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Research Article

An Investigation of Hand-Drawn Representations of Rivers by Fifth-Grade Students in Greek Elementary Schools

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This paper is part of a wider study and reflects an attempt to explore the cognitive representations that Greek pupils in the 5th grade of elementary school have, as they emerge from the freehand drawing of rivers. An attempt was made to explore the extent to which the cognitive representation skills of school pupils are associated with real images of space and the extent to which intervention by the teacher who presents the structure of a river emphasizing on how it is formed can contribute to an improvement in the drawings made. Two groups of pupils ($n = 125$, $n = 113$) took part in this study. They were taught one of two parallel lesson plans, to create representations relating to the concept of river. This was followed by an analysis of the drawings and the pre- and postteaching interviews ($n = 60$/group). The results indicate that pupils perceive the differences between reality and how it is conveyed in images, and they reproduce stereotypical models of rivers presented in schoolbooks without using complex structures to represent them. In addition, it was clear how encouraging use of children's mental maps can be not only in revising existing teaching theories but also in building new ones.

1. Introduction

Although several studies have been conducted concerning school pupils' ideas about the concept of "river" and how teachers can investigate those ideas, there is a wide range of research methodologies available which teachers could use to deepen school pupils' thoughts and ideas on the topic [1]. One research methodology which is not widespread but which provides valuable information involves exploring school pupils' ideas through the drawings they make. Hayes et al. [2] have shown that in science-related classes which include depictive models, pupils "are happy to convey the concepts as images." Conveying concepts through drawings is also a useful, alternative form of expression for children who have difficulty in expressing their ideas verbally [3]. Some pupils more easily convey concepts through drawings rather than through written descriptions. Drawings can be used by teachers in various activities in order to explore pupils' understanding of the Science.

In the educational sector, this is not the first time that such an approach has been attempted. Studies by Goodnow and Levine [4], Glenn et al. [5], and Dove [6] all examined drawings by pupils that featured rivers. The images created by school pupils were investigated, as was the question of how pupils oriented the river on the page. The conclusion was that pupils usually tend to draw the river from left to right or from top to bottom. While exploring why rivers were drawn with that orientation, Dove [6] concluded that this perspective is chosen either because it is the direction in which words are written in the West (left to right) or because the image is associated with the flow of the river (from top to bottom) or because the children being examined were affected by images contained in textbooks which present rivers with that perspective.

Mackintosh's survey [7] used the structuralists approach to investigate school pupils' drawings and, through them, the alternative ideas associated with "river". According to this researcher, in order for school pupils to develop 3D cognitive

models of rivers they need to be given more time to acquire experiences by visiting different parts of the river from the spring to the delta, rather than "focusing" on terminology to describe the features and processes of rivers through books or images. Similar ideas had also been employed in the past by May [8], Harwood and Jackson [9], Platten [10, 11] Lunnon [12], and Piaget [13].

Dove et al. [14] examined the views of city children about rivers through drawings. The researchers claimed that children "bring" stereotypical images of rivers into the classroom, which depict clear water, abundant vegetation, and the countryside. In their conclusions, researchers reported that teachers must take into account the pupils' stereotypical ideas when presenting images to them. Consequently, when teaching about rivers teachers must not focus on just stereotypical models but use a wealth of images which present different river landscapes.

All these studies examined the images of rivers drawn by children of different ages. However, how much do those images change over time? To what extent can a teaching method contribute to this and how? This paper is part of a wider study and sets out the attempt being made to explore the cognitive representation skills, which Greek pupils in the 5th grade of elementary school, living in an urban environment, have in relation to rivers. The starting point for this survey was a realisation that 5th grade pupils were unable to talk about rivers (a section on this is included in the Greek curriculum), to name the various parts of a river, and to explain (as far as their age permits) how those parts are created. An attempt was made to explore the extent to which the cognitive representation skills of school pupils are associated with real images of space and the extent to which intervention by the teacher who presents the structure of a river and places emphasis on how it is formed can contribute to an improvement in the drawings made.

2. Research Methodology

Two groups from the 5th grade of elementary school took part in the study (a control group and an experimental group). The 5th grade of elementary school was chosen for the study based on the fact that the 5th grade is the first class in Greek schools where geography appears as a separate subject, since up until then geography has been taught to pupils through the "Learn about the Environment" lesson.

The schools where the study was conducted are located in Attica, Greece, and are attended by populations of different socioeconomic backgrounds. Schools which represent very low or very high income brackets were avoided since it was considered that such deviations would affect the study's results. Schools with two 5th grade classes were sought, so that social or economic factors would not affect the study. Classes were also selected based on an equal number of girls and boys overall, to the extent possible, so that both genders were equally represented in the interviews conducted.

Of the pupils who took part in the interviews, half were girls and the other half were boys so that the gender factor would not affect the study. Over their entire school career they had followed the same curriculum as presented in books approved by the Pedagogical Institute of Greece. That was important because in practical terms it meant that the concepts examined by the pupils over the course of their education up until the study was carried out and the teaching methodology that was followed were the same.

The choice of pupils who took part in the study was made by teachers based on overall performance in all classes and not just in the geography lesson. Three groups of 6 pupils each were formed (comprised of boys and girls) whose performance at school was rated as high, average, and low, respectively. That was done to minimise influences due to learning abilities.

The methodology used to carry out the qualitative study was pre- and postinterviews using the control group and the experimental group [15–18]. A total of 238 pupils took part in the study and 120 protocols were generated for processing a number which is considered adequate to carry out a qualitative study (17–131). Sixty (60) of those were pre- and postinterviews with pupils (15 boys and 15 girls with high, average, and low performance at school, resp.) from the control group and another 60 (15 boys and 15 girls with high, average, and low performance at school, resp.) were pre- and postinterviews with the experimental group.

Each of the two groups (the control group pre1 and the experimental group pre2) was asked to draw a river "from start to end with as much detail as possible" and then to place preselected images (photographs) on the drawing at various characteristic points along the river. The preevaluation is considered to be acceptable and valid given, that it is, the initial evaluation, and corresponds to what the pupils knew up until that point, which was something common for both groups (the control and experimental group). Following that, the teaching methodology currently used in schools continued for the control group, as presented in the school textbook approved by the Hellenic Pedagogical Institute, while an innovative teaching method for this topic was used on the experimental group, which had been designed based on the study's hypothesis. After one month's progress, a time period considered necessary to eliminate factors relating to short-term memory and to allow the duration of knowledge to be checked [19], a new evaluation was carried out on the two groups (control group post1 and experimental group post2). A comparative study of the data generated by the pre- and postevaluations was then carried out. Changes in the drawings prepared based on the teaching methodologies were identified, and a comparative study of the data from the postevaluations was carried out in order to draw comparative conclusions about the two teaching methods.

3. Teaching Materials Used

The teaching materials used for each group were reflective of the detailed curriculum for geography for 5th grade at Greek elementary schools. The current school textbook under the title "5th Grade Geography-Learning about Greece" [20] was used for the control group. The textbook refers to the "parts of a river" (source, main flow, and delta) and provides definitions. The images accompanying the presentation are

nonfunctional since there is no correspondence between the terminology being taught and the objects displayed in the images.

As a contrast to the current teaching materials, the researchers developed materials based around the curriculum but which presented the structure of a river through a sketch enriched with other natural features of the river and tied into the corresponding vocabulary. The terminology used was more descriptive, was actually contained in the sketch, and reflected the vocabulary of children of that age. The connection between river formations and gravity and the incline of the land, the presentation of the concepts of erosion and alluviation, and the inclusion of photographs in the sketch all helped in the river being understood as a dynamic phenomenon and led to the creation of more complete drawings of the river.

4. Results

The pupils' drawings were examined in detail and answers were coded in categories. Each evaluation was conducted on two levels. The first level included evaluation of the pupils' drawings and identification of the objects depicted in them. The second level included matching real photographs to parts of the river. A detailed presentation of the results is set out below:

(A) Representations of Rivers. Representation of a model of a river by pupils, which was as complete as possible (the watershed, tributaries, the flow, waterfalls, the meander belt, and the delta at the mouth of the river), is very important since through it one can ascertain the mental map formed by pupils after being taught about this topic. Pupils' representations of rivers which are as close as possible to the above model are perhaps an indicator for investigating whether pupils (a) have a clearer idea of the processes occurring in the river over time and (b) can better interpret both the same phenomenon and man's activities related to it. The use of scientific geographical terms in the description of the river is also important, since it indicates achievement of substantial results in enriching the pupils' "geographical vocabulary" (Table 1).

From the representations of rivers generated by using the current teaching method (for the control group) it would appear that the mental map that pupils have of the river does not change much after being taught about such phenomena since 73.33% of pupils continued to depict the source like a straight line and only 26.67% as a network of tributaries. As far as the main body of the river is concerned, 46.67% presented it as a straight line while 33.33% presented it as a winding line. As far as the mouth of the river is concerned, 20% presented it as a delta and the other 60% depicted the mouth as a straight line, and 20% drew other river models that cannot be included in one of the above categories. Shown in Table 2 is an indicative presentation of how pupils described the river they drew before and after teaching.

When the innovative teaching method was applied to the experimental group the results were more encouraging in terms of the changes in representations, and therefore pupils' conception of rivers.

After being taught, 73.34% of pupils depicted a full model of a river (winding line with a network of tributaries at the source and a delta at the mouth). That is important since it is an initial indicator that pupils understand the structure of a river in the way they have been taught and can represent it with great accuracy. 3.33% depicted the river as a simple curvy line (and did not depict the source or the mouth/delta), and 3.33% preferred another river model. Shown in Table 3 is an indicative presentation of how pupils described the river they draw before and after teaching.

When analysing the pupils' drawings, an attempt was made to determine at which part of the river depicted by pupils they would place characteristic features such as the source or the mouth, and what other features they had depicted.

As is clear from Table 4, before being taught using current teaching methods, 83.33% of pupils mentioned that rivers started in the mountains, 16.67% mentioned that rivers started from "lakes", "a rock with flower," or "grass". After being taught, 96.67% of pupils mentioned mountains, and 3.33% placed the source in other places.

In the innovative teaching model, before being taught, 70% of pupils mentioned mountains and 30% mentioned lakes, waterfalls, or plains as the starting point of rivers. After being taught, all pupils mentioned mountains, and 100% mentioned sources and the same percentage placed the source in the mountains.

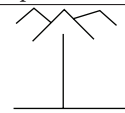
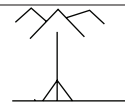
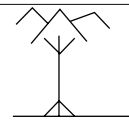
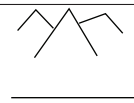
Table 5 shows the location at which pupils placed the mouth of rivers in their drawings. Under the current teaching model, after being taught, 83.33% of pupils mentioned that "the river pours into the sea," and 43.33% also mentioned the word "mouth" when referring to the sea. 13.33% of pupils also mentioned the word "delta" when referring to the sea, and 20% mentioned that the river discharged to rocks, lakes, or a village. Overall, 16.67% more pupils used more specialised vocabulary after being taught.

In the innovative teaching model, after being taught, 96.67% of pupils mentioned that rivers discharge to the sea and depicted this in their drawings. Moreover, 90% mentioned the word "mouth", 46.67% also mentioned the word "delta", and only 3.33% mentioned that rivers discharge into lakes. Consequently, we can see that as a far as the mouth of the river is concerned, pupils more correctly depicted this concept and a very high percentage used specialised geographical vocabulary.

Table 6 shows other elements which pupils depicted in their representations of rivers. It is clear that after the current teaching model was applied, the drawings were not enriched with additional elements. In contrast, after the innovative teaching method was applied, a clear lead appears. 86.67% depicted meander belts, 86.67% depicted deltas, and 63.33% drew tributaries. The percentage figures for drawings of waterfalls and gorges were very low.

(B) Identification of Photographs, Spatial Placement (on the Drawing), and Interpretation. After they had drawn the river, pupils were asked to identify characteristic river landscapes through photographs and to place them on their drawings. It has already been stressed how important it is for pupils to

Table 1: Representations of rivers: comparative presentation.

Model	Representations	pre-A*	post-A	pre-B*	post-B
Straight line that starts from the mountains and flows into the sea.		40%	20%	26.67%	
Straight line that starts from the mountains and forms embranchments in the sea.		20%	20%	20%	
Straight line with embranchments in sea and mountain, respectively.		6.67%	6.67%		
Arched or sinuous line that starts from the mountains and flows into the sea.			13.33%	33.33%	3.33%
Arched or sinuous line that starts from the mountains and forms embranchments in the sea.		13.33%			16.67%
Arched or sinuous line with embranchments in sea and mountain, respectively.			20%		73.34%
Horizontal, straight line without representation of mountains and mouth.		3.33%	3.33%	3.33%	3.33%
Other.		16.67%	16.67%	16.67%	3.33%

The models presented in the table (column 1) and the schematic representations (column 2) were generated from pupils' drawings and are a categorisation thereof. The category "other" includes representations that cannot be placed in any of the above categories.
The column pre-A presents representations of rivers by pupils in the control group before being taught in accordance with the school textbook (pre-perceptions).
The column post-A presents representations of rivers by pupils in the control group after being taught in accordance with the school textbook (post-perceptions).
The column pre-B presents representations of rivers by pupils in the experimental group before being taught in accordance with the researchers developed materials (pre-perceptions).
The column pre-B presents representations of rivers by pupils in the experimental group after being taught in accordance with the researchers developed materials (post-perceptions).

Table 2

	Control group	
Pupil	Before teaching	After teaching
12	"A straight line that starts from Mornos Reservoir and ends up in Athens"	"A curved line that starts from the mountain and ends up in a lake"
16	"A curved line that starts from the grass and ends at the trees"	"A straight line that starts from the forests and ends at some rocks"
30	"A curved line that starts from the mountain and ends up in a lake or in the sea, but I prefer the lake"	"A curved line that starts from the mountain and ends up in a lake"
34	"A straight line that starts from a rock with flowers and ends up in culture" (the pupil probably means city)	"A curved line that starts from the mountain and ends up in a village. The mountain and the village are not shown"

recognise and place real images on a drawing and how pupil education must gradually move from schematics to realistic images.

Castner [21] states that the portrayal of reality "is the most important distinctive feature that can be attributed to a photograph." In light of this, realistic photographs were chosen that depicted the environment. The photographs were used in order to ascertain whether and to what extent the pupils were able to recognise real landscapes and to what extent they could place them correctly on their drawings.

Table 3

Pupil	Experimental group	
	Before teaching	After teaching
42	"A zigzag ending in a waterfall"	"A curve that meanders and ends up in the sea forming a delta"
48	"A straight line that starts from a lake/plain and ends in a delta at the sea"	"Tributaries form a river that ends at a delta at the sea"
56	"A curved line that starts from a plain grass and ends at the sea"	"Tributaries that start in the mountains, join the river that discharges into the sea".
59	"A curved line that starts from a waterfall in the mountains and ends up at the flowers"	"A curved line that starts from the mountains grass and discharges into the sea"

Table 4: The location/place of the springs in the rough drawing.

	Group A			Group B	
	Location	Pupils%		Location	Pupils%
Pre-1	Mountains	83.33%	Pre-2	Mountains	70%
	Other	16.67%		Other	30%
Post-1	Mountains	96.67%	Post-2	Mountains	100%
	Other	3.33%		Other	0%

Table 5: The placement of the river's mouth into children's rough drawing.

	Group A			Group B	
	Location	Pupils%		Location	Pupils%
Pre-1	Sea	73.33%	Pre-2	Sea	66.67%
	Other	26.67%		Other	33.33%
Post-1	Sea	83.33%	Post-2	Sea	96.67%
	Other	16.67%		Other	3.33%

Table 6: Other features of the river represented by the students.

	Group A			Group B	
	Location	Pupils%		Location	Pupils%
Pre-1	Waterfalls	13.33%	Pre-2	Waterfalls	10%
	Meander	6.67%		Meander	13.33%
	Lake	10%		Lake	23.33%
	Delta	20%		Delta	20%
	Canyon	0%		Canyon	0%
	Streams	6.67%		Streams	33.35%
Post -1	Waterfalls	6.67%	Post-2	Waterfalls	10%
	Meander	23.33%		Meander	86.67%
	Lake	10%		Lake	13.33%
	Delta	30%		Delta	86.67%
	Canyon	6.67%		Canyon	6.67%
	Streams	23.33%		Streams	63.33%

In the photographs used, particular emphasis was placed on ensuring that the main subject of the photograph was well positioned within the frame. Thus, each of the photographs chosen depicted only one individual and separate part of the river. Particular attention was paid to the resolution of the photographs, to ensure they were not blurred or that parts were erased. Images were chosen so that did not contain superfluous details, since pupils of that age frequently have the tendency to observe details and to ignore the substantive subject matter of what they are observing.

Table 7 shows that 46.67% of pupils in the group taught in line with the current teaching model identified the delta, with 53.33% recognising the image and naming it "a river that reaches the sea and has an opening" or "a river that opens up and pours into the sea." The results for the way in which the delta was spatially placed under the current teaching method were more encouraging. 80% of pupils recognised that the delta was located at the mouth of the river and 20% placed it in the mountains or said they did not know.

With the innovative teaching model, only 3.33% did not recognise the delta (calling it the river mouth, but not delta, which was the issue). All pupils placed the delta in the correct position.

Of the pupils who were taught based on the current teaching method, only 6.67% recognised meanders (Table 8) after being taught about that phenomenon. Indicative responses included the following.

Pupil 13-post : "A river as is moves along…"

Pupil 16-post : "A river that goes here and there…"

80% placed the meander belt in a plain and 20% replied that they did not have a meander in their drawing or that there was none.

For pupils who received innovative teaching, after being taught, 80% named meanders and 20% could not name them. Of the pupils who were taught based on the innovative teaching model, all placed the meander in the plains.

The level of identification of canyons was satisfactory (Table 9), primarily in terms of recognising the phenomenon in the pre- and post-responses provided by both groups. In the group which was taught based on the current teaching model, 56.67% of the pupils identified the canyon while after innovative teaching model 86.67% of the pupils identified it. Canyons were correctly placed by 73.33% of pupils who received teaching under the current teaching model while the figure was 96.67% for the innovative teaching model. Note that in the photograph given to pupils, the formation was clearly visible and related to the section of the river after the source.

Table 7: Identification of the rivers' delta and placement of delta into drawing.

	Group A					Group B			
	Answers	Pupils%	Location	Pupils%		Answers	Pupils%	Location	Pupils%
Pre-1	Yes	20%	Mouth	66.67%	Pre-2	Yes	16.67%	Mouth	66.67%
	No	80%	Other	33.33%		No	83.33%	Other	33.33%
Post-1	Yes	46.67%	Mouth	80%	Post-2	Yes	96.67%	Mouth	100%
	No	53.33%	Other	20%		No	3.33%	Other	0%

Table 8: Identification of the river's meanders and the placement of the meanders into children's rough drawing.

	Group A					Group B			
	Answers	Pupils%	Location	Pupils%		Answers	Pupils%	Location	Pupils%
Pre-1	Yes	0%	Plain	76.67%	Pre-2	Yes	0%	Plain	73.33%
	No	100%	Other	23.33%		No	100%	Other	23.33%
Post-1	Yes	6.67%	Plain	80%	Post-2	Yes	80%	Plain	100%
	No	93.33%	Other	20%		No	20%	Other	0%

Table 9: Identification of the canyon and placement of the canyon into children's rough drawing.

	Group A					Group B			
	Answers	Pupils%	Location	Pupils%		Answers	Pupils%	Location	Pupils%
Pre-1	Yes	16.67%	Upper part of the river	86.67%	Pre-2	Yes	16.67%	Upper part of the river	60%
	No	83.33%	Other	13.33%		No	83.33%	Other	60%
Post-1	Yes	56.67%	Upper part of the river	73.33%	Post-2	Yes	86.67%	Upper part of the river	96.67%
	No	43.33%	Other	26.67%		No	13.33%	Other	3.33%

5. Conclusions

This study confirms the research conclusions of Goodnow and Levine [4], Glenn et al. [5], and Dove [6], already referred to at the start of this paper, in terms of representations. When pupils depict a river they orient it vertically on the page and the direction of the river for most of them is from top to bottom, which conveys for them the fact that the river's watershed is in the mountains and the mouth is at a lower level (the sea). The flow of the river in most pupils' drawings is from left to right following the flow of Western script while a smaller percentage of pupils drew the river in the centre of the page so as to make the incline obvious.

Moreover, this study also confirms the findings of Mackintosh [7] and Dove et al. [14] relating to the decisive role played by experience in the representation of geographical objects. Given that this study was conducted in an urban area, many of the pupils had seen a river but had never observed, or did not have a complete picture of, a river, and consequently depicted it in a fragmentary way, primarily opting for parts of the river they had visited or were more familiar with. This observation makes it clear how essential fieldwork in the geography lesson is. Since that is not always feasible, the use of audiovisual materials (carefully chosen photographs, videos, etc.) can prove to be equally effective in teaching.

The identification of spatial images (photographs) and matching them to the space represented (as is clear from the study) is a difficult process for pupils. This process becomes all the more difficult when they have to identify areas or landscapes that are not part of their experiences. As is only natural, the geography curriculum contains concepts, which are outside the immediate environment of pupils. As is clear from Dove's study (1999) children have the tendency to approach geographical concepts in accordance with what they already know, thereby bolstering previous perceptions. Pupils who have formed a specific image about some part of a river through audiovisual stimulation, even after being taught about a phenomenon, find it difficult to change their perceptions. However, using the teaching approach outlined in this study it would appear that particular emphasis needs to be placed on how concepts are approached by the teacher and that a teaching model such as the one proposed here, which is based on the causes of phenomena, can make a positive contribution in this direction.

Teaching of subjects relating to the natural environment must be planned so that pupils can become aware of their beliefs, understand the limits of explanations given to them, and attempt to change them. An important advantage of the teaching approach proposed here is that it places greater emphasis on constructive intervention, which means that the approach is based on the assumption that knowledge is not passively conveyed but is built up by the individual who receives it. New ideas presented to pupils are built on top of and in relation to preexisting knowledge. The change in the mental map for rivers that pupils have after being taught is accompanied by a corresponding change in how they express themselves or how they describe rivers, with the scientific, geographical vocabulary of pupils being clearly enriched.

In conclusion, the way in which geographical concepts are approached and the needs of the times require that geographical knowledge in Greek schools move away from traditional frameworks. To that end, use of teaching approaches based on children's mental maps could be encouraging. Those models can be used as intermediary mechanisms to revise existing teaching theories and build new ones.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

References

[1] R. Driver, A. Squires, R. Rushworth, and V. Wood-Robinson, *Making Sense of Secondary Science: Research into Children's Ideas*, Routledge, London, UK, 1994.

[2] D. Hayes, D. Symington, and M. Martin, "Drawing during science activity in the primary school," *International Journal of Science Education*, vol. 16, no. 3, pp. 265–277, 1994.

[3] L. J. Rennie and T. Jarvis, "Children's choice of drawings to communicate their ideas about technology," *Research in Science Education*, vol. 25, no. 3, pp. 239–252, 1995.

[4] J. J. Goodnow and R. A. Levine, "The grammar of action: sequence and syntax in children's copying," *Cognitive Psychology*, vol. 4, no. 1, pp. 82–98, 1973.

[5] S. M. Glenn, K. Bradshaw, and M. Sharp, "Handedness and the development of direction and sequencing in children's drawings of people," *Educational Psychology*, vol. 15, pp. 11–21, 1995.

[6] J. E. Dove, "Student preferences in the depiction of the water cycle and selected landforms," *International Research in Geographical and Environmental Education*, vol. 6, no. 2, pp. 135–147, 1997.

[7] M. Mackintosh, "Children's understanding of rivers," *International Research in Geographical and Environmental Education*, vol. 14, no. 4, pp. 316–322, 2005.

[8] T. May, "Children's ideas about rivers," *Primary Geographer*, vol. 25, pp. 12–13, 1996.

[9] D. Harwood and P. Jackson, "Why did they build this hill so steep? Problems in assessing primary children's understanding of physical landscape features in the context of the UK National Curriculum," *International Research in Geographical and Environmental Education*, vol. 2, no. 2, pp. 64–79, 1993.

[10] L. B. Platten, "Talking geography. An investigation into young children's understanding of geographical terms. Part 1," *International Journal of Early Years Education*, vol. 3, no. 1, pp. 74–92, 1995.

[11] L. B. Platten, "Talking geography. An investigation into young children's understanding of geographical terms. Part 2," *International Journal of Early Years Education*, vol. 3, no. 3, pp. 69–84, 1995.

[12] A. J. Lunnon, "A further case for the visual," *Geographical Education*, vol. 3, no. 3, pp. 331–340, 1979.

[13] J. Piaget, *The Child's Conception of the World*, Routledge and Keegan Paul, London, UK, 1930.

[14] J. E. Dove, L. A. Everett, and P. F. W. Preece, "Exploring a hydrological concept through children's drawings," *International Journal of Science Education*, vol. 21, no. 5, pp. 485–497, 1999.

[15] D. T. Campbell and J. C. Stanley, "Experimental and quasi-experimental designs for research," in *Handbook for Research on Teaching*, N. L. Gage, Ed., Rand McNally, Chicago, Ill, USA, 1963.

[16] F. N. Kerlinger, *Foundations of Behavioral Research*, Holt, Rinehart and Winston, New York, NY, USA, 1970.

[17] L. Cohen, L. Manion, and K. Morrison, *Research Methods in Education*, Routledge Falmer, London, UK, 2000.

[18] S. B. Merriam and Associates, *Qualitative Research in Practice*, Jossey-Bass, San Francisco, Calif, USA, 2002.

[19] G. Papageorgiou and P. Johnson, "Do particle ideas help or hinder pupils' understanding of phenomena?" *International Journal of Science Education*, vol. 27, no. 11, pp. 1299–1317, 2005.

[20] K. Koutsopoulos, M. Sotirakou, and M. Tastsoglou, *Fifth-Grade Geography-Learning about Greece*, OEDB-PI, Athens, Greece, 2007.

[21] H. W. Castner, "Photographic mosaics and geographic generalizations: a perceptual approach to geographic education," *Journal of Geography*, vol. 102, no. 3, pp. 121–127, 2003.