Transforming the representations of preschool-age children regarding geophysical entities and physical geography

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ABSTRACT

A semi-structured interview was individually administered to 76 preschoolers. The interview raised questions about the conceptual understanding of certain geophysical entities. A teaching intervention designed to attempt an understanding of the relationship between them and earth's surface was implemented with groups of 5-9 children in order to help children construct a more "realistic" model of earth. The intervention's effectiveness was consequently evaluated (after two weeks) using an interview similar to that conducted prior to the intervention. The results of the study indicated that prior to the intervention many children faced difficulties in descriptive understanding of even familiar geographic features, such as rivers, lakes and islands. After the intervention the majority of children readily conceptualized certain aspects of most of the geophysical entities and correlated them with earth's surface. Educational and research implications are discussed.

KEYWORDS

Geophysical entities, preschool children's representations, earth's surface, implications for teaching

RÉSUMÉ

Un entretien semi-directif individuel a été administré à 76 enfants d'age préscolai-

re. L'interview contenait des questions sur le schème du soleil et de la terre et sur la compréhension de certaines entités géophysiques. Une intervention didactique visant à tenter de comprendre la relation entre eux et la surface de la terre a été mis en œuvre avec des groupes de 5-9 enfants, afin d'aider les enfants à construire un plus "réalistes" modèle de la terre. L'intervention didactique a été évaluée en conséquence (au bout de deux semaines) à l'aide d'un entretien similaire à celle réalisée avant l'intervention. Les résultats de l'étude ont indiqué que, avant l'intervention de nombreux enfants ont des difficultés à la compréhension de la description des caractéristiques géographiques, même familiers, tels que des rivières, des lacs et des îles. Après l'intervention la majorité des enfants conceptualise facilement certains aspects de la plupart des entités géophysiques et leur corrélation avec la surface de la terre. Des implications pour l'éducation et la recherche sont discutées.

Mots-Clés

Entités géophysiques, représentations d'enfants d'âge préscolaire, surface de la terre, implications pour l'enseignement

Introduction

Over the past few years, a certain number of studies in Science Education and Preschool Education have focused on how young children understand concepts and phenomena of the natural world. The results of these studies reveal that the representations formed by children often display features that are incompatible with scientific knowledge. However, a series of studies and theoretical processing have shown that even children 5 to 6 years of age are capable, given the appropriate learning environment, to mentally construct knowledge about the natural world that is compatible with the models created for education (Inagaki, 1992; Metz, 1995; Ravanis & Bagakis, 1998; Zogza & Papamichael, 2000; Robbins, 2005; Kampeza, 2006; Ergazaki & Andriotou, 2007; Resta-Schweitzer & Weil-Barais, 2007; Gallegos Cázares, Flores Camacho & Calderón Canales, 2008; Fleer, 2009). It is within this scope that the present paper proposes to study issues of understanding geophysical entities and physical geography.

Theoretical Framework

In his work entitled *The child's conception of the world* (1929), Piaget, a pioneer in the study of children's thought, mentions examples from interviews with young children that refer to the origin of rivers, lakes, the sea and the mountains. He detects specific features in the thought of children emerging from their interpretations, and in particular for rivers, lakes, and the sea, he sees a gradual evolution consisting of three stages. The majority of children in the first stage believe the water in lakes and rivers to possess intellect and a conscience, and attributes its existence to the human factor. In the second stage this animism recedes (rivers were dug by humans and water came from the rain), while in the third stage the prevailing answers are more compatible with geophysical knowledge. Regarding mountains, two stages are detected in the thought of children: the first one is marked by a mixture of animism and artificialism (mountains were made by humans, but are often credited with living organism traits since they are supposed to grow), while in the second stage their creation is attributed to nature. For Piaget, in general, the thought of preschool-age children is usually placed among the first stages of conceptual development and remains pre-causal.

Sheridan (1968) studied children's representations for thirty concepts related to physical geography, among them the concepts of the island, the mountain, the ocean, the lake, and the river. He used an oral test to define concepts and made use of images out of which each child would choose the one s/he thought represented the concept. Eight images were used for each concept, four of which were relevant to the concept while four were not. The sample consisted of 55 children in the first grade. The results showed that the children perceived most concepts only partially and focused mainly on the most intense or impressive features, ignoring other features that distinguished one concept from another. Regarding the concept of the river, children exhibited incomplete knowledge, despite the fact that it formed part of their immediate surroundings.

Lunnon (1979) examined the use of visual material with respect to the oral description of ten geographical terms, among which river, mountain, and beach. The sample comprised 140 children from the earlier school grades (5-12 years of age) and the technique applied was that of the individual interview. Children were first asked to orally describe each term. They were also presented with photographs (4-5 for each concept), some of which were related to the concepts while some were not, and were asked to answer whether these photographs presented the geographical features, e.g. "is this a desert?". The results showed that the children performed better when processing concepts through photographs, both across the entire sample and within each age group separately. This, according to the researcher, demonstrates the need for frequent and efficient use of visual material in the teaching of geographical concepts.

Harwood & Jackson (1993) studied the way children understand nine concepts (beach, sea, river, mountain, hill, ocean, cliff, port, and valley) with the use of three individual assessment methods: oral interview, image recognition, and sketching. The sample consisted of nine children aged 9-11. The results when using the first method showed that a large part of the sample seemed confused and did not show signs of understanding the concepts. For the method of image recognition, 16 picture postcards were used, two per concept. The results indicate that, through the use of images, the children seemed to exhibit better knowledge of the concepts that had previously troubled them. It was also observed that they had difficulty in distinguishing between entities related to water (river, sea, port, lake). The concepts of river and mountain were chosen for the drawing method. Conversation regarding the children's drawings revealed various alternative representations for rivers as well as mountains (where the water comes from, how mountains were created). The researchers stress the risk of using only one method of assessment, which may lead to underestimating the children's level of understanding geophysical features, and they point out their need to directly experience these features.

Stressing the need for research in the understanding of geographical terms by young children, Platten (1995) studied the answers given by 50 7-year-old children during personal interviews where 30 terms were discussed, among which river, mountain, and sea. The interview structure included a verbal description of each concept as well as the use of photographs, a combination deemed more efficient by the researcher. The children's answers were grouped into four categories with increasing requirements in the understanding of the concepts. The results showed that more than half of the sample's subjects were familiar with the terms. However, 57% of the sample was placed in the "restricted understanding" category and merely 8% in the "enhanced understanding" category. It is worth noting here that, among the concepts of river, sea and mountain –which are the ones most pertinent to our own investigation – children seemed to know more about the sea and mountain and less about the river. All in all, the researcher points out the need for direct experience and avoidance of stereotypical and monolithic views of a concept.

In the study by Dove, Everett & Preece (1999), which was oriented towards the concept of river, the techniques used were drawing and content analysis. 306 children from Great Britain took part in the study, all between 9 and 11 years of age. Each child was asked to draw a river on a large sheet of paper, showing where it begins and where it ends, and to add an arrow indicating the river's flow. This was followed by interviews with 60 of the children of the original sample. The results render clear that children prefer to draw rivers that flow towards the bottom part of the page, or from left to right. It is also shown that they have difficulties with the scale they need to use in order to depict what they want on a single piece of paper. Moreover, most children place rivers in agricultural regions, perhaps considering the latter as the ideal surroundings in which to depict a river.

In another study focusing on rivers (May, 1996), 10-year-old children seem to believe that rivers were made by men and that their flow is caused by the wind. It was also shown that, although the majority of the sample knew rivers begin in hills or lakes, some children thought they begin from the sea and flow "inwards". In the same study, children were asked to sort photographs based on whether they thought they represented examples of rivers or not. Photographs of large rivers flowing in agricultural areas were considered as good examples of rivers, while small canals or rivers with evident human interventions were rejected.

Trend, Everett & Dove (2000) studied relations among children's drawings and answers with respect to mountains and mountainous surroundings. They also examined children's representations regarding the origin and internal structure of mountains through the task of creating a paper model. The sample consisted of 444 children aged 7-11. Each drawing was analysed based on its content, producing two large categories: a) elements related to the natural environment (rivers, rocks), and b) elements related to human interventions (buildings, roads). The results of the study showed that the knowledge young children have of mountains and mountain ranges is not systematic and is not related to any perception as to tectonic plates or eruptive activity. Furthermore, the study showed that there is great confusion regarding the origin of mountains.

Cin & Yazici (2002) studied the relation between the answers given by 80 8-year-old children in Turkey regarding the creation of geophysical features related to water (river, lake, sea) and their direct experience of those features. The sample came from different environments (a seaside and a lakeside region) with similar socioeconomic backgrounds. The subjects had not been taught these topics at school. The results showed that a large percentage of subjects from both regions were unable to provide an answer as to the creation of these geophysical features, while the prevalent perception was that they were created by God or by men (artificialism).There were also a few answers attributing the creation of geophysical features to nature. The researchers conclude that direct surroundings do not affect children's ideas regarding creation of these geophysical features. They also believe that teaching relevant topics through field work may not be as effective as teaching them through simulation in class, where students will have the opportunity to observe the entire process.

In a review of the studies that have been carried out on the topic at hand, Mackintosh (1999) mentioned that, since the time of Piaget (1929), very little has been studied of children's representations with respect to physical geography concepts and features. Interviews, drawings, and the use of photographs are the main techniques used in the teaching process, focusing more on the description and meaning of terms and less on interpretation and causality. She considers there is a need to research children's learning process as well as the efficiency and suitability of teaching strategies in and out of the classroom. Dove (1998) emphasized that, while there are many possible origins for the alternative conceptions identified, it is argued that some of these ideas are founded on various pedagogical practices, such as imprecise use of language, oversimplification of concepts, use of rote learning, as well as on the inadequate use of prerequisite knowledge on the part of students.

So it would seem that the studies carried out in relation to geophysical features and physical geography focus mainly on the degree of understanding of geophysical concepts and the origin of specific geophysical entities. Children are usually asked to describe or recognise these geophysical features in photographs. Research results have shown that children have difficulties with numerous concepts, such as the distinction between concepts related to water (river, lake) and the origin of rivers and mountains. In the present study we have attempted to study and reconstruct the representations of preschool age children regarding geophysical features, seeking not only to describe and recognise these elements, but also to relate them to the Earth's surface in order to focus on a more "realistic" model for the Earth's shape. This approach is due to the conviction that combining the geophysical features of the Earth's surface with the Earth's shape can improve learning results and enhance children's learning abilities and capacities in this field (Sharp, 1999).

We have assumed, therefore, that the mental processing of geophysical features achieved through involvement of the infants in the teaching intervention activities can help improve recognition of geophysical features and facilitate comprehension of the notion that these elements form part of the Earth's surface.

Methodological Framework

Sample

The sample consisted of 76 infants (39 boys and 37 girls) from five state kindergartens in the city of Patras, all in areas with similar socioeconomic features. The children were randomly chosen among those who volunteered to take part in "the game". The answers, descriptions, and interpretations provided by the subjects were videotaped and record protocols were kept in order to record non-verbal responses and special personal observations.

Design

As has been already mentioned, many children have difficulties in understanding and distinguishing between geophysical features, even when these are part of their direct surroundings. The use of images combined with other techniques is shown by previous research to be an effective methodological approach. Our study consists of:

1. an exploratory stage, during which we try to detect preschool-age children's representations of the Earth's geophysical surface;
2. the teaching intervention, carried out during two days of kindergarten classes; and,
3. assessment of the teaching intervention performed.

During the pre- and post-test procedures, the technique we used was the individual semi-structured interview; it was chosen because its features are suitable for achieving the study's goals, they allow the researchers flexibility as well as the necessary focusing on the topic, and correspond to the sample's age level. The post-test was performed about ten days after the teaching intervention, and included the same tasks that had been used in the pre-test using the same technique, in order for the results to be directly comparable.

Tasks and teaching intervention

For the tasks that traced and assessed children's representations (pre- and post-test), photographs were used which depicted the Earth's geophysical features (mountains, seas, rivers, lakes, islands), three-dimensional bodies were created with a painted geophysical surface so as to respond to children's representations of the Earth's shape, and photographs were taken that depicted a river seen from different viewpoints (ordinary photograph, aerial photograph, satellite photograph).

Task 1

First we presented the infants with ten images depicting geophysical entities, namely mountains, rivers, seas, lakes and islands. For each entity there were two images, so as to avoid any bias in the image selection. The question addressed to the children was: "I will show you some pictures of mountains, rivers, lakes, seas, and islands that exist on our Earth. Have a close look at them and tell me what you see. In which of them do you see mountains, a river, a lake, etc?".

Task 2

Five of the aforementioned photographs (one for each entity) were cut into fragments in which the entity could be discerned and recognised by the children if compared to the original photograph. Three-dimensional polystyrene bodies with geophysical

FIGURE 1

3-D objects with geophysical surface designed for the selection of the earth's shape

surfaces representing land and sea were also constructed (Figure 1). We asked the infants to choose the body that most resembled the Earth, describe its surface and then glue the geophysical entities onto it (Figure 2).

Figure 2

Earth with geophysical entities on the surface

Task 3

We then presented the infants with three photographs depicting a river seen from three different viewpoints. One photograph showed the river as seen from the Earth's surface, another one as seen from an aeroplane (aerial photograph), and the third one as seen from a satellite (Figure 3). We made the following introduction: "I'm going to show you three photographs. They were taken by a man sitting on a bench, a pilot in his aeroplane, and an astronaut in his spaceship. But they have got mixed up so I would like you to show me which photo was taken by the man on the bench, which one by the pilot and which one by the astronaut. Why do you think this is the one?"

Figure 3

Photographs depicting a river seen from three different viewpoints.

During the post-test, the tasks of the pre-test are repeated, focusing on analytical justification of the answers so as to avoid mechanistic data reproduction.

Teaching intervention

The teaching intervention process adhered to the structure and duration of two daily kindergarten classes and was developed along two axes:

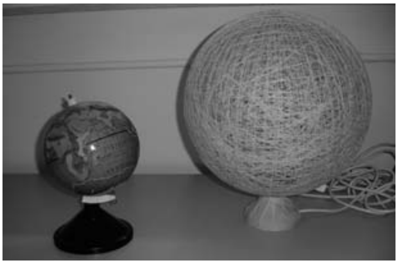
- in the first one we attempted to facilitate understanding of the Earth as a celestial body and as part of the solar system (experimenting with the lit and dark side of planets, discussing the planets' structure and movement in space based on a video, constructing an improvised solar system model, practically representing the movement of planets and the succession of day and night), while

- in the second one we tried to lead the children's thought towards identifying the Earth as a celestial body where daily life and human activity take place.

The teaching intervention activities were carried out in small groups of infants (5-9 subjects, depending on the number of infants studying in each class), providing the possibility of interaction and the development of collaboration among the infants. The teaching intervention took the form of a story according to which two astronauts are lost in space and are trying to return to Earth. The use of stories constitutes a dynamic means of communication with young children and allows the possibility of introducing ideas and concepts or planting problems within a framework that has meaning and significance for the children, thus reinforcing their active involvement in the activities.

After they have processed the concept of the solar system (structure and movement of the planets) and recognised that the Earth is a spherical planet and forms part of this system, the children set out to help the two astronauts verify that the planet they want to land on is indeed the Earth. This is done through describing and locating geophysical features on the surface of a geophysical globe. At this point the story comes across as follows: *"All of a sudden, astronaut Roy Orbitson said: 'We must be very careful in figuring out which planet is the Earth or we'll get mixed up and we won't make it back home' and then he nearly burst out crying. 'Don't you worry', said Mickey Star, 'I've thought of a way to make sure which planet is the Earth! We just need to take a close look and see on which planet there are mountains, seas, rivers, lakes and islands; for only on the Earth do all these things exist and on no other planet'. 'What a good idea!' said Roy Orbitson. 'There, I think that's the Earth over there, that's where we should land', he went on, pointing at one of the planets, '...but then again, I'm not all that sure!"*. Using the elements of the story as a springboard, there is a discussion on the specific geophysical features, during which the children share relevant experiences, search their school books for images, acquire new information, and thus process their intuitive mental representations. Then we present the children with a geophysical globe and ask them to locate on its surface the geophysical features we have mentioned. The globe is placed near a spherical lamp which represents the sun and sheds light on only one side of the globe (Figure 4), and the infants are then asked to determine on which part the astronauts of the story can land according to whether this part is lit (daytime) or shaded (night time). *"Is it daytime or nighttime on this mountain/river/lake? And what do you think, is it always day time on this*

Figure 4

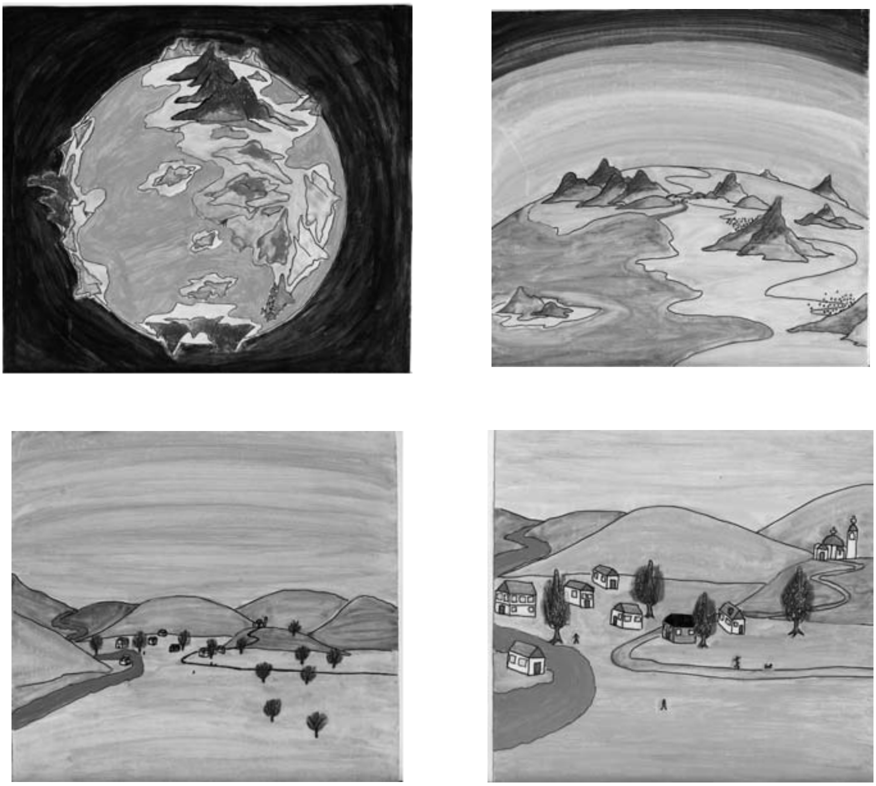


The globe and the lamp that were used in the teaching intervention

one? How does it turn into night?" or "Children, let's find out on which mountain/river it is day time! How does it turn into night time there?".

While in the story the spaceship approaches the Earth, the children set out to help lead the astronauts *"from outer space to their home"* through ordering images which correspond to different viewpoints. Responding to the needs of this activity, we constructed cards which depicted a part of the Earth seen from decreasing distances, i.e. cards showing what the astronauts see from the spaceship as they land on Earth (Figure 5).

Figure 5



Cards representing what the astronauts view as they approach earth

The children are asked to comment on them and through the discussion generated we focus on the shape of the Earth, geophysical features, and the change in perspective (when seen from nearby or from afar). More precisely, the first card depicts one side of the Earth and the infants comment on its shape and describe its surface. The following cards depict part of the Earth as seen from decreasing distances and this time the children are asked "what changes in this picture compared to the previous one? Why does the house look bigger now?" etc. The cards are then shuffled and the infants are asked to put them in order so as to show what the astronauts see while approaching the Earth, and to justify their choices.

Results

In Table 1 we present the children's answers regarding recognition of geophysical entities (mountains, seas, rivers, lakes, and islands), resulting from the descriptions they were asked to give of the ten photographs.

Table 1

Distribution of subjects' answers regarding the recognition of geophysical features

	Pre-test		Post-test	
	Recognition	**No recognition**	**Recognition**	**No recognition**
Mountain - 1st photo	72	4	73	3
Mountain - 2nd photo	74	2	76	
Sea - 1st photo	74	2	75	1
Sea - 2nd photo	75	1	76	
River - 1st photo	46	30	51	25
River - 2nd photo	49	27	60	16
Lake - 1st photo	15	61	43	33
Lake - 2nd photo	19	57	35	41
Island - 1st photo	12	64	30	46
Island - 2nd photo	18	58	31	45

We observe that the geophysical entities which seem to confuse the infants are the river, the lake, and the island. Similar difficulties have been mentioned in literature regarding the concept of the river (Sheridan, 1968) and the distinction between entities related to water, excluding the sea, which seems to be a very familiar concept (Harwood & Jackson, 1993). The data from our study's sample show that preschool age children also seem better acquainted with the mountain and sea and less so with the river, which reinforces the findings of previous relevant studies (Platten, 1995).

We created an overall grade on a scale of 0 to 10 for each subject according to how many photographs it recognises, ascribing the value of 1 for recognition and the value of 0 for non-recognition. Furthermore, we grouped the subjects' grades considering that subjects who scored 0-3 can be placed in the inadequate answer category, subjects who scored 4-7 in the intermediate category, and those who scored 8-10 in the adequate answer category. We performed the Wilcoxon test, which showed a statistically significant movement of the subjects from the pre-test to the post-test ($z=4.70$, $p<0.01$). So while the majority of the subjects (78,95%) were in the intermediate category prior to the teaching intervention, after the intervention there is a statistically significant movement towards the adequate category, which now comprises 44,7% of the subjects.

Table 2 shows the subjects' choices regarding the shape of the Earth along with the geophysical surface.

Table 2

Distribution of subjects' answers regarding the shape of the Earth and the description of its surface

	Pre-test				Post-test			
Shape	**Description (sea/land)**	**f**	**No description**	**f**	**Description (sea/land)**	**f**	**No description**	**f**
Cube	15,43,53,67	4	29,35,58,69,75	5	15,39,48,67,69	5	75	1
Discus	6,8,11,18,19,31, 36,48,49, 56,68,73	12	1,9	2	8,18,29,30, 31,36,56, 73	8		
Pyramid	2,5,17,20	4	54	1	20	1		
Hemisphere	71	1	30,76	2	6,19,35,71,76	5		
Sphere	3,4,7,10,12,13,14,16, 21,22,23,24,25,26, 27,28,32,37,38,41, 44,46,47,52,55,57, 59,60,61,62,64, 65,66,70,72,74	36	33,34,39,40, 42,45,50,51,63	9	1,2,3,4,5,7,9,10, 11,12,13,14,16, 17,21,22,23,24, 25,26,27,28,32, 33,34,37,38,40,41, 42,43,44,45,46, 47,49,50,51,52, 53,55,57,58,59, 60,61,62,63,64, 65,66,68,70,72,74	55	54	1

The "no description" category includes all subjects who made no mention of sea, countries, or grass, but merely referred to colours or other features, e.g. "they are birds, here is the eagle's mouth and this blue is the sky" (subject 75, post-test), or "orange and blue" (s. 9, pre-test). We also observe that, even as early as the pre-test, most subjects choose the sphere as a representative shape for the Earth. After the intervention, the frequency of choosing this category increases significantly, while most answers regarding description of the surface describe land and sea. More precisely, prior to the intervention, 75% of the sample was in a position to recognise land and sea on the surface of the body chosen, while after the intervention this percentage increased to 97,4%.

We then attempted to trace the infants' representations regarding the geophysical entities under study by asking the infants to place them where they thought they belonged on the surface of the body they had chosen as their Earth model (Table 3).

TABLE 3

Distribution of subjects' answers regarding the placing of geophysical features on the surface of the body chosen to represent the Earth

	Pre-test		Post-test	
	On land	**On sea**	**On land**	**On sea**
Mountain	49	27	64	12
Sea	16	60	9	67
River	27	49	35	41
Lake	23	49	38	38
Island	18	54	14	62

We observe that the river and lake seem to cause the infants more difficulties than the other geophysical entities as to whether they should be placed on land or sea. In the pre-test, there is a clear tendency to place both the lake and the river on sea, which may be attributed to the relation these elements bear to water. On the other hand, the mountain seems to be placed rather constantly on land, as are the sea and island placed constantly on sea, both prior to and following the intervention.

As explained previously, the representations of the sample's subjects when approaching an area "from nearby" or "from a distance" with the aid of geophysical elements are presented through a matching task based on three photographs of a river. The first one is taken from the surface of the Earth, the second one is an aerial photograph and the third one is a photograph taken from a satellite. The infants are asked to match each photograph with the person who took it, based on what it depicts (Tables 4 & 5).

The first thing we observe is that during the pre-test most subjects seem to have already constructed the perception of what an area looks like "from nearby", but find it difficult to relate the differences observed in the elements present as the distance from the Earth increases. Some subjects justify their choices, though based on rather intuitive criteria, e.g. "because there are people and it is not high but low" (s. 27, pre-test), "because I can see where they are sitting" (s. 28, post-test), "because I can see it above (aerial photograph)" (s. 28, pre-test), "because it is seen from above (satellite

Table 4

Distribution of subjects' answers regarding the recognition of distances from the Earth during the pre-test

	Pre-test					
	Regular photograph (close-up)	**f**	**Aerial photograph**	**f**	**Satellite photograph**	**f**
Photographer on Earth's surface	1,2,3,4,5,7,8,9,10,12, 13,14,16,19,21,22, 24,25,26,27(j),28(j) 30,31,32,33(j),34, 35, 36,37,38,40,43,44, 45,46,47,49,50,52,54, 56,57,58(j),59(j),60(j), 62,64,65,70(j),72(j), 74(j),75,76	53	11,17,18,29,41, 48,55, 61,63, 71,73	11	6,15,20,23,39, 42,51, 53,66,67,68, 69	12
Photographer in airplane	6,11,17,20,23,29, 39,41,42,51,61	11	1,2,3,4,7,10,15, 16,21, 22,26(j),30,33(j), 35,36,37,38,44(j),45, 47(j),50,52,53,56,58(j), 59(j),60(j),62(j),66,67, 68,69,70(j),72(j),74(j),	35	5,8,9,12,13,14,18,19, 24,25,27,28(j),31,32, 34,40,43,46(j),48, 49,54,55,57,63,64, 65,71,73,75,76	30
Photographer in spaceship	15,16,18,48,53,55, 63,66,67,68,69,71,73	13	5,6,8,9,12,13,14, 19,20,23,24,25,27, 28(j),31,32,34,39,40, 42,43,46(j),49,51, 54,57,64,65, 75,76	30	1,2,3,4,7,10,11,17, 21,22(j),26,29,30, 33(j),35,36,37(j),38, 41(j),44,45,47,50, 52,56,58(j),59(j), 60(j),61(j),62,70(j), 72(j),74(j)	33

* Subjects marked with (j) provided justifications for their choice.

photograph)" (s. 28, pre-test). In the post-test the matching is more successful, e.g. "because the river, the grass, the trees are all near (regular photograph)" (s. 7, post-test), "because it seems a bit higher (aerial photograph)" (s. 7, post-test), "because it is far away and nothing can be seen, just the river (satellite photograph)" (s. 7, post-test). At the same time, the distinction between the two extreme positions, i.e. nearest and farthest, seems to be more constant. The subjects' explanations given in the post-test in order to justify matching the satellite photograph to the astronaut make use of the relation between the distance and the way the Earth's surface looks; e.g. "because it shows half the planet, there's that black thing (space) and the half circle" (s. 27, post-test), "because here it looks round" (s. 33, post-test).

TABLE 5

Distribution of subjects' answers regarding the recognition of distances from the Earth during the post-test

	Post-test					
	Regular photograph (close-up)	**f**	**Aerial photograph**	**f**	**Satellite photograph**	**f**
Photographer on Earth's surface	1,2,3(j),4(j),5,6,7(j), 8,9,10,11,12(j), 13,14,16,17,18,19(j), 21,24,26(j),27(j), 28(j),30,31,32,33(j), 34,35,36,37(j),39,40, 41,43,44(j),45,46, 47(j),49,50(j),52, 53,54,56,58(j),59(j), 60,62(j),64(j),65,67, 68,69,70(j),71, 72, 73,74(j),75(j),76	61	15,20,22,23,25, 38,48,55, 57,61, 63,66	12	29,42,51	3
Photographer in airplane	15,20,22,23,25, 29,38,42,48, 51,61, 63,66	13	1(j),3(j),4(j), 6, 7(j),8(j),9,12(j), 13,16,17,19(j),21, 26(j),27(j),28(j),30, 31,32,33(j),36,37(j), 40(j),43,47(j), 49(j), 53,56,58(j), 59(j),60(j), 62(j),64,65(j),67, 68,70(j),72,74(j), 75(j),76	41	2,5,10,11,14, 18,24,34,35,39,41, 44,45,46,50,52, 54,55,57,69,71,73	22
Photographer in spaceship	55,57	2	2,5,10,11,18,24(j), 29,34,35,39,41,42, 44,45,46,50,51,52, 54,69,71,73	22	1(j),3(j),4(j),6(j),7(j), 8(j),9,12(j),13,14,15, 16,17(j),19(j),20,21(j), 22(j),23(j),25,26(j), 27(j),28(j),30,31, 32,33(j),36,37(j),38, 40(j),43(j),47(j),48, 49(j),53,56,58(j), 59(j),60(j),61(j),62(j), 63,64(j),65, 66, 67(j),68(j), 70(j),72(j), 74(j),75(j),76	52

* Subjects marked with (j) provided justifications for their choice.

In order to statistically check the infants' progress we ascribed the value of 1 to each correct matching, so that subjects who succeed in all matchings score 3. We also ascribed the value of 1 for each correct matching that was justified by the subject and the value of 0 if the choice was not justified. Because there were only three photographs, it is obvious that if a child matched two of them correctly, the third one would by necessity also be correct. So in order to avoid any confusion and make the differences clear, two categories were created: subjects with two correct matchings and correct justifications were placed in the adequate answer category, while the rest of the combinations ended up in the inadequate answer category. Prior to the intervention, only 17,1% of the subjects were in the adequate answer category, whereas after the intervention the percentage rose to 40,8%. The Wilcoxon check performed showed the movement towards this category to be significant ($z = 3.84$, $p<0.05$).

Discussion

In the study presented here we researched the representations of preschool age children regarding geophysical features, in order to make use of the data in teaching interventions. Even though the entities we focused on are familiar to young children, relevant studies have shown that even older children have difficulty in distinguishing between them, a finding that was verified in our sample as well. More precisely, recognition of the river, lake, and island seemed to cause preschool age children the most difficulty. Nevertheless, it seems that children who took part in our study's teaching intervention were in a position to determine and recognise more geophysical entities and describe the Earth's geophysical surface with greater clarity. However, placing the river and lake onto the Earth's geophysical surface according to the land versus the sea criterion proved difficult for the infants even after the teaching intervention. It is suggested that awareness of, and attention to, those features would significantly improve teaching and learning.

We also attempted to provide another perspective to the processing of geophysical entities. We tried to correlate geophysical entities with the Earth's surface through activities using the globe, in order to lead children's thought to construct an enriched pattern of understanding the Earth and to help them comprehend that everything they observe in their natural surroundings is part of our planet's surface. The results indicate that, after the teaching intervention, young children are in a position to incorporate into their reasoning the relation between geophysical entities and the Earth's surface based on how these are seen from different viewpoints.

So we seem to determine elements related to preschool age children's representations which can be used through the planning of teaching activities regarding geophysical entities. At the same time, our research allows us to formulate new research questions regarding the incorporation of elements of physical geography into the investigation of the understanding of the world of Astronomy and into the construction of a representation of the Earth as a celestial body.

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