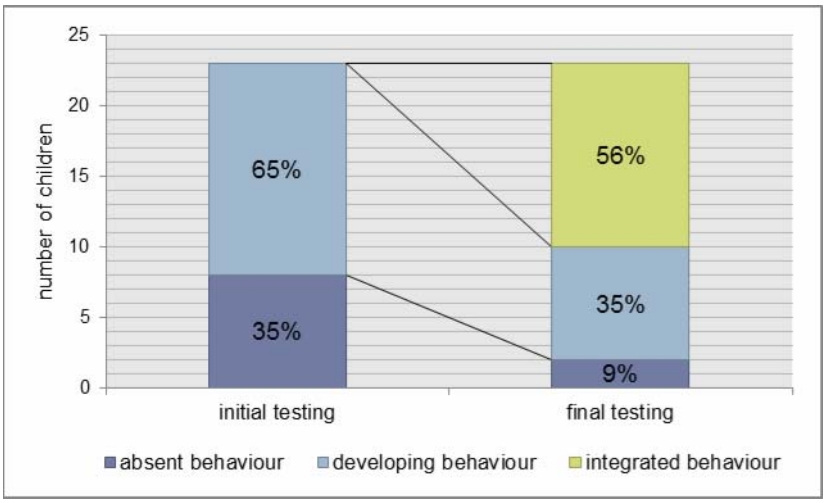

Fig. 4. Results in item A4 (pre-mathematical intellectual operations) in initial testing and in final testing

A5) *Be able to order objects according to various criteria (colour, shape, length, thickness, by the sound/smell they produce etc.) with at least four degrees of differentiation.* We noticed that the final test results were much better that the initial test results (Fig. 5), as 13 children (56%) displayed integrated behaviour, 8 children (35%) displayed developing behaviour and merely 2 children (9%) displayed absent behaviour. We could conclude that most children ordered the objects by the criteria length, thickness.

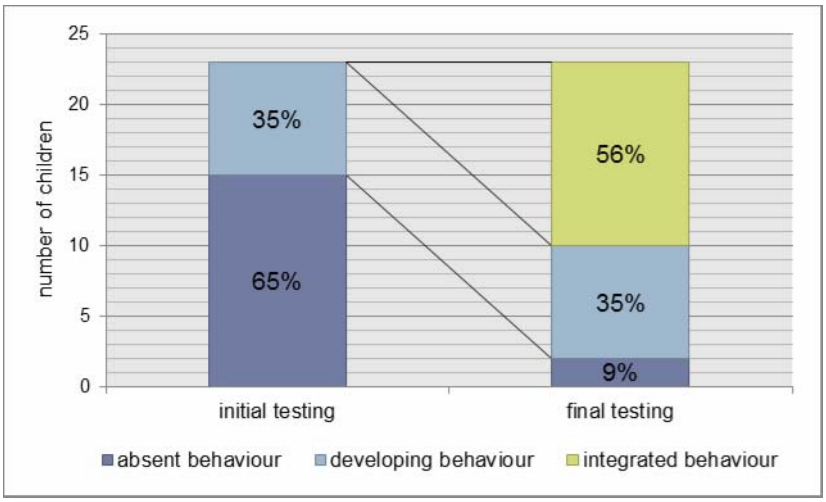

Fig. 5. Results in item A5 (pre-mathematical intellectual operations) in initial testing and in final testing

B) Ability to use measuring units correctly by using adequate vocabulary

B1) *Be able to compare the length of two or more objects and express which is shorter, longer or whether they have the same length.* When analysing results (Fig. 6), we noticed that most children had no difficulty in comparing two or more objects. In the final test, out of the 23 children, 24 (61%) displayed integrated behaviour and 9 children (39%) displayed developing behaviour. This represented remarkable progress considering the fact that the initial test showed absent behaviour in 48% of the children (Fig. 6). Children were able to identify the similarities and differences between objects as far as their length was concerned.

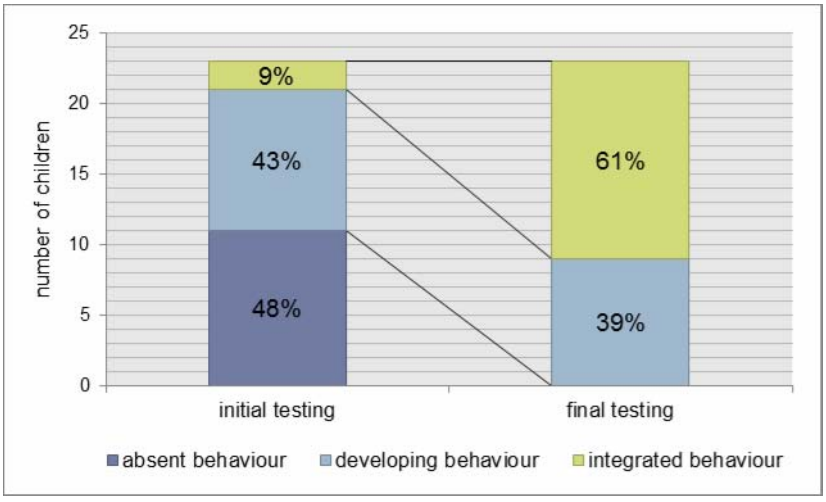

Fig. 6. Results in item B1 (ability to use measuring units correctly by using adequate vocabulary) in initial testing and in final testing

B2) *Compare the width of two or more objects and express which is wider, which is narrower or whether they have the same width.*

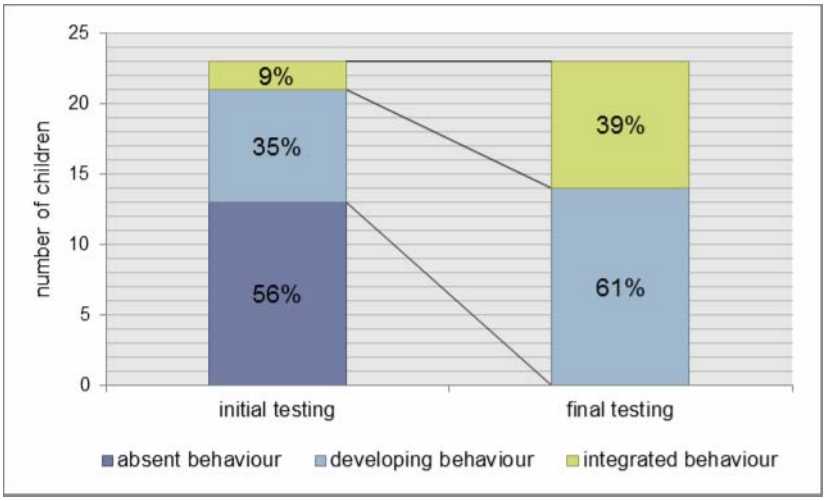

Fig. 7. Results in item B2 (ability to use measuring units correctly by using adequate vocabulary) in initial testing and in final testing

The results of the final test were higher than the results of the initial test, with none of the children displaying absent behaviour, although initially 56% had fallen into this category (Fig. 7). In the final test, out of the 23 children, 9 (39%) displayed integrated behaviour and 14 (61%) displayed developing behaviour. Children were able to identify the similarities and differences between objects as far as their width was concerned.

B3) Be able to compare the height of two or more objects and express which is shorter, taller or whether they have the same height. When analysing results (Fig. 8), we noticed that most children had no difficulty in comparing the height of two or more objects. Though in the initial test more than half of the children (56%) displayed absent behaviour, in the final test none of the children fell into this category. Out of the 23, 12 children (52%) displayed developing behaviour and 11 children (48%) displayed integrated behaviour. Children were able to identify the similarities and differences between objects as far as their height was concerned.

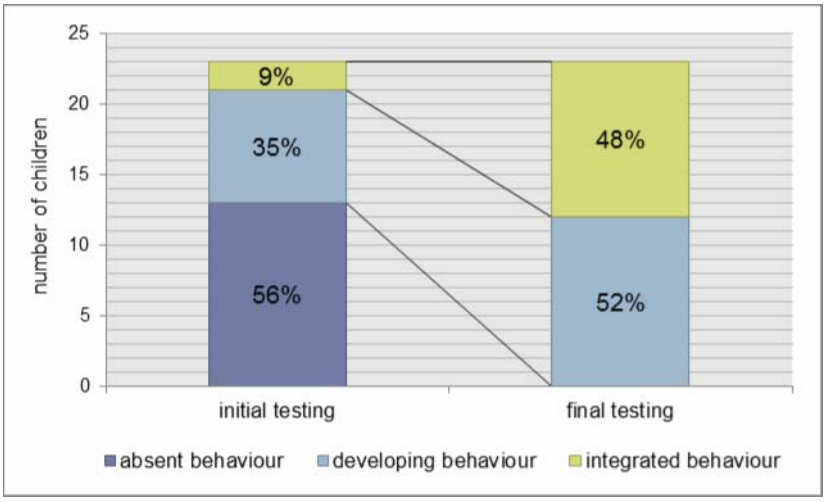

Fig. 8. Results in item B3 (ability to use measuring units correctly by using adequate vocabulary) in initial testing and in final testing

C) Ability to know and understand the environment, stimulating curiosity to investigate it

C1) *Analyse the components of the environment by engaging all senses.* When analysing results (Fig. 9), we noticed that the obtained results in the final test were superior to those obtained in the initial test, when none of the children displayed integrated behaviour, while a relatively large proportion of them (35%) displayed absent behaviour. In the final test, out of the 23 children, 14 (61%) displayed integrated behaviour and 9 (39%) displayed developing behaviour. We noticed that most children

displayed an integrated or developing ability to analyse the components of the environment by using all their senses, especially their eye-sight.

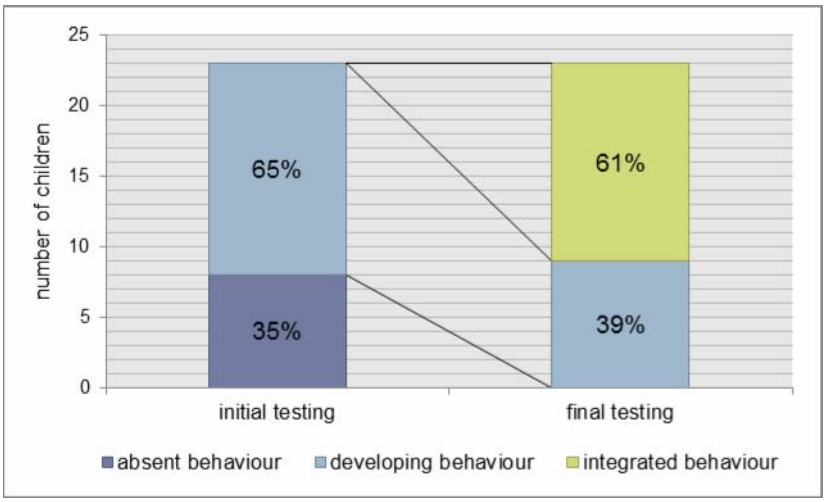

Fig. 9. Results in item C1 *(*ability to know and understand the environment, stimulating curiosity to investigate it) in initial testing and in final testing

C2) *Enumerate the component elements of the human body, plants, and animals.* It was noticeable that in the final test (Fig. 10) most children displayed no difficulty in enumerating the component parts of the human body, plants and animals. 15 children (65%) displayed integrated behaviour and 8 children (35%) displayed developing behaviour. This item was characteristic of the domain of Sciences (Biology), but we included it in the research because it was necessary for children to be able to identify component parts of bodies in Geography as well.

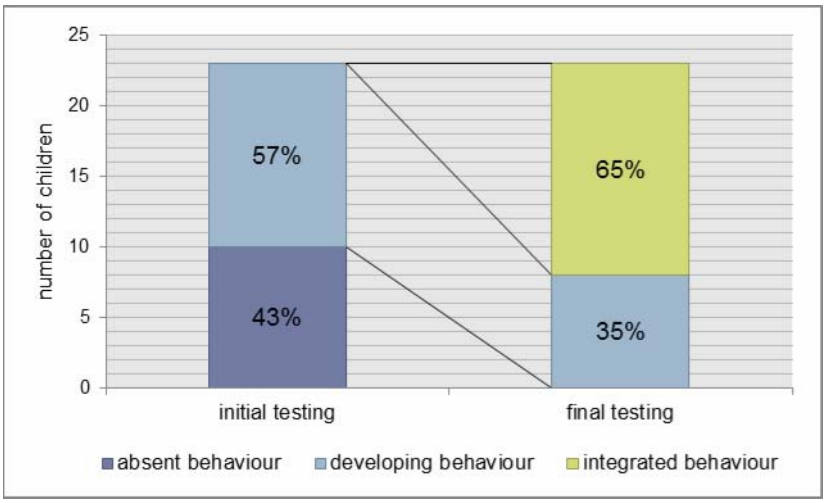

Fig. 10. Results in item C2 *(*ability to know and understand the environment, stimulating curiosity to investigate it) in initial testing and in final testing

C3) Recognize natural phenomena (wind, rain, hail, snow, frost, blizzard, storm, thunder, lightning) as they occur. When analysing the results (Fig. 11), we noticed that the results obtained in the final test were better than the results in the initial test. Thus, 16 children (70%) displayed integrated behaviour and 7 children (30%) displayed developing behaviour, therefore most children were able to recognize naturally occurring phenomena, particularly the visible and most spectacular phenomena (rain, snow, lightning, and hail).

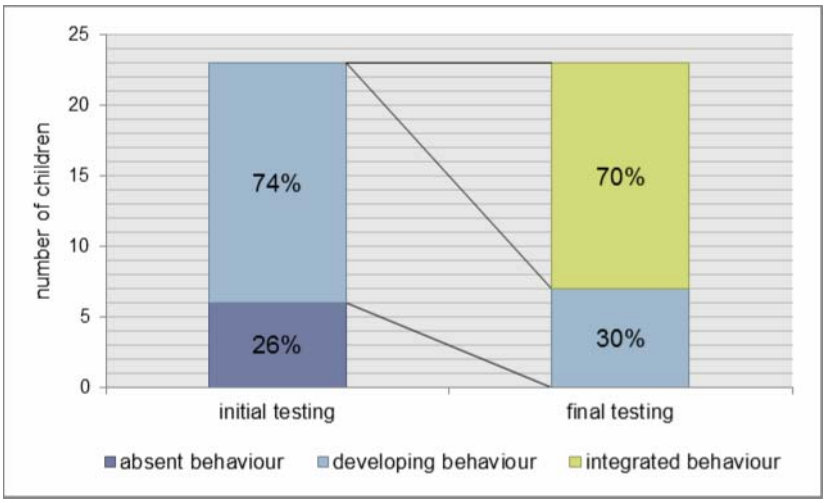

Fig. 11. Results in item C3 *(*ability to know and understand the environment, stimulating curiosity to investigate it) in initial testing and in final testing

C4) Identify the features of the seasons and their corresponding months.

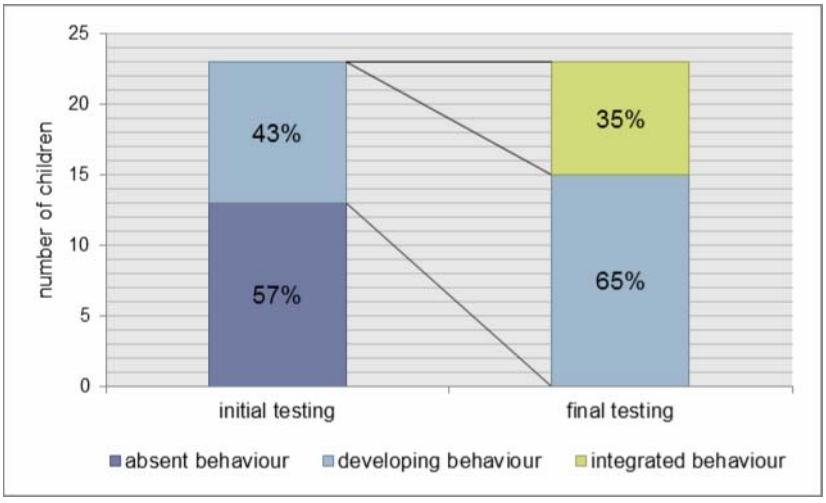

Fig. 12. Results in item C4 *(*ability to know and understand the environment, stimulating curiosity to investigate it) in initial testing and in final testing

We noticed (Fig. 12) that most children in the experimental group had no difficulty identifying the features of the seasons in the initial test: 15 (65%) displayed developing behaviour and 8 children (35%) displayed integrated behaviour.

C5) *Observe and enumerate the modifications occurring in the lives of humans, plants, and animals depending on the season*.

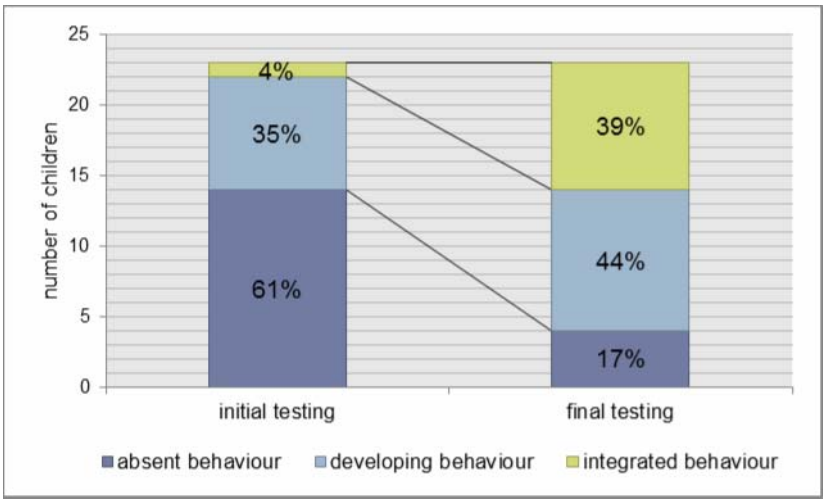

Fig. 13. Results in item C5 *(*ability to know and understand the environment, stimulating curiosity to investigate it) in initial testing and in final testing

When analysing the results (Fig. 13), we noticed children's progress, particularly as far as the integrated behaviour was concerned: in the initial test only 1 child (4%) displayed it, whereas in the final test 9 children (39%) displayed it. In the final test, 10 children (44%) displayed developing behaviour and only 4 children (17%) were still displaying absent behaviour. Most children displayed the integrated or developing ability to observe and enumerate the modifications occurring in the lives of humans, plants, and animals depending on the season.

C6) *Speak about specific local elements (social, cultural, economic, historic, religious objectives).*

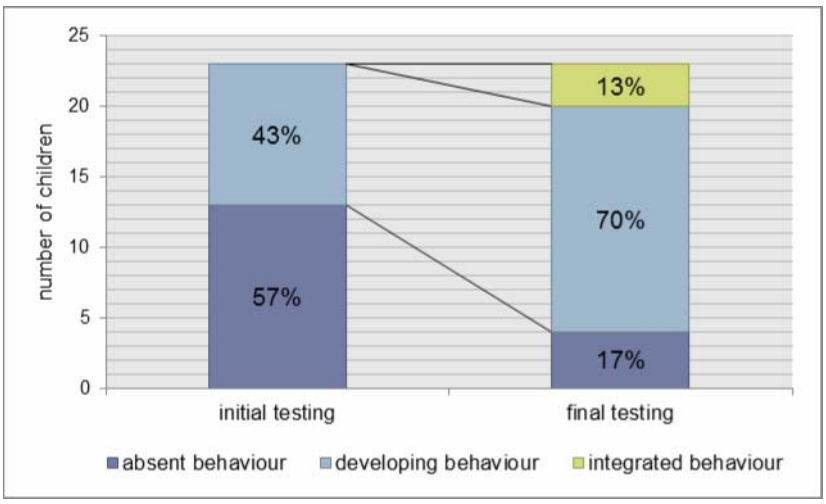

Fig. 14. Results in item C6 *(*ability to know and understand the environment, stimulating curiosity to investigate it) in initial testing and in final testing

When analysing the results (Fig. 14), we noticed children's progress in the reduction of the percentage of children displaying absent behaviour (from 57% to 17%) and in the emergence of a group of 3 children (13%) that displayed integrated behaviour. The majority of children displayed developing or integrated behaviour.

C7) *Name/describe briefly celestial bodies, space vehicles based on perceptive criteria.* The progress of the children could be noticed (Fig. 15) particularly in the disappearance of the group of children displaying absent behaviour and in the integration of the behaviour in the case of 8 children (35%). Moreover, in the final test, 15 children displayed developing behaviour, whereas in the initial test merely 48% displayed this type of behaviour. Most children displayed the integrated or developing ability to name or briefly describe celestial bodies and space vehicles based on perceptive criteria.

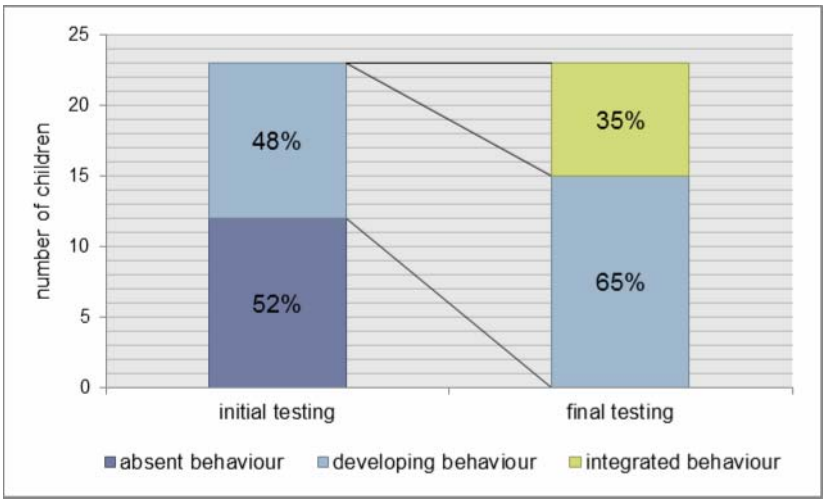

Fig. 15. Results in item C7 *(*ability to know and understand the environment, stimulating curiosity to investigate it) in initial testing and in final testing

D) Using appropriate language in describing phenomena occurring in nature and in the environment

D1) *Acknowledge the existence of various life environments and the factors that may influence them.* When analysing the results (Fig. 16), we noticed that the ones in the final test were superior to those obtained in the initial test in the sense that 5 children (22%) displayed integrated behaviour, 15 children (65%) displayed developing behaviour and 3 children (13%) displayed absent behaviour, despite the fact that in the initial test the percentage of the latter was much higher (57%). At this age, it is difficult for pre-school children to know the factors that may influence life environments particularly as they are often invisible unlike effects that are visible.

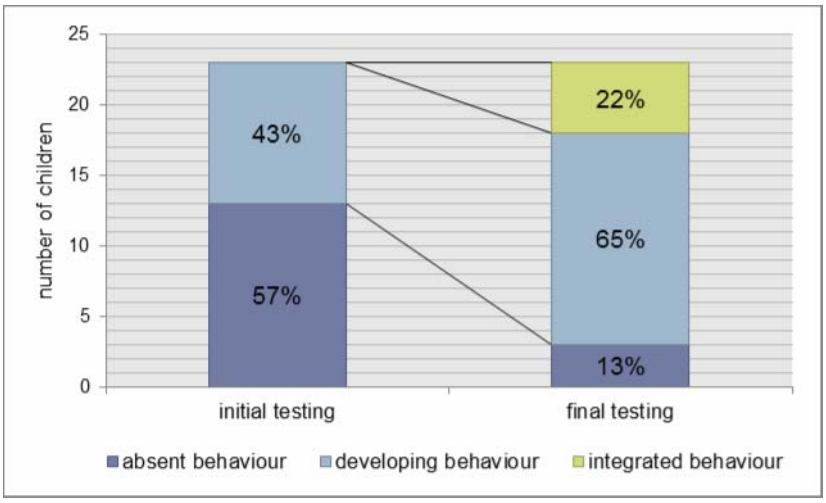

Fig. 16. Results in item D1 (using appropriate language in describing phenomena occurring in nature and in the environment) in initial testing and in final testing

E) Caring for and protecting the environment activities

E1) *Express personal emotions regarding nature and its protection through artistic, practical, and musical activities*.

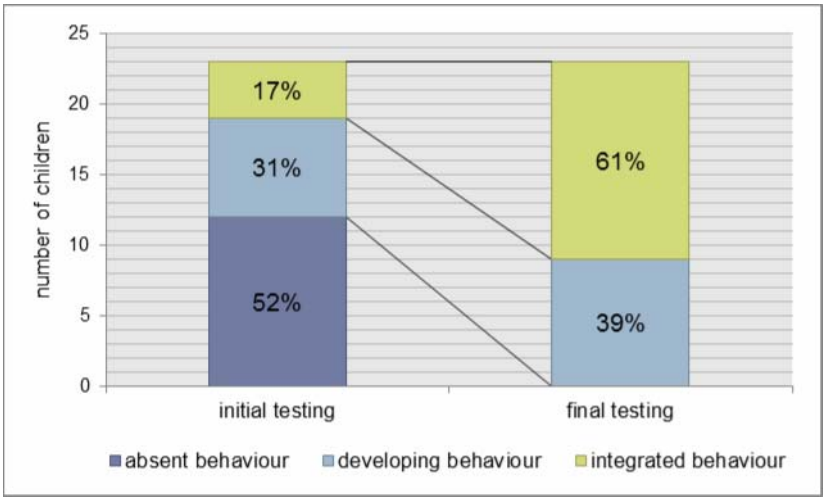

Fig. 17. Results in item E1 (caring for and protecting the environment activities) in initial testing and in final testing

When analysing the results (Fig. 17), we noticed children's progress as in the final test 14 children (61%) displayed integrated behaviour and 9 children (39%) displayed developing behaviour. Most children had integrated or were developing the expression of emotions and impressions regarding nature and its protection through artistic, practical, musical activities, but the focus the testing carried out in this situation was on children's ability to express their emotions and opinions.

In Table 4, we presented the results obtained by each child in the initial and final test. If we analyse each child's evolution as a whole, we notice a definite progress in solving tasks, therefore they developed the desired abilities through games and they formed the representations targeted in the

objectives. One may notice the progress of each child between the initial and final testing, with two of the children managing to obtain integrated behaviour in all 17 items. Based on these evaluations, the hypothesis used as the starting point of the research was confirmed: if didactic games were used in the activities of environment discovery in relation with targeted behaviours, the representations and cognitive abilities of children developed.

Table 4. Initial and final testing results (behaviours) centred on the subjects

Subject	Integrated behaviour		Developing behaviour		Absent behaviour	
	Initial testing	*Final testing*	*Initial testing*	*Final testing*	*Initial testing*	*Final testing*
1.	-	6	9	11	8	-
2.	-	-	-	11	17	6
3.	5	16	12	1	-	-
4.	-	5	8	12	9	-
5.	-	4	5	13	12	-
6.	-	7	7	10	10	-
7.	-	13	14	4	3	-
8.	-	10	5	7	12	-
9.	-	1	-	16	17	-
10.	-	1	4	16	13	-
11.	6	17	11	-	-	-
12.		17	17	-	-	-
13.	-	-	-	16	17	1
14.	-	-	-	11	17	6
15.	1	16	16	1	-	-
16.	-	10	17	7	-	-
17.		6	5	11	12	-
18.	-	7	7	10	10	-
19.	-	12	17	5	-	-
20.	-	-	-	14	17	3
21.	-	1	2	16	15	-
22.		6	6	11	11	-
23.	2	16	15	1	-	-

The image of the whole experimental group shows an evolution between the initial and final tests (Fig. 18), particularly in the obvious increase of the percentage of integrated behaviour subjects (from 9% to

48%) and the decrease of the percentage of subjects displaying absent behaviour (from 35% to 9%), and developing behaviour (from 56% to 43%).

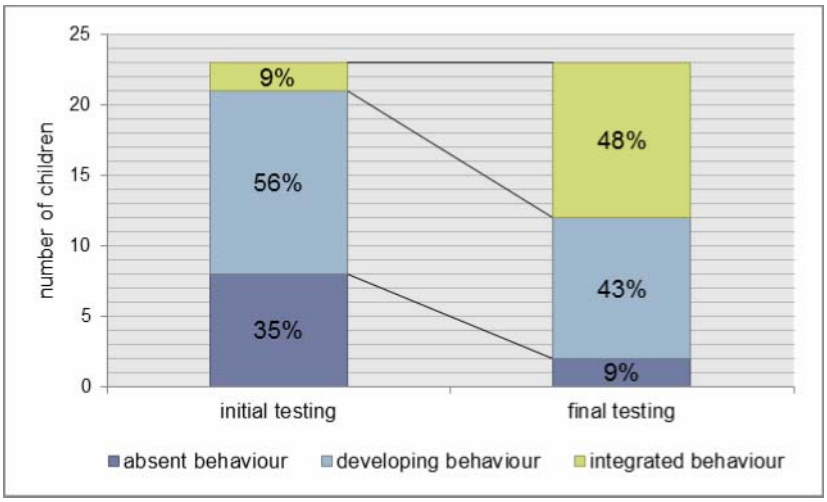

Fig 18. Results of the experimental group in initial and final testing

In Table 5 and Fig. 19, there is a centralized view of the results obtained in initial and final testing for each tested item.

Table 5. Initial and final testing results centred on items

Item	*Integrated behaviour*		*Developing behaviour*		*Absent behaviour*	
	Initial testing	*Final testing*	*Initial testing*	*Final testing*	*Initial testing*	*Final testing*
A1	1	7	9	16	13	-
A2	-	6	9	15	14	2
A3	5	15	10	8	8	-
A4	-	13	15	8	8	2
A5	-	13	8	8	15	2
B1	2	14	10	9	11	-
B2	2	9	8	14	13	-
B3	2	11	8	12	13	-
C1	-	14	15	9	8	-
C2	-	15	13	8	10	-
C3	-	16	17	7	6	-
C4	-	8	10	15	13	-
C5	1	9	8	10	14	4
C6	-	3	10	16	13	4
C7	0	8	11	15	12	-
D1	-	5	10	15	13	3
E1	4	14	17	9	12	-

We noticed that in the case of 10 items, over 10 children demonstrated formation of the targeted behaviour and developed the representations targeted by objectives. We also noticed that pre-school children displayed greater difficulty in forming orientation abilities (items A1 and A2) in understanding more complex environmental issues (items C4, C5, C6, C7, and D1).

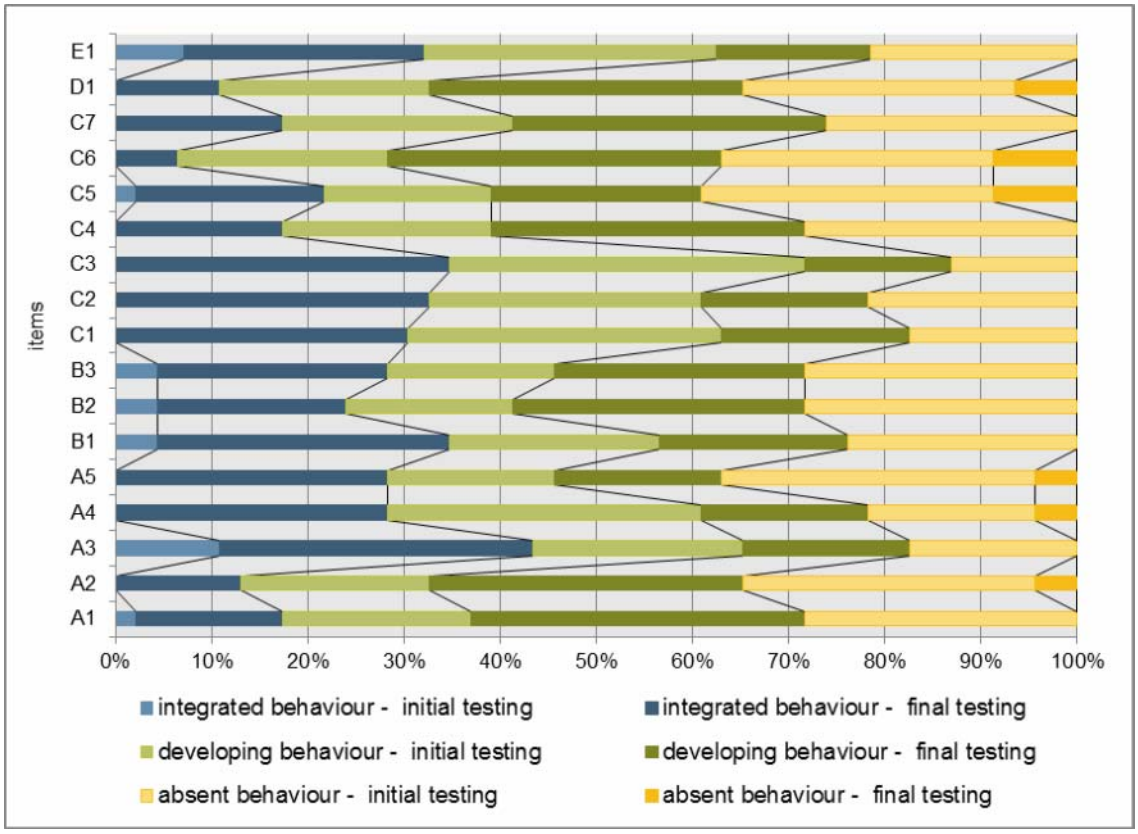

Fig 19. Results obtained in initial and final testing for each tested item

CONCLUSIONS

At the end of this study, we reached the following conclusions:

1) Regarding the didactic games employed, we considered that by using them in teaching, pre-school children developed the abilities and representations targeted in a short period of time and in conditions that were adequate to the children's level of development and age peculiarities.

2) Regarding the evaluation instruments, they allowed us to evaluate the targeted abilities and representations.

3) As far as the Evaluation Form for pre-school children as proposed by MECTS (2011) was concerned, we believed that it could be improved by further detailing a larger number of descriptors for each competence.

4) When analysing the initial testing results as compared to the final testing results, we considered that the hypothesis of the research was confirmed. Pre-school children experienced greater difficulty in forming orientation abilities and in understanding high complexity environmental issues.

5) Taking into consideration the fact that this didactic experiment was applied to only one group of pre-school children, the conclusions of this study could not be generalised to cover the entire population within this age group attending kindergarten.

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